LILLY'S CROP BOOK

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LILLY'S CROP BOOK

Practical Cultural Suggestions for the Western Farm and Garden
By Prominent and Reliable Authorities

THE VEGETABLE GARDEN

ALMOST anyone can plant seeds, and if he does not treat them too cruelly they will grow, but to be a successful gardener requires skill, knowledge and experience. It must be remembered that plants are living things; that they breathe, drink and eat; that if their surroundings are congenial they will thrive, but if uncongenial they will struggle along between life and death, and although they may finally reach maturity, they will never reach the state of perfection which will make the gardener proud of his achievement. Plants are almost human, and it is sometimes surprising that they thrive as well as they do under adverse conditions.

If possible, the garden should be located in a sunny position with a slight slope to the south or southeast, and a windbreak of some sort on the north will be advantageous. It should be free of stumps and stones, and the soil should be a deep, rich, sandy loam, well drained, either naturally or artificially; but as few of us can have everything exactly as we would wish, the best rule is to use the best you have and improve conditions as much as possible.

The size of the garden should depend upon the amount of labor that you can expend upon it. Never make it larger than you can care for thoroughly. A small garden thoroughly tended will produce more than a large garden improperly cared for.

The ground should be carefully plowed or spaded, care being taken to not go so deep as to turn poor soil on top, and the rich soil under so deep that the roots of the plants will not reach it. If the soil is a stiff clay, or if there is a hard subsoil near the surface, it should be broken up to a considerable depth without turning the subsoil on top. It is best to plow a stiff clay soil in the fall, leaving it rough, to be broken up by the action of the weather during the winter. In the spring it should be repeatedly harrowed and rolled, or otherwise stirred, until it is thoroughly pulverized.

The thorough preparation of the soil is of the greatest importance; do not slight it, expecting to remedy it by cultivation after the seed is planted. Do not be satisfied to have the surface smooth, while there are lumps beneath, and spaces between the lumps for the air to circulate in and waste the moisture, for there is the home of the delicate little roots of the plants, and a soft bed must be prepared for them.

The time to work the soil is when it will crumble into fine particles when pressed between the hands. Never work it when it is sticky.

In addition to providing a home for the plants to live and grow in, you must provide food for them. Most soils contain at least a part of the necessary nourishment, but many

are deficient in one or more important elements. It is difficult to judge exactly what is required until you have experimented and learned from observation what is lacking in your soil.

It is useless to have the soil analyzed, for an analysis might show that it contained an abundance of one or more important constituents which in reality were lacking on account of being in a state unavailable for the use of the plants. The only way is to provide an abundance of everything the first year, and experiment and make observations for future use.

If the plants make a slow, weak growth, the soil is probably deficient in nitrogen, while if they make a too rank growth there is too much nitrogen in proportion to potash and phosphoric acid. If the plants make a healthy growth, but the fruit is small and lacks color and flavor, potash is lacking. If the soil contains sufficient nitrogen and potash, but the plants are not thrifty, are generally debilitated and do not produce seed properly, phosphoric acid is lacking.

The soil is strong only in proportion to its weakest ingredient. It may contain sufficient of two of these elements but if lacking in the third it will not produce satisfactory crops. If you know what is lacking it is only necessary to add the one chemical.

Fertilizers are valuable for, and in proportion to, the amount of nitrogen, potash and phosphoric acid which they contain. Other substances are needed for plant growth, but they are usually present in the soil in sufficient quantity, unless we except lime and humus.

The effect of nitrogen is to promote the growth of stems and leaves, while buds and flowers are retarded; also to deepen the color of the foliage, which is a sign of vegetative activity and health.

Potash is essential to the formation and transference of starch in plants. Starch is formed in the leaves and gradually passes into the fruit.

Phosphoric acid aids the plant to make use of or assimilate other ingredients, and the plant does not come to maturity, and does not produce seeds, unless phosphates are in the soil for the plant to feed upon.

The function of lime is to improve the mechanical condition of the soil by loosening heavy clay soils and by holding together and giving body to light sandy soils. It aids in the decomposition of animal and vegetable matter, and tends to convert them into available plant food, but its most important function is in correcting acidity in soils which are sour.

Humus is decaying vegetable or animal matter in the soil. It is necessary to keep the soil in proper tilth, absorbs and retains moisture, and aids the plants in making use of the plant food which is in the soil.

Plant food may be applied in the form of stable manure, plowing under a green crop such as vetch, clover, alfalfa, etc., or commercial fertilizers. When possible it is best to combine the three methods.

Stable manure has the disadvantage of containing weed seeds, which are especially undesirable in lawns, pastures, meadows, grain fields, etc., which are not cultivated. It also contains an excess of nitrogen in proportion to potash and phosphoric acid, and those should be added in the form of commercial fertilizers.

Green manuring, i. e., plowing under a green crop, preferably one of the legumes, adds humus to the soil, and although the material plowed under contains an excess of nitrogen, there are usually other ingredients in the soil in unavailable form which it aids in making available.

Commercial fertilizers have the advantage of supplying the needed elements in the correct proportions, being convenient and easy to apply, are usually more economical when manure must be purchased and hauled or a green manure crop occupies the land for a season, they contain no weed seeds, and they are especially valuable when used in conjunction with stable manure or a green manure crop.

Manure should be applied as long as possible before the seed is to be planted. It is best to plow it under in the fall, especially if not well rotted. Most commercial fertilizers are best applied several weeks before the seed is planted, to give them time to become incorporated with the soil so that they will be available when required by the young plants. They may be applied in the hills or drills at the time the seed is planted, or may be used as a top-dressing. When applied in the hills the fertilizer must be thoroughly mixed with the soil so that the seeds or roots will not come into direct contact with any considerable quantity of it.

During the winter you should procure seed catalogs, decide what you wish to plant, and order seeds early before the seedsmen are sold out of the choice varieties. Make a diagram of the garden showing where the various seeds are to be planted.

Arrange it so that the taller plants will not shade the smaller ones. Quick growing plants such as radishes, lettuce and onion sets for green onions should be planted between the rows of such plants as will occupy the ground for a longer period, and will be out of the way before the space is required by the other plants. Radish seed may be mixed with such seeds as onion, lettuce, carrot, parsnip, beet, etc., and the radishes will be used before they are in the way. Large plants such as tomatoes and cabbage may be set in the rows of early maturing plants.

By all means have the ground thoroughly pulverized, granulated, mellow and smooth. Make the rows straight. If the ground is wet, beds may be raised by cutting paths a few inches deep around them for drainage, but otherwise the garden should be left flat.

Be sure to have good seed. There is little danger of getting poor seed from a reliable seedsman who tests all seeds sold. Never buy cheap seeds, the little that you save is insignificant compared with a crop failure.

Do not plant too early. A few vegetables such as radishes, onions and peas may be planted as soon as the ground is in proper condition to work, but most other seeds should not be planted until the weather is settled and the ground warm, so that the plants will start to grow promptly and keep on growing. A few cold days will give them a set-back that they will never recover from.

Do not plant the seed too thickly; and as soon as the plants are large enough to get hold of thin them severely, leaving plenty of room for them to grow in. It may seem heartless to pull out so many good plants, but it is better to have one good plant than several weak, spindling ones.

Do not plant too deeply. An old rule is to plant to a depth of five times the diameter of the seed. The earth should be pressed firmly over the seed, especially when the soil is light.

Commence cultivating as soon as the plants are large enough so that you can follow the rows. It will pay to have a hand cultivator, for you can do better work with a very small percentage of the labor required with a hoe.

Always cultivate as soon as the ground is dry enough to work after each rain or each time that you have irrigated. Shallow cultivation is best; not more than an inch deep. If the soil has been properly prepared before planting, this will keep the soil below the dust mulch mellow and moist during the entire season.

Do not cultivate for the main purpose of killing weeds: cultivate to maintain a dust mulch to conserve moisture, and do it so frequently and thoroughly that weeds will not have a chance to start.

If the garden is watered, it is better to give it a thorough soaking once a week, or when the ground becomes too dry, than to sprinkle it every day.

Many persons seem to think that seed must grow, regardless of how, where or when planted. Life in seed is wonderfully persistent, but there are some obstacles that it cannot overcome. In nearly every case of failure the failure is attributed to poor seed, but in ninety-nine cases in every hundred the cause is carelessness in planting or unfavorable conditions of soil or weather. Of course some poor seed is sold, but if you purchase tested seed from a reliable seedsman you will never have a failure on that account. Frequent causes of failure are planting too early, too late, or too deep.

Often the seed will germinate quickly, but the plants make a feeble growth. This may be on account of unfavorable weather or improper preparation of the soil. Plants should not hesitate in their growth. They should be thrifty and of good color. Nitrate of soda will act as a stimulant, and the effect will be noticeable within a very few days. It is best applied by dissolving in water and sprinkling on the ground, keeping it off the leaves as much as possible. Not more than two hundred pounds per acre should be applied at one time, and it should be dissolved at the rate of one pound of nitrate of soda to five gallons of water.

STARTING THE PLANTS

By S. W. Fletcher.

There are few adjuncts to a farm home which will bring more satisfaction for the investment than a hot bed. Not only is it the most desirable way of starting plants for transplanting to the garden and so securing an earlier crop, but it may also be the means of supplying the table with crisp lettuce and radishes in early spring when something succulent is relished most. The farm home which has not at least a 6x6 hot bed is missing much. It costs but a few dollars, and is worth many. Hot bed sash can also be used to force a few hills of asparagus or rhubarb ahead of the season, and protecting a few hills of choice tomatoes from fall frosts.

Our short season makes it necessary to start tomatoes and cabbages under glass or in the house. Watermelons and muskmelons also are often benefited by being started on pieces of sod or in strawberry boxes; but the difficulty of hardening them off so they will stand transplanting to the field usually makes it discouraging work. An extra early crop of lettuce may also be secured by starting the plants inside. In lieu of a hot-bed or cold-frame, tomato and cabbage plants may be started in shallow boxes by the kitchen window, or any other sunny place in the house; but this is a poor make-shift when a frame can be built so cheaply. Start tomatoes and cabbages at least six weeks before it is thought they can be transplanted to the field, and onions about five weeks. Give the plants plenty of room and plenty of sunlight; make them grow luxuriantly and stocky, not weak and spindling. Transplant them to the field on a cloudy day, or late in the afternoon. Dirt may be settled around the roots with a little water, but this is apt to compact the soil and form a clod, unless care is taken to loosen the soil before it hardens. We much prefer to puddle the roots before transplanting, and to use no water on the surface.

In connection with transplanting to the field plants of melons, cucumbers, squashes and other tender vegetables, which have been started in the hot-bed or elsewhere, we find the use of hand-boxes very beneficial. Hand-boxes are rectangular wooden boxes, preferably made of half-inch material, and having no tops or bottoms. They are made the right size to receive a 10x12 pane of glass in a groove at the top. The top is cut slanting, so as to give a slant to the glass. The hand-boxes are set over hills of melons, etc., which are transplanted to the field in early spring, or over hills of the same vegetables which are planted in the field very early in spring. A little dirt is banked around the side of the boxes to prevent them from being blown away by the wind. The protection afforded by these miniature cold-frames is often sufficient to establish plants in the soil two weeks earlier than would be possible otherwise, and an earlier crop is secured. Endless boxes, even without glass tops, are often of great protection to plants, as they keep off cold winds. We believe it will pay many home gardeners to have a few dozen of these boxes, particularly if they desire to grow melons, winter squashes, or egg plants.

THE CONSTRUCTION OF A HOTBED

Select an open, sunny position, preferably with a building, tight board fence, or other windbreak on the north. Make a frame, similar to that shown in accompanying cuts, fifteen inches high on the north side and nine inches high on the south side, making a slope of six inches to the south.

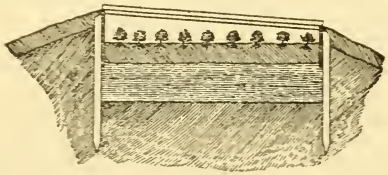

Fig. 1.

This frame should be the right size to be covered by the desired number of sash. A standard hotbed sash is 3x6 ft. Three sash is a good size for average home use. It should be placed where there will be a space of at least three feet on all sides, making plenty of room to work.

Excavate inside this frame to a depth of twenty-eight inches from top of south wall; using the dirt to bank against outside of frame.

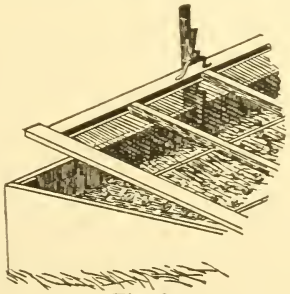

Fig. 2.

To provide heat for the hotbed decomposing horse manure is generally used. While a large amount of straw is not desirable, one-third of the amount may consist of urine-soaked bedding.

The manure should be forked over and placed in a pile. If it is dry it should be moistened with a fine spray, but not soaked. Within four or five days the giving off of steam will indicate that heating has commenced, and it should be spread evenly in the hotbed, taking care that the corners are well filled. It should be filled to the proper depth so that when finally packed down the surface will be ten inches from top of south wall.

When it has again become heated it should be tramped down solid and covered with six inches of soil, leaving the surface four inches from top of frame in front and ten inches in the back.

The soil should be very rich and contain a large amount of sand and humus. When boxes of seeds or plants are to be placed in the hotbed three inches of soil will be sufficient.

The sash should now be placed in position. The bed will be very warm for a few days, and the seed should not be planted until the temperature of the soil, as shown by a hotbed thermometer thrust into the soil, has fallen below ninety degrees.

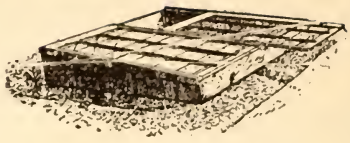

Fig. 3.

During severe weather the sash should be covered at night with mats, burlap or old carpet, which should be removed in the morning. When the sun is shining, or when the bed is too hot, it should be ventilated by raising the sash, as shown in Fig. 2, or sliding it down as shown in Fig. 3. By the middle of the afternoon the sash should be replaced.

A cold frame is made in the same manner, but there is no excavation under it, no manure to furnish heat, and white muslin is sometimes used instead of glass.

THE HOME VEGETABLE GARDEN

By W. R. Beattie. U. S. Dept. of Agriculture, Farmers' Bulletin No. 255.

It would be difficult to give a plan or specific arrangement for a garden that would suit all demands, and a plan must be devised by each individual grower.

The first consideration in planning the arrangement of a garden is the kind of cultivation that is to be employed. Where the work is to be done mainly by means of horse tools the arrangement should be such as to give the longest possible rows, and straight outlines should be followed. The garden should be free from paths across, and turning spaces should be provided at the ends.

For hand cultivation the arrangement can be quite different, as the garden may be laid off in sections, with transverse walks, and the rows can be much closer for most crops. Horse cultivation is recommended whenever possible, as it materially lessens the labor and cost of caring for the crops.

The second matter for consideration is the location of permanent crops, such as asparagus and rhubarb, and if any of the small fruits, such as raspberries, currants and gooseberries, are to be planted within the garden inclosure, they should be included with the permanent crops.

The area devoted to the hotbed, cold frame and seed bed should be decided upon, but these may be shifted more or less from year to year or located in some convenient place outside the garden.

When there is any great variation in the composition of the soil in different parts of the garden it will be advisable to take this into consideration when arranging for location of the various crops.

If a part of the land is low and moist, such crops as celery, onions and late cucumbers should be placed there. If part of the soil is high, warm and dry, that is the proper location for early crops and those that need quick, warm soil.

In planning the location of the various crops in the garden, due consideration should be given to the matter of succession, in order that the land may be occupied at all times.

As a rule it would not be best to have a second planting of the same crop follow the first, but some such arrangement as early peas followed by celery, or early cabbage or potatoes followed by late beans or corn, and similar combinations, are more satisfactory.

In the south as many as three crops may be grown one after the other on the same land, but at the extreme north, where the season is short, but one crop can be grown, or possibly two by some such combination as early peas followed by turnips.

Where there is considerable choice in the location of the garden plot, it is often possible to select land that will require very little special preparation. On the other hand, it may be necessary to take an undesirable soil and bring it into suitable condition, and it is generally surprising to note the change that can be wrought in a single season.

There are very few soils that are not improved by some form of drainage. Heavy clay soils are benefited most by drainage, but sandy soils having a clay subsoil are made warmer and greatly improved by having the excess soil water removed quickly.

Autumn is the best time for plowing hard or stiff clay soils, especially if in a part of the country where freezing takes place, as the action of the frost during the winter will break the soil into fine particles and render it suitable for planting. Sandy loams and soils that contain a large amount of humus may be plowed in the spring, but the work should be done early in order that the soil may settle before planting. In the Southern States, where there is not sufficient frost to mellow the soil, this process must be accomplished by means of frequent cultivations, in order that the air may act upon the soil particles. It is desirable to plow the garden early, at least a few days sooner than for general field crops.

Sandy soils will bear plowing much earlier than heavy clay soils. The usual test is to squeeze together a handful, and if the soil adheres in a ball it is too wet for working.

In the garden greater depth of plowing should be practiced than for ordinary farm crops, as the roots of many of the vegetables go deeply into the soil. Subsoiling will be found advantageous in most cases, as the drainage and general movement of the soil moisture will be improved thereby.

Hand spading should be resorted to only in very small gardens or where it is desirable to prepare a small area very thoroughly.

After plowing, the next important step is to smooth and pulverize the soil. If the soil be well prepared before planting, the work of caring for the crops will be very materially lessened. It is not sufficient that the land be smooth on top, but the pulverizing process should extend as deep as the plowing. Some gardeners prefer to thoroughly cut the land with a disk harrow before plowing, so that when it is turned by the plow the bottom soil will be fine and mellow.

After the plow the disk or cutting harrow is again brought into play and the pulverizing process completed. If the soil is a trifle too

dry and contains lumps, it may be necessary to use some form of roller or clod crusher to bring it down. For smoothing the surface and filling up depressions a float or drag made from planks or scantlings will be found serviceable.

The kind of fertilizer employed has a marked influence upon the character and quality of the vegetables produced. For the garden only those fertilizers that have been carefully prepared should be used. Fertilizers of organic composition, such as barnyard manure, should have passed through the fermenting stage before used. The use of night soil generally is not to be recommended, as its application, unless properly treated for the destruction of disease germs, may prove dangerous to health.

For garden crops there is no fertilizer that will compare with good, well-rotted barnyard manure. In localities where a supply of such manure cannot be secured it will be necessary to depend upon commercial fertilizers, but the results are rarely so satisfactory.

In selecting manure for the garden, care should be taken that it does not contain any element that will be injurious to the soil. An excess of sawdust or shavings used as bedding will have a tendency to produce sourness in the soil.

Chicken, pigeon and sheep manures rank high as fertilizers, their value being somewhat greater than ordinary barnyard manures, and almost as great as some of the lower grades of commercial fertilizers. The manure from fowls is especially adapted to dropping in the hills or rows of plants.

Commercial fertilizers are sold under a guaranteed analysis, and generally at a price consistent with their fertilizing value. No definite rule can be given for the kind or quantity of fertilizer to be applied, as this varies with the crop and the land. At first the only safe procedure is to use a good high-grade fertilizer at the rate of from 1,000 to 2,000 pounds per acre and note the results. Market gardeners frequently apply as much as 2,500 pounds of high-grade fertilizer per acre each year.

Plants grown in a house, hotbed, or cold frame will require to be hardened off before planting in the garden. By the process of hardening off, the plants are gradually acclimated to the effects of the sun and wind so that they will stand transplanting to the open ground. Hardening off is usually accomplished by ventilating freely and by reducing the amount of water applied to the plant bed. The plant bed should not become so dry that the plants will wilt or be seriously checked in their growth. After a few days it will be possible to leave the plants uncovered during the entire day and on mild nights. By the time the plants are required for setting in the garden they should be thoroughly acclimated to outdoor conditions and can be transplanted with but few losses.

Where plants are not to be transplanted twice, but remain in the plant bed until required for setting in the garden, it may be necessary to thin them somewhat. This part of the work should be done as soon as the plants are large enough to pull, and before they begin to "draw" or become spindling from crowding.

When thinning plants in the plant bed it should be the aim to remove the centers of the thick bunches, leaving the spaces as uniform as possible. When thinning the rows of seedlings in the garden the best plants should be allowed to remain, but due consideration should be given to the matter of proper spacing. Failure to thin plants properly will invariably result in the production of an inferior crop.

At the North, where the growing season is short, it is necessary to transplant several of the garden crops in order to secure strong plants that will mature within the limits of the growing season. In the Southern States the season is longer, and transplanting, while desirable, may not be necessary, as many of the crops that must be started indoors at the North can be planted in the garden where they are to remain. Transplanting should be done as soon as the seedlings are large enough to handle, and again when the plants begin to crowd one another.

Aside from producing more uniform and hardy plants, the transplanting process has several other very marked influences. Certain crops which are grown for their straight roots are often injured by having their roots bent or broken in transplanting. On the other hand, such plants as celery, which at first have a straight root and are grown for their tops, are generally benefited by transplanting. In all cases transplanting has a tendency to increase the number of small roots, and these are the main dependence of the plant at the time it is set in the open ground.

A large number of garden crops, including melons, cucumbers and beans, do not transplant readily from the seed bed to the open ground, and some special means for handling the plants must be employed where extra early planting is desired. A common practice among gardeners is to fill pint or quart berry boxes with good soil and plant a single hill in each box.

Another method is to cut sods into pieces about two inches thick and six inches square and place them, root side upward, on the greenhouse bench or in the hotbed, the seeds being planted in the loamy soil held in place by the roots of the grass.

When the weather becomes sufficiently warm, and it is desired to set the plants in the garden, the berry boxes or pieces of sod are placed on a flat tray and carried to the place where the planting is to be done. Holes of sufficient size and depth are dug and the boxes or sods are simply buried at the points where it is desired to have the hills of plants. The boxes should be placed a little below the surface and fine earth packed in around the plants. If it is thought desirable, the bottoms of the boxes may be cut away when set in the garden.

A few hours before removing the plants from the seed bed or plant bed they should be well watered and the water allowed to soak into the soil. This will insure a portion of the soil adhering to the roots and prevent the plants from wilting. If the plants have been properly thinned or transplanted it is often possible to run a knife or trowel between them, thus cutting the soil into cubes that are transferred with them to the garden.

Where the soil does not adhere to the roots of the plants it is well to puddle them. In the process of puddling, a hole is dug in the earth near the plant bed, or a large pail may be used for the purpose, and a thin slime, consisting of clay, cow manure and water, is prepared. The plants are taken in small bunches and their roots thoroughly coated with this mixture by dipping them up and down in the puddle a few times. Puddling insures a coating of moist earth over the entire root system of the plant, prevents the air from reaching the rootlets while on the way to the garden, and aids in securing direct contact between the roots and the soil.

Previous to setting out plants, the land should be worked over and put in good condition, and everything should be ready for quick operations when a suitable time arrives. The rows should be measured off, but it is well to defer making the furrows or digging the holes until ready to plant, in order to have the soil fresh.

The time best suited for transferring plants from the plant bed to the open ground is when there is considerable moisture in the air and clouds obscure the sun, and if the plants can be set before a shower there will be no difficulty in getting them to grow. During seasons when there is very little rain at

planting time, or in irrigated regions, evening is the best time to set the plants.

It is possible to set plants in quite dry soil, provided the roots are puddled and the earth well packed about them. When water is used in setting plants it should be applied after the hole has been partially filled, and the moist earth should then be covered with dry soil to prevent baking. Where water is available for irrigation it will be sufficient to puddle the roots and then irrigate after the plants are all in place.

Plants should be set a trifle deeper in the garden than they were in the plant bed. The majority of plants require to be set upright, and where the dibble is used for planting care should be taken that the soil is well pressed around the roots and no air spaces left.

No definite rule can be given regarding the time for planting seeds and plants in the garden, for the date varies with the locality and the time that it is desired to have the crop mature. A little practice will soon determine when and how often sowings should be made in order to escape frost and mature the crop at a time when it will be most useful. Certain crops will not thrive during the heated part of the summer, and their time of planting must be planned accordingly.

Some plants require protection from the direct rays of the sun in summer or from the cold in winter, and there are many that need special protection while they are quite small. Seedlings of many of the garden crops are unable to force their way through the crust formed on the soil after heavy rains, and it is necessary either to break the crust with a steel rake or soften it by watering.

Throughout the portions of the country where rains occur during the growing season it should not be necessary to irrigate in order to produce the ordinary garden crops. In arid regions, where irrigation must be depended upon for the production of crops, the system best adapted for use in that particular locality should be employed in the garden. Wherever irrigation is practiced the water should not be applied until needed, and then the soil should be thoroughly soaked.

After irrigation, the land should be cultivated as soon as the surface becomes sufficiently dry, and no more water should be applied until the plants begin to show the need of additional moisture. Constant or excessive watering is very detrimental in every case.

CULTURAL DIRECTIONS FOR GARDEN VEGETABLES

ARTICHOKE, GLOBE

There are two distinct varieties of artichokes. The Globe Artichoke resembles a giant thistle, and the edible portion is the immature flower head; also, the young suckers are sometimes served like asparagus.

Deep, rich, sandy loam, with a liberal supply of well-rotted manure, is best suited for growing artichokes. Plant the seed as soon as the soil is warm in spring, and when the plants have formed three or four leaves they may be transplanted to rows three feet apart and two feet apart in the row. The plants do not produce until the second season, and in cold localities some form of covering will be necessary during the winter. This crop is not suited for cultivation where the temperature goes below zero.

After the bed is once established the plants may be reset each year by using the side shoots from the base of the old plants. If not reset the bed will continue to produce for several years, but the burs will not be so large as from new plants. The bur or flower bud, is the part used, and should be gathered before the blossom part appears. If they are removed and no seed is allowed to form, the plants will continue to produce until the end of the season.

The heads, or burs, are prepared for the table by boiling, and are served with melted butter or with cream dressing.

ARTICHOKE, JERUSALEM

The tubers, resembling potatoes, are the edible portion of Jerusalem Artichokes, and although by some they are considered a great delicacy, they are used in this country mostly for hog food.

They will grow in any good garden soil, and should be planted three to four feet apart each way, with three or four small tubers in a hill. If large tubers are used for planting they should be cut the same as potatoes.

Plant as soon as the ground becomes warm in spring, and cultivate the same as for corn. The tubers will be ready for use in October,

but may remain in the ground and be dug at any time during the winter.

The tubers are prepared for the table by boiling until soft, and are served with butter or creamed. They are also used for salads and pickles. When planted for hog food they are generally left in the ground and the hogs allowed to root them out. They do well on new land and the hogs will do an excellent job of cultivating and subduing the soil.

ASPARAGUS

Asparagus should have a place in every home garden. It can be grown on almost any well-drained soil, but will do best on a deep, mellow, sandy loam. There is little possibility of having the land too rich, and liberal applications of partly rotted barnyard manure should be made before the plants are set.

One ounce of seed will produce about five hundred plants. One hundred to two hundred plants will produce all the sprouts required in an ordinary home garden. To produce the plants from seed, sow early in spring, one inch deep, in drills twelve to eighteen inches apart, and thin the plants to four inches apart in the rows. As the seed germinates very slowly, it is advisable to mix radish seed with it to mark the rows for cultivating.

The plants will be large enough for transplanting to the permanent bed when one year old, and are considered better at that age than when older, but may be left until the second year if desired. They should be cultivated thoroughly during the summer, and in the fall the tops should be cut off close to the ground and the bed mulched with manure.

As the permanent bed should last for twenty years or more, much care should be taken in its preparation. It is essential that the land should be in a high state of cultivation. It should be loosened very deeply, either by subsoil plowing or deep spading, and a very heavy application of manure should be plowed under deeply. In addition to this, kainit at the rate of one thousand pounds or more per acre will be very beneficial. The ground should then be harrowed repeatedly until it is thoroughly pulverized.

It is best to transplant in the spring, any time before the first of June, but on the Pacific Coast, where the winters are mild, it could be done in the fall.

Make furrows eight inches deep and three to four feet apart. Any sprouts that have started should be broken off, and about one-third of the length of the roots should be cut off, making them even. Set them about fourteen inches apart on the bottom of the furrows on little mounds made by pressing the half-closed hand into the soil, and spreading the roots carefully on all sides of these mounds; then cover two or three inches deep. Do not fill the furrows full at this time, but fill them gradually as the plants grow, by cultivation.

Cultivation during the summer should be frequent. No sprouts should be cut during this season. The tops should be allowed to grow until the seed is ripe in the fall, when they should be cut off close to the ground and burned, to avoid scattering the seed. The bed may then be mulched with manure.

As soon as the ground is in proper condition to be worked in the spring it should be thoroughly and deeply cultivated. This may be done with a horrow, or even with a plow if it does not cut too deep, and no attention need be paid to the rows for the roots, being deep in the ground, will not be harmed if the cultivating is done early in spring.

Kainit is the best fertilizer for asparagus, and it will be found profitable to apply it early each spring at the rate of about one-half ton per acre. It should be applied broadcast and harrowed in.

Some of the sprouts may be used the second year. They should not be cut after about the middle of June, when the bed should be mulched with manure and the tops allowed to grow until the seed is ripe, then cut close to the ground and burned.

The next and following seasons will be a repetition of this, except that full crops will be produced.

The sprouts should be cut when the proper size, whether needed or not, for if permitted to grow they retard the growth of new sprouts. They should be cut two inches below the surface when about six inches high, care being taken to not injure the crowns of the plants.

These instructions are for producing the green tips. If blanched asparagus is preferred light soil or the mulch should be ridged over the rows, forcing the sprouts to grow up through it, and cutting four or five inches below the surface.

BEANS

Bush beans are easy to grow, and for that reason are more extensively grown than the pole varieties. They should not be planted until late in spring, after all danger of frost and chilly weather are past and the soil is thoroughly warmed. For succession plant at intervals of a week or two weeks until the middle of June. A warm, rich, rather heavy soil is best, and they will stand heavy fertilization with a fertilizer in which phosphoric acid and potash predominates, as an excess of nitrogen will cause a too rank growth of foliage at the expense of beans and pods. The ground should be carefully prepared, the same as for any other garden crop, and the seed sown two to four inches apart and two inches deep in drills two to three feet apart, according to whether to be cultivated with horse or by hand. Beans should not be cultivated while wet with dew or rain.

Pole beans require the same soil and weather conditions. Poles, six feet long, should be set firmly in the ground three to four feet apart each way, and around the base of these six to ten seeds should be planted two inches deep. The plants should be thinned to three of the strongest plants to each hill after danger of insects is past. It is usually necessary to give them a little help in starting to wind around the poles; they always wind from right to left.

Tall lima beans will not succeed in the Northwest, but the dwarf limas are more or less successful. The culture is the same as for bush beans, except that they are even less hardy and should be planted a week later.

BEETS—TABLE

The round, or turnip, varieties are grown for summer use. The long varieties are grown for winter use, and on the Pacific Coast may be left in the ground all winter and pulled from time to time as needed. A rich sandy soil is most suitable. The seed will germinate much quicker if hot water is poured on it and left to soak a day or more before planting. Sow the seed in drills twelve to thirty inches apart, according to whether to be cultivated by hand or with a horse, covering the seed one inch deep. Plant very early in spring, and for succession plant turnip varieties at intervals of two or three weeks until the middle of July. Thin the plants to three or four inches apart in the row. The young plants which are pulled out make splendid greens. For extra early, a few plants may be started in the hotbed and transplanted to the garden.

BEETS—STOCK, MANGEL AND SUGAR

The culture is about the same as for table beets, except that as they are generally cultivated with a horse, the rows should be twenty-four to thirty inches apart, and they should be thinned to about six inches apart in the row. They make splendid stock and poultry food, produce wonderful crops in the Northwest, and should be more generally grown.

An article on the subject appears elsewhere in this book under the head of Root Crops.

BROCCOLI

This is a winter substitute for cauliflower, to which it is similar but hardier and inferior.

The culture is the same as for cauliflower, but it matures much later, and on the Pacific Coast may be left in the ground until wanted for use during the winter.

BRUSSELS SPROUTS

Closely related to cabbage and cauliflower, and grown in the same manner. Instead of a single head, Brussels sprouts form a large number of small heads in the axils of the leaves.

As the heads begin to crowd, the leaves should be broken from the stem of the plant to give them more room. A few leaves should be left at the top of the stem where the new heads are being formed.

Brussels sprouts are more hardy than cabbage, and in mild climates may remain in the open ground all winter, the heads being removed as desired. For winter use in cold localities, take up plants that are well laden with heads and set them close together in a pit, cold frame or cellar, with a little soil around the roots.

The uses of Brussels sprouts are similar to those of cabbage, but they are considered to be of a superior flavor.

CABBAGE

One ounce of seed should produce 1,500 to 2,500 plants. Seed of the early varieties may be sown in seed bed in September and transplanted to cold frame to be wintered over, or may be sown in hotbed in January or February and the plants transplanted to cold frame when large enough.

Seed of the second early or summer varieties should be sown in seed bed or cold frame early in April, and of the late or winter varieties in May or June. The plants will be greatly improved by transplanting once before setting out in the garden or field.

Plants of the early varieties should be set out as soon as the ground is in good condition to work. They should be set twelve to eighteen inches apart in the rows and the rows should be two to three feet apart, according to wheeler to be cultivated with horse or by hand. These should be ready for use in June.

The second-early varieties should be set out in May and should mature in July and August.

Late varieties, for winter use, are set out in July, sixteen to twenty-four inches apart in rows two to three feet apart. They mature in October or November. In the mild climate of the Pacific Coast they may be left in the ground until wanted for use during the winter. In colder climates they may be placed, heads down, in trenches, and covered with sufficient straw and dirt to keep them from freezing.

The plants should always be set in the ground up to the first leaves, and should be planted on a cool, wet day, or immediately after a heavy rain, while the ground is wet.

Sometimes the seed is sown in drills, where the cabbages are to grow, and the plants thinned to the proper distance apart. Although this method may be successful, it is not generally practiced.

Cabbage is a cool weather crop, does not thrive in very hot weather, and makes the best growth in spring and fall. Our cool, moist climate in the Pacific Northwest makes this an ideal locality for growing cabbage.

The soil for starting the plants should be carefully prepared and cultivated, but should not be extremely rich, for it would produce plants too quickly, making them too succulent and not sufficiently hardy to stand transplanting. But the land for growing the cabbage should be made very rich by applying large quantities of well-rotted stable manure and commercial fertilizers containing large proportions of nitrogen and potash.

Cabbage may be grown on most any good soil, but, especially early cabbage, prefer a light, rich loam.

It is useless to attempt to grow cabbage on poor soil or careless preparation and cultivation. Cultivation should be frequent, thorough, and shallow, to conserve moisture.

Quick-growing crops, such as lettuce, radishes, etc., may be grown between the rows of cabbage, and will be out of the way before the cabbage requires the space. Late cabbage may be grown after some early harvested crop is out of the way, or early cabbage may be harvested in time to plant a late crop on the same ground.

The worst enemies of cabbage are cabbage worms, green aphis, and root maggots. They must be watched very closely. Cabbage worms are easily controlled with arsenate of lead. Although arsenate of lead is a poison, it is perfectly safe to use before the cabbage have neared maturity, for cabbage grows from the inside, and none of the poison is retained in the head. Any nicotine solution, such as Black Leaf 40, is a cure for green aphis. Root maggots are the most troublesome, for there has not yet been found any sure and practical cure for them.

CARROT

Carrots, like other root crops, do best in a rich, sandy loam, thoroughly tilled. For early carrots, sow the seed as soon as the ground is in good condition in spring, in rows twelve to fifteen inches apart, thinning the plants to about three inches apart in the row. For later crops the seed may be sown any time up to the middle of June.

Carrot seed is rather slow to germinate, and radish seed may be sown with it to mark the rows to aid in cultivation.

They do well in the Northwest, and are valuable for stock food as well as for the table. In the mild climate west of the Cascades they may be left in the ground during the winter.

One ounce of seed is sufficient for about one hundred and twenty-five feet of drill, or four pounds for an acre.

CAULIFLOWER

Cultivation and soil should be very much the same as for cabbage, but it is more difficult to grow. To produce perfect heads cauliflower requires a cool, moist season and a rich, moist, loamy soil. In the Sound country cauliflower does exceedingly well in the average season. For a spring or early summer crop sow in March or early in April, in hotbed, and transplant to a cold frame when sufficiently large, and to the open ground as soon as danger of hard freezing is over. For a late crop sow at the same time as for late cabbage and treat in the same manner. With the early cauliflower, when the heads begin to form, the leaves should be brought over and tied around the heads to blanch them. The heads should be cut for use when the "curd" is very compact or hard, as they soon become tough and bitter after they open and separate into branches. Best results will be obtained by planting either very early or very late, in order to avoid the hot mid-summer season when heads are being formed.

CELERIAC

A large-rooted form of celery of which the root is the edible portion, and is used for cooking. The plants may be started the same as celery, and transplanted about five inches apart in rows two feet apart. Cultivation is the same as for celery, but blanching is not required. The roots may be left in the ground during the winter, until wanted for use, but in cold localities should be mulched to prevent freezing.

CELERY

Sow the seed in hotbed, cold frame or seed bed early in spring. Transplanting once or twice before setting the plants in the garden will be very beneficial. The tops should be clipped off to induce stockiness, and, when transplanting, the ends of the roots should be cut off.

Celery requires a deep, very rich, moist soil. Fresh stable manure is liable to make the celery coarse, stringy, and of inferior fla-

vor, but well-rotted manure may be used if applied some time before planting. Kainit is very beneficial for celery, the same as for asparagus, and should be used in large quantities, one thousand pounds, or more, per acre.

The plants may be set in the garden after some early harvested crop has been removed. They should be set six inches apart in rows three feet apart. They should be given frequent shallow cultivation.

When the plants have attained considerable size, the leaves should be drawn up and a little soil compacted about the base of the plants to hold them upright.

There are several ways of blanching the plants, but the favorite method is with boards. When the plants are a little more than a foot high, set twelve inch boards on edge close to the plants on both sides of the row. Let the tops of the boards lean together against the plants so that they will be only two or three inches apart. Hold the boards in this position by nailing cleats across the tops. A few of the leaves will show above the boards. The foliage will soon fill the space, excluding the light, and the stalks will be blanched in ten to twenty days.

If the plants are blanched with earth, care must be taken that the crowns do not become filled.

Celery may be kept for winter use by banking with earth and covering the tops with leaves or straw to keep it from freezing. Or it may be dug and removed to a cellar, cold frame, vacant hotbed, or pit, and reset close together with the roots bedded in earth. While in storage it should be kept as cool as possible without freezing.

The seed is slow to germinate, and the seed bed must be in perfect condition. One ounce of seed will produce about three thousand plants; one pound will produce plants for an acre.

CHERVIL

Seed of Curled Chervil may be sown in well-prepared ground at any time during the spring. Culture is the same as for parsley. The rows should be about twelve inches apart, and the plants thinned to four inches apart in the row. The leaves are used the same as parsley, for garnishing and for flavoring soups.

CHICORY

Chicory is used for several purposes. The roots are used to adulterate coffee; the leaves are used like spinach; or the tender, blanched leaves are eaten raw as saalad or are boiled and used as greens.

The culture is the same as for carrots. A deep, rich, loam soil is required. The seed should be sown early in spring in rows twelve inches apart, and the plants thinned to two or three inches.

When used like spinach, the leaves should be boiled in two waters to remove the bitter taste. To blanch the leaves for salad or greens, the roots are dug in fall and planted in a cellar or under a greenhouse bench.

CHIVES

Chives, or Schnittlauch, are hardy perennial plants, resembling small onions in appearance, and growing in clusters. They are grown for the young leaves, which are produced freely early in spring and throughout the summer. The leaves are cut off close to the ground when wanted, and are used in soups, salads, sausages, etc., imparting a mild onion flavor.

Seed may be sown the same as onions, and the plants transplanted or thinned; or clumps of plants may be obtained from your seedsman. Large clumps should be divided, and placed about a foot apart in a part of the garden where they may remain for several years.

COLLARDS

The Georgia Collard is a non-heading form of cabbage, grown extensively in the south for greens. Culture is the same as for late cabbages. They are best after having been touched by frost.

CORN—SWEET

Sweet Corn should be planted as soon as the soil is thoroughly warmed in spring, and successive plantings should be made at intervals of two weeks; or early, medium and late varieties planted; for succession. It is very sensitive to frost, and early plantings may be killed, but it is neither much trouble or expense to replant. If the early plantings are not killed the result will be worth taking a chance for.

In our cool climate west of the Cascade Mountains, to grow corn successfully, a rich, light, warm soil must be selected, and it must be highly cultivated and fertilized. Light applications of nitrate of soda or nitrate of lime early in the growing season will help to give it a good start.

The seed may be planted in drills three feet apart and the plants thinned to a single stalk every foot in the rows, or five or six kernels may be planted in hills three feet apart each way and thinned to three plants in each hill.

Large quantities of commercial fertilizers should be used, with potash and phosphoric acid predominating. Nitrates should be used early in the season only, as they tend to retard maturity. Cultivation should be frequent and thorough, and, especially after spring rains have ceased, should be shallow.

One pound of seed is sufficient for about two hundred hills; fifteen pounds for an acre.

CORN SALAD

Corn Salad, also known as Fetticus and Lamb's Lettuce, is used as a salad or substitute for lettuce. The seed is sown early in spring the same as lettuce, or for an extra early crop the seed may be sown in fall and when cold weather begins protected with a light mulch of straw or other coarse material. The leaves may be used in their natural green state, or they may be blanched by covering the rows with anything that will exclude the light.

CRESS

There are two forms of cress, Water Cress and Garden Cress or Peppergrass. Peppergrass is sown in any good garden soil in drills a foot apart. The plants last but a short time, and if a continuous supply is desired it will be necessary to sow at intervals of a week or two during the spring and summer. It is a pungent plant and is used as a salad.

Water Cress must be grown in shallow water, and the seed is simply scattered at the edge of a stream or pond.

CUCUMBER

Cucumber plants are very tender, will not endure frost or chilly weather, and should not be planted out of doors until late in spring after the weather is thoroughly settled and the soil is warm. They require a light, rich, warm, porous soil, very heavily fertilized. It is difficult in the Puget Sound country to make them mature all their fruit before being killed by frost in the fall, and they must be forced in every way possible. The plants may be started in berry boxes or on inverted pieces of sod in the kitchen window or in the hot-bed, planting a half dozen or more seeds in each box or sod the latter part of April. By the time that they should be planted out of doors they will have attained a height of eight or ten inches and will be about ready to vine. Set in the garden a little deeper than they stood in the boxes, removing the boxes without disturbing the soil around the roots. After danger from beetles is past thin to three plants to the hill.

There are many methods of planting. Some plant in hills six feet apart each way; others plant in hills six by two or three feet, and others in drills six feet apart, thinning the plants to one foot apart in the rows after danger of destruction by beetles is past. We prefer the latter method. A row of beans or peas may be planted between each two rows of cucumbers. They will protect the cucumbers and will be removed before the space is required by them.

The seed should be planted about one inch deep, and enough seed should be planted so there will be plenty of good plants after the beetles have finished their depredations. It seems to be impossible to entirely eliminate cucumber beetles, but their depredations may be controlled to some extent by dusting the plants and the ground around the plants frequently with tobacco powder. Or the plants may be covered with mosquito netting.

Pick all of the cucumbers before they begin to mature, for as soon as the vines begin to mature fruit they cease to produce.

DANDELION

In the lawn, dandelions are a very troublesome weed, but when properly grown and cultivated they make delicious greens. Being perennials, they should be placed in a part of the garden where they may remain for several years. They should not be allowed to go to seed.

The seed should be sown in spring in rows a foot apart and the plants thinned to eight to twelve inches. They will produce greens early the following spring. The quality is greatly improved by blanching. This may be done by placing boards over the rows in the form of an inverted trough, to exclude the light.

EGG PLANT

Makes a very satisfactory crop in the Yakima Valley and other favored sections of the Northwest, but will not mature fruit in the Sound country. Plants should be started under glass and should be six to eight inches high when set out. Transplanting should not take place until the weather is warm and all danger of frost is past. The better plan is to start them in two or three-inch pots or berry boxes. They require a rich loamy soil.

ENDIVE

A fine salad vegetable that does exceedingly well in all sections of the Northwest. During the summer and in the dryer and hotter sections it is superior to lettuce. Cultivation and soil required are the same as for lettuce.

GARLIC

Garlic is closely allied to the onion, but will remain in the ground from one year to another if undisturbed. It is planted by setting the small bulbs, or cloves, either in fall or early spring. The culture is practically the same as for onions. The bulbs are used for flavoring.

HORSERADISH

Grows best in rich, cool, clay loams. Seldom produces seed and is generally started by setting out small plants. Should be planted in rows two and a half feet apart and 10 to 12 inches in the row. It is best to plant rather late in the spring. Sets planted in May, small end down, with top one inch below surface, will form radish of large size in one season's growth. Do not plant horseradish in places where you do not want it permanently, as it is hard to get rid of. Use very little, if any, stable manure, as it contains too much nitrogen.

KALE

Grown for supplying greens during the fall, winter and spring; also used for garnishing. For winter use, sow in September in drills eighteen inches apart, covering the seed one inch deep, and thin to twelve inches apart in the rows. The young plants which are thinned out may be used for greens like spinach. The plants are hardy and are left in the ground until wanted for use. Frost improves the quality. For summer use, plant very early in spring. The soil should be very rich.

KOHL-RABI

This belongs to the cabbage family, and the seed resembles cabbage seed. The edible portion is the peculiar swollen stem just above the ground. It is used and grown the same as turnips. Where it is well known it is more highly esteemed than turnips for early summer use. Like turnips, it should be sown in drills very early in spring, and used while young and tender, or for winter use it may be sown in July or August, and can be stored the same as turnips.

LEEK

Belongs to the same class as onions, but requires different treatment. The seed is usually sown in the bottom of a shallow trench, and the plants thinned to about four inches apart in the row. The trench will be filled gradually by cultivation as the plants grow, and when they have attained nearly full size the earth is drawn around them to a height of six or eight inches to blanch the fleshy stem.

The leek does not form a true bulb like the onion, but the stem is uniformly thick throughout. They are marketed in bunches like young onions. They may be stored for winter use the same as celery.

LETTUCE

For early crop sow the seed in hotbed in February or early March; transplant the seedlings to coldframes or flats, and when the ground is warm enough transplant to the garden in rows a foot apart and eight to twelve inches apart in the rows

For general crop, sow when ground is in good condition to work in spring in rows a foot apart and thin the plants to six or eight inches apart. For succession sow at intervals of two or three weeks. The plants which are thinned out may be transplanted to other rows.

Some use only a part of the leaves from the plants, allowing the plants to continue to grow; or allow them to grow thickly in the rows and thin as wanted for use; but it is much better to thin the plants when they are small, allow them to form heads, and use the entire heads.

Lettuce does best in the cool weather in spring and fall. That grown during the hot weather in summer should be protected from the sun, or planted in the shade of some taller crop. It is best when grown quickly, and frequent light applications of nitrate of soda will be very beneficial. A rich, warm, sandy loam soil is best.

The seed may be sown in fall and the plants wintered over in cold frames, like early cabbages.

MELON—MUSKMELON OR CANTALOUPE

The muskmelon is a long season crop, and when grown west of the Cascade Mountains conditions must be favorable and they must be encouraged in every way possible to insure success. The soil must be a warm, sandy loam with an abundance of well-rotted manure and commercial fertilizers. Nitrate of soda may be used as suggested elsewhere in this book under the head of Nitrate of Soda for Garden Crops.

For an early crop, or for main crop in other than the most favorable localities, the plants should be started in berry boxes or on inverted sods as suggested on page 7.

In warmer localities the seed may be planted, when weather is settled and the soil is thoroughly warmed in spring, in hills six feet apart each way, eight or ten seeds in each hill, and thinned to four plants to the hill. Or the seed may be sown in drills and the plants thinned to eighteen to twenty-four inches apart when they have become thoroughly established. Rows of short season crops may be planted between the rows of muskmelons.

Muskmelons are subject to a number of diseases and pests. While the plants are young they are attacked by the cucumber beetle, and the same precautions should be taken as with cucumbers.

MELON—WATERMELON

The cultivation of the watermelon is practically the same as for the muskmelon, except that the plants grow larger and require more room. They should be set in hills ten feet apart each way, or in drills ten feet apart and the plants thinned to three feet apart in the rows. The young plants are also subject to attack by cucumber beetles.

MUSHROOMS

The most important conditions in mushroom growing are proper and uniform temperature

and very rich soil. The most suitable place is a cellar, but they may be grown in any place where the temperature can be kept at 50 to 70 degrees, as near 55 degrees as possible. The place may be either dark or light.

Mix thoroughly three parts fresh horse manure, free from straw, and one part rich loam soil. Make it into a compact pile and allow it to stand for a few days until it becomes heated, then fork it over and allow it to stand until it again becomes heated, when it will be ready for the bed. Make the beds about four feet wide, so that you can reach all parts without tramping on them, and any desired length. If the room is heated, so that manure is not needed to produce heat, six or eight inches will be sufficiently deep to make the beds, but otherwise they should be made twelve to eighteen inches deep.

In making up the beds shake the manure loosely, and spread it evenly over the bed, beating it down firmly with the fork as you go along, continuing until the desired depth is attained, then tread it down firmly and evenly. Insert a hot bed thermometer in the bed. Within a few days the temperature should rise to 110 or 120 degrees. Never spawn the bed while the temperature is rising, but when it has subsided to below 90 degrees the bed is ready to spawn.

Mushroom spawn is put up in two forms. What is known as English spawn is preserved in horse manure pressed in the form of bricks, and is preferred by most growers. French spawn is not pressed in bricks, but is handled in the form of flakes, in bulk. One pound of English spawn will spawn about ten square feet of bed.

Cut a brick of spawn into about twelve equal pieces, and insert the pieces in the bed about ten inches apart and one to two inches below the surface. The bed should then be firmed down evenly and covered with two inches of rich loamy soil. Some prefer not to cover with soil until five to ten days after the spawn has been inserted, but this seems to be only a matter of choice.

Do not water the bed if it can be avoided, but if they become dry should be moistened with a fine spray.

If the temperature is right you may expect mushrooms in six to eight weeks, and the beds will bear about thirty days. After the first crop is removed spread over the bed an inch of loam and moisten with water.

OKRA, OR GUMBO

Sow the seed in the open after the ground has become quite warm, or start the plants in berry boxes in a hotbed and transplant them to the garden after all danger of frost is past.

The rows should be four feet apart for the dwarf sorts or five feet apart for the tall kinds, with the plants two feet apart in the rows. Okra does best in rather rich land and requires frequent shallow cultivation until the plants cover the ground.

The young pods are the part used, and these are employed principally in soups, to which they impart a pleasant flavor and mucilaginous consistency. If the pods are removed from the plants, and none are allowed to ripen, the plants will continue to produce pods until killed by frost, but the best pods are grown on young plants. The pods can be dried or canned for winter use.

ONION

For young onions, sets are generally planted in rows about 12 or 14 inches apart and about one and a half inches apart in the row. This will give very early green onions.

For dried onions, seed is sown, and it requires a rich, well-drained loam. No other soil should be used if it can possibly be avoided. The land should be very rich and it is absolutely necessary that it should have raised a hoed crop the previous season. It is a mistake to attempt to grow onions on weedy or rundown land. To get the best results a heavy top dressing of well-rotted barnyard manure should be well worked into the soil. After this a complete commercial fertilizer containing a large proportion of potash should be used. This should be sown broadcast at the rate of 1,000 pounds per acre. If the land has been in a high state of cultivation the commercial fertilizer may replace the barnyard manure. Onion soil, however, must be very rich. The most successful growers use, in addition to the above, about five hundred pounds per acre of nitrate of soda, applied broadcast in three or four light applications early in the season. It must not be used later, as it will retard maturity.

The cost of growing and cultivating onions is very high, and it must be borne in mind that it costs no more to cultivate a crop that yields 800 bushels per acre than it does to cultivate a crop that yields only 300 bushels. When land is in good condition onions may be grown on it from year to year. Seed should be sown as early in the spring as the land can be worked. If intended for hand cultivation, sow in rows 12 to 14 inches apart, and if for horse cultivation about 30 inches apart. It requires from three to six pounds of seed per acre.

For those who intend raising many onions it will be money well spent to get one of the many good books published in reference to the production of this crop. It will pay to buy the best seed and from reliable sources, as onion seed loses its vitality after the first year.

PARSLEY

Parsley seed germinates very slowly, and should be soaked several hours in warm water before planting. Sow the seed early in spring in drills one foot apart. It is well to sow radish seed with it to mark the rows for cultivation. Thin the plants to four inches.

In mild climates it will live outdoors during the winter if given a light mulch. In colder climates the plants may be transplanted to cold frames for winter use. The leaves are used for garnishing meats and for flavoring soups.

PARSNIP

Sow the seed in a rich, deep soil, early in spring, in drills eighteen inches apart and thin the plants to three inches apart. Give frequent shallow cultivation during the summer. The roots may remain in the ground until wanted for use during the winter. They are improved by freezing.

Roots not used during the winter should be dug in spring, for they will produce seed and become weeds. Parsnips that have run wild are considered poisonous.

PEAS

Peas are easy to grow, and not very particular in regard to soil or weather, but they do best in a rich clay loam and while the weather is not too hot or dry. Early peas will be produced earlier on light, warm soil.

Stable manure or other highly nitrogeneous fertilizers should not be applied immediately before planting the seed, as they are liable to cause an excessive growth of vines at the expense of pods. It is better to apply the manure the previous season, or to use commercial fertilizers containing large proportions of phosphoric acid and potash.

The seed should be sown in drills very early in spring, as soon as the ground is in good condition to work, and covered two or three inches deep. Rows of the extremely dwarf varieties may be as close as twelve to eighteen inches apart; the semi-dwarf and tall varieties should be two to four feet apart.

Some sow the seed in double rows six inches apart, placing trellis or brush between the rows, thus making one row of supports do for two rows of peas.

For succession, seed should be sown at intervals of about two weeks until the middle of June. They do not do well in hot weather in summer, but good crops may again be produced in the fall.

On the Pacific Coast, where the winters are mild, the seed may be planted in rather light, porous, well-drained soil in November, as in-

structed elsewhere for Sweet Peas, and will be ready for use early in June.

One pound of seed is sufficient for fifty to seventy-five feet of drill, two hundred pounds for an acre.

PEPPER

Peppers are a very uncertain crop west of the Cascade Mountains, and the plants should be started in berry boxes or on inverted sods as described for melons. In warmer climates the plants may be started under glass the same as tomatoes. They should not be planted outdoors until very late in spring, after the weather and soil are thoroughly warmed. The plants should be set about thirty inches apart each way in well-tilled rich soil.

POTATO

U. S. Dept. of Agriculture; Farmers' Bulletin No. 255.

A rich, sandy loam is best suited to the production of Irish potatoes, and the fertilizers employed should contain high percentages of potash. The main crop of Irish potatoes for family use should be grown elsewhere, but a small area of early ones properly belongs to the garden. The preparation of the soil should be the same as for general garden crops.

Early potatoes should be planted as early in the spring as it is feasible to work the land. Late potatoes should be planted late in May or during June. The rows should be two and one-half to three feet apart, and the hills fourteen to eighteen inches apart in the row.

Lay off the rows with a one-horse plow or lister, and drop the seed, one or two pieces in a place, in the bottom of the furrow. Cover the seed to a depth of about four inches, using a hoe or one-horse plow for the purpose.

One to three weeks will be required for the potatoes to come up, depending entirely upon the temperature of the soil. The ground may freeze slightly after the planting has been done, but so long as the frost does not reach the seed potatoes no harm will result, and growth will begin as soon as the soil becomes sufficiently warm.

As soon as the potatoes appear above the ground and the rows can be followed, the surface soil should be well stirred by means of one of the harrow-toothed cultivators. Good cultivation should be maintained throughout the growing season, with occasional hand hoeing, if necessary, to keep the ground free from weeds. Toward the last the soil may be well worked up around the plants to hold them erect and protect the tubers from the sun after the vines begin to die.

After digging the potatoes they should not be allowed to lie exposed to the sun or to any light while in storage, as they will soon become green and unfit for table use. Early potatoes especially should not be stored in a damp place during the heated period of the summer, and will keep best if covered with straw in a cool, shady shed until the autumn weather sets in, after which they can be placed in a dry cellar or buried in the open ground. The ideal temperature for keeping Irish potatoes is between thirty-six and forty degrees F., but they will not withstand any freezing.

PUMPKIN

Pumpkins thrive best in a warm sandy loam. The seed should not be planted until the ground is thoroughly warmed and all danger of frost is past in spring. It is a common practice to plant the seed in the corn field in occasional hills at the time corn is planted, or later in hills where corn is missing.

For garden culture the seed should be planted in hills eight feet apart each way, six or eight seeds to a hill, and thinned to three plants to the hill. Where there is danger of their not maturing, the vines should be pruned. Confine each plant to about three runners, and cut off the ends. This throws all of the energy of the plant into producing fruit, and at the same time allows the sunlight to enter.

RADISH

This is a hardy, quick-growing crop, and the seed may be sown as soon as the ground can be worked properly in early spring, and for succession at intervals of ten days or two weeks as long as wanted. The soil should be very rich, light and warm. To make them crisp and brittle they must be grown quickly, and for that purpose one or two applications of nitrate of soda will be very beneficial.

The seed may be sown in drills a foot apart and the plants thinned to about two inches, or the seed may be mixed with seeds of slower growing crops such as lettuce, carrots, parsnips, etc., and the radishes will be used before the other crops need the space.

Winter radishes are grown the same as turnips, and the seed should be sown in the latter part of July or any time in August.

Radishes are very subject to root maggots, the only practical cure for which seems to be to sow the seed in different localities each year.

RHUBARB

Every garden should contain a half dozen good plants of rhubarb. It comes in very early in spring and takes the place of fruit at a time when fruit is scarce.

It may be propagated by dividing the roots of old plants, but best results are obtained by growing or purchasing one-year-old or two-year-old plants grown from seed.

The soil should be a light loam, and extremely rich. In addition, top dressings of stable manure or commercial fertilizers should be applied each year. As they remain for many years, the plants should be set at one side of the garden where they will be out of the way. If more than one row is planted, the rows should be at least four feet apart; the plants should be three feet apart in the rows.

Set the plants in trenches, the same as asparagus, so that the crowns will be four or five inches below the surface; cover lightly and gradually fill the trenches by cultivation as the plants grow during the summer. None of the stalks should be used the first season. The plants should never be allowed to produce seed.

Rhubarb may be forced for winter use by setting large, old roots in a bed of manure, and covering with three or four inches of moist sand, under the benches of a greenhouse, in a cold frame, cellar, pit, or shed. Heat is not essential. Better rhubarb will be produced by excluding the light. Rhubarb outdoors may be produced earlier in spring by covering with a box or barrel to exclude the light.

RUTABAGA

The culture of the rutabaga is the same as for the turnip, except that it requires more room and a longer period for growth. The roots are quite hardy and will withstand considerable frost. They are used for the table like turnips, and are valuable for stock food.

SALSIFY

The culture of salsify, or vegetable oyster, is the same as for parsnips. The roots may be left in the ground until wanted for use during the winter, or they may be dug in the fall and stored in the cellar.

Salsify is deserving of more general cultivation. Its uses are similar to those of the parsnip, and when boiled and afterwards coated with rolled crackers and friend in butter it has a decided flavor of friend oysters.

SPINACH

Spinach is easy to grow, thrives in cool weather, and is valuable for greens during the winter and early spring.

For spring and summer use, sow in drills one foot apart very early in spring and at intervals of two weeks for succession.

For winter and early spring use, sow in September or after other crops have been removed from the ground. Mulch with straw on the approach of very cold weather.

The soil should be light and rich. Light applications of nitrate of soda will greatly im-

prove the quality. In gathering spinach the entire plant is removed rather than merely cutting off the leaves. If not sown too thickly, the only thinning necessary will be to use the larger plants first, giving the smaller plants room to develop.

SQUASH

The early summer varieties of squash do well in all sections of the Northwest, and if given proper care the winter varieties may also be grown in even the most unfavored sections. Where the season is short they may be started by the same method as described for musk melons. They require a warm, fertile soil, preferably sandy. The bush varieties of summer squash are grown almost exclusively now, and these should be planted in hills about four feet apart. Winter varieties, such as the Hubbard, should be planted in hills 12 feet each way, for the Hubbard and other long trailing kinds use the same treatment as described for the pumpkin, and no trouble will be had in getting the squash to mature in any section of the Northwest. Care should be used to see that the squash are all picked and stored before the first fall frost, as they are very easily injured. In gathering the winter varieties care should be exercised that the stem is not broken from the squash, and that the fruit is not bruised.

TOBACCO

Tobacco can be grown in the warmer sections of the Northwest. The plants should be started early in spring in hotbed or cold frame and transplanted to the open ground when the weather has become thoroughly settled and warm. Wood ashes should be mixed with the soil, and the plants set four feet apart each way. Cultivation is the same as for corn. Fertilize with sulphate of potash. Do not use muriate of potash, kainit, or other fertilizers containing chlorine.

TOMATO

The plants should be started in a greenhouse, hotbed, or in a warm, light room in February or early in March, and transplanted once or twice before being set outdoors. The best plants are produced by transplanting single plants to pots or berry boxes.

They cannot stand any cold, and should not be set outdoors until the weather is thoroughly warm. The soil should be rich, mellow, and in fine condition. If the plants are not to be pruned they should be set four feet apart each way. They may be set in rows with early maturing crops that will be out of the way before the tomatoes need the room.

West of the Cascade Mountains, where the climate is cool, they must be favored in every way possible. Set the plants two feet apart in rows four feet apart. Prune the plant to a single stem and keep all side shoots and other superfluous growth pruned off, and train the plant to a stake set at each plant. Or set the plants four feet apart, set a stake at each plant and stretch wires along the row of stakes, one twelve inches from the ground and the other thirty inches from the ground. This will form a trellis for the plants, which should be pruned to four stems, which should be trained on the wires.

Pruning increases the size of the fruits, and also permits the sunlight to reach the blossoms and fruits, thus promoting a much earlier crop.

TURNIP

Turnips may be grown in any good garden soil, but do best in rich, light, sandy soil. For table use, the early varieties should be sown as soon as the ground is in good condition to work in spring in drills twelve to fifteen inches apart; the plants should be thinned to three inches apart in the rows. For succession, sow at intervals of about three weeks. Turnips should be used for table while young, before they are full grown. They may be grown during the summer, but do best in cool weather in spring and fall.

For fall and winter use, the seed should be sown in August or September. For stock food, the seed is sometimes sown broadcast in the field after last cultivation of corn or other cultivated crop.

Turnips are quite hardy and need not be harvested until after several frosts. West of the Cascade Mountains they are sometimes left in the ground until wanted for use during the winter. They may be stored in a cellar or buried in a pit.

Rutabagas, or Swedish turnips, are grown in the same manner, but require more room and a longer period for growth.

VEGETABLE MARROW

U. S. Dept. of Agriculture; Farmers' Bulletin No. 255.

The so-called vegetable marrows are closely allied to the pumpkin, both as to species and habit of growth, the principal difference being that the vegetable marrows are used while quite young and tender, and may be baked and served very much the same as sweet potatoes. The vegetable marrows should receive thorough cultivation in order that a tender product may be secured, and should be gathered while the outside skin is still so tender that it may easily be broken by the finger nail. The flesh is either boiled and mashed or baked in the oven and served with butter while hot.

CONCERNING SOME FARMING FAILURES

By H. L. Blanchard, Assistant Superintendent
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In his institute trips the writer occasionally visits a farming community where many of the farmers would have it appear that there is no market for the things they produce on their farms and therefore their farms are offered for sale. In fixing upon a price for these farms, the owners are generally governed by the prices asked for the farms that are producing a profit for their owners—hence the former do not attract buyers. To the person who is familiar with farms and farming, the most of such farms spell failure at a glance.

The unsuccessful farmers of the communities referred to are, as a rule, not farmers by either birth or training, and to them farming consists of growing some potatoes, cabbages or other vegetables, planting a few fruit trees and berry bushes, keeping a few chickens, and possibly a cow and a pig. These farmers depend upon their potatoes, vegetables and a few eggs for their meager cash receipts. There may be no demand for the vegetables and what eggs they do get are laid at the season of the year when eggs are the cheapest, and were it not for the milk from the cow and the meat from the pig, the family would starve, and no doubt they do go hungry half the time as it is.

Thus we have the condition where the farmers stubbornly persist in giving nine-tenths of their time and labor producing these things of which there is often over production and consequently little demand, while the remaining one-tenth of their time only is given to producing the things that to a great extent furnished the family its living—milk, meat, and eggs.

Only a little inquiry should be necessary to convince these farmers that a radical change in their system of farming could not result otherwise than to their great advantage.

They would at once discover that milk and its products, pork, eggs, and poultry are always in demand, and can with careful management be sold at a price that insures a profit over the cost of production; whereas, it frequently happens that not only do the markets periodically become over-stocked with vegetables, fruit, and other perishable products—thus bringing about low prices, but there is a

great loss through decay as well as through a percent of the crop being inferior and unmarketable.

The fact is that we are a nation of meat eaters. The diet of practically every family that can afford it and of every restaurant and hotel consists primarily of meats, poultry and dairy products. We are not producing in the State of Washington nearly all of these products that are consumed. On the other hand, market gardeners and truck growers living in the vicinity, produce the larger part of all the vegetables and truck crops needed in our cities. When the farmers of the country go quite generally into the growing of such crops it of course means that there is an over-production, and prices go down The gardeners who have their trade established are able to sell their products while often the farmers are not. Those farmers who during this fall have had quantities of potatoes, cabbage, cauliflower, celery, etc., to sell could not fail but be impressed with the fact that there is an overproduction of these products, a very different condition from that of poultry and dairy products, hogs, etc. It is good practice often to grow what might be termed cash farm crops, but to succeed the grower must be expert in the production of the crop, his soil must be suitable, and the market fairly stable.

Some system of live stock raising should be the basis of practically all western Washington farming, not only because it can be made profitable in itself, but in order to eliminate all wastes of crops and land.

It would be a better practice for most farmers to farm along the line of least resistance and produce these animal products for which there is always a demand as stated. Their cropping system could well be changed to the growing of such crops as can be utilized in the production of animals, and which would include many of the vegetables, crops like mangels, carrots, rutabagas, etc.; together with some of the legumes and forage plants, like clover, vetch, kale, corn, etc. These crops fed to animals and the manure returned to the land, will at once result in making these small and infertile farms more and more productive. A continuous income every week if not every day may be secured, and the farm home will be developed into a better home every year.

THE FLOWER GARDEN

SOME of the most satisfactory flowering annuals may be grown practically the same as garden vegetables, but others, although not difficult to grow, require different treatment. Most of the failures in growing flowering plants from seeds are on account of a lack of knowledge of the habits of the different plants. If the following directions are followed closely, success will be the rule.

Flowering plants are classed as annuals, biennials, and perennials; and these are divided into three classes, hardy, half-hardy, and tender.

Hardy Annuals are of the easiest culture, and among them are some of the most pleasing and satisfactory flowers. The seed may be sown outdoors in fall or early spring, either in a seed bed, to be transplanted, or in the bed where they are to remain during the summer. The plants will bloom the first season, and will then die. When the seed is sown in the fall the plants may not make much growth until spring, but will bloom much earlier than when sown in spring. They may be started indoors if desired.

Half-hardy Annuals will stand only slight frost. For early blooms the plants should be started in a greenhouse, hotbed, or in boxes or pots in the house. The seed may be sown outdoors in seed beds, or in the beds where they are to remain, when the ground is warm and weather settled in spring. Most of them may be sown in fall and the plants wintered over in a cold frame.

Tender Annuals will not stand frost or cool weather, and the plants should not be set outdoors until late in spring.

Biennials live until the end of the second season, and then die. Some of them bloom the first season, the same as annuals, but most of them do not bloom until the second season.

Hardy Perennials seldom bloom the first year, but usually bloom the second and many succeeding years. The seed may be sown in spring, but is best sown in September.

Half-hardy Perennials require some protection during the winter. The seed may be sown outdoors late in spring; or the plants may be started in boxes or pots or wintered over in a cold frame.

Tender Perennials are usually grown in a greenhouse or conservatory. They require protection during the greater part of the year.

For starting plants indoors a greenhouse or hotbed is best, but they may be started very satisfactorily in shallow boxes or earthenware seed pans in a window in a reasonably warm room in the house.

In the bottom of the box, or flat, which should be only two or three inches deep, should be placed an inch of broken pots or other coarse material to insure perfect drainage. The box should then be filled to within about a half inch of the top with finely sifted soil consisting preferably of equal parts of sand, leaf mold and light garden loam. Fertilizer should not be used until the plants are transplanted.

The soil should be pressed down firmly and evenly and watered thoroughly the day before the seed is to be sown. Sow the seed thinly on the surface, and cover with finely sifted soil pressed down firmly. Very small seeds should be barely covered; larger seeds may be covered to a depth of about one-eighth of an inch. Many failures are on account of covering the seeds too deply.

Cover with a pane of glass or sheet of paper, to prevent too rapid evaporation of moisture, and keep in a temperature of as nearly sixty to seventy degrees as possible.

Watering is of the utmost importance. The soil must not become dry, and it is fully as important that it should not be too wet. It is best done with a fine spray.

Remove the covering after the seeds have germinated. When the plants are large enough to handle they should be transplanted into similarly prepared boxes, an inch or more apart each way, or into small pots, to be kept until time to plant outdoors. The soil should be rich, and may be fertilized with well-rotted manure or commercial fertilizer.

The plants should have an abundance of air, and should be gradually hardened off before they are set outdoors.

When setting the plants outdoors they should be allowed plenty of room, and the soil and location should be suitable for that particular species. To get pleasing and artistic results they should be placed with regard to height, color and time of blooming to harmonize with other plants, shrubs and surroundings. There is unlimited opportunity for display of taste, and in this lies one of the greatest pleasures of gardening.

CULTURAL DIRECTIONS FOR FLOWERS

ABRONIA (Sand Verbena)

Abronia, or Sand Verbena, is a pretty, trailing, hardy annual, thriving in dry sandy places, and is valuable for rockeries, hanging baskets, and for covering dry banks where other plants will not grow. Clusters of very fragrant pink flowers are borne early and continuously during the summer. Seed may be sown outdoors in fall or early spring, but it is better to start the plants in fall, winter them over in a cold frame, and plant outdoors in spring.

ADLUMIA
(Mountain Fringe. Allegheny Vine. Fumitory)

A graceful hardy biennial climber growing about fifteen feet high, with feathery foliage resembling the Maiden-hair Fern, and bearing the first year clusters of small rose-colored, tube-shaped flowers in great profusion. It usually reseeds itself, making it practically a perennial. Fine for covering trellises, stumps, etc. The seed should be sown early in spring in the ground where the plants are to remain.

ADONIS (Floss Adonis. Pheasant's Eye)

A hardy annual growing about one foot high with feathery foliage and bearing showy crimson flowers in June. The seed is rather slow to germinate, but it is of the easiest culture, and may be sown outdoors in fall or early spring. It prefers moist soil, but will grow in most any good soil, and in either sunshine or partial shade.

AGERATUM (Floss Flower)

The best hardy annual for blue effects in the garden; generally used in bedding and borders in contrast with such plants as geraniums, amaranthus, etc.; also exceedingly attractive when mingled with alyssum, candytuft, and similar plants. They succeed in almost any soil and climate. The plants are neat, bushy and erect, with a continual profuse clustering of pretty brush-like flowers throughout the season. Grows six to eight inches tall, and should be planted eight to twelve inches apart. For early bloom the seed should be sown in cold frame or in boxes in the house in March and transplanted in May, but for summer and fall bloom the seed may be sown in well prepared beds in early spring. Seed sown in August will produce plants for winter flowering.

ALYSSUM (Sweet Alyssum)

There are both annual and perennial varieties of this pretty little plant. They are both hardy, and are excellent for borders, beds, baskets, pots, rockeries, and for cutting. They grow about nine inches high and are covered with a profusion of small white flowers during the summer and fall.

The seed of either variety may be sown in fall and the plants wintered over in a cold frame, may be started indoors early in spring, or may be sown when the ground is in good condition to work in spring in the position in which the plants are to remain, and the plants thinned to about four inches apart.

AMARANTHUS
Love Lies Bleeding. Joseph's Coat)

Hardy annual bedding and background plants, growing three to five feet tall, chiefly valuable for their brilliant foliage. They thrive best in hot, sunny locations. The seed may be sown either in fall or early spring in seed beds or in the beds where the plants are to grow, or the plants may be started indoors.

ANTIRRHINUM (Snapdragon)

This is a valuable border plant, and although it is a perennial, it may be treated as an annual, blooming the first season from seed. The bright colors and peculiar form of the flowers are attractive, and the spikes are useful for cutting, as they keep fresh a long time. Seed may be sown in the open ground in May, and the plants will bloom in August, but for early bloom, the seed should be sown in the hot-bed in February or March, and the plants transplanted into beds of warm, dry, rich soil early in May. They grow about eighteen inches tall, and should be planted six inches apart. During the winter they should be protected with a light mulch, and will bloom early the next spring.

AQUILEGIA (Columbine)

A delightful hardy perennial, growing about two feet high, and splendid for permanent beds and borders. Its habit of growth is to form large clumps. It blooms profusely early in the season and remains in bloom for a considerable period. Sow the seed in the permanent bed in early spring, and thin the young plants to

one foot apart; or the seed may be sown in the fall and the plants will bloom the following season. They will thrive with ordinary garden soil and culture, but do best in a partially shaded, well-drained location. Few hardy perennials are so easily grown from seed.

ARABIS (Rock Cress)

A hardy perennial and one of the earliest and prettiest spring flowers. The spreading tufts are covered with a sheet of pure white flowers very early in spring. It withstands drought, and is unequalled for rockeries and edging. Grows six inches high and a foot or more in diameter. Sow the seed in fall or spring, preferably in seed bed, to be transplanted when wanted. May be propagated by division of plants or by cuttings.

ARCTOTIS (African Daisy)

Handsome hardy annuals forming robust branching bushes two to three feet high and bearing showy daisy-like flowers with petals pure white on the upper surface and lilac-blue on the reverse side. One of the best for cutting. Does best in a sunny exposure. Seed may be sown in seed bed or in bed where the plants are to grow early in spring. They will begin blooming in July and will continue until killed by hard frost.

ASTER

The aster is certainly one of the most satisfactory annual flowering plants. The great variety in its size, color, form and season of blooming makes it a most satisfactory plant for supplying cut flowers. In fact, many of the improved sorts produce flowers equal in form and size to some of the better sorts of chrysanthemums. The habit of growth adapts the aster not only to close planting for cut bloom, but some forms are robust, tall-growing plants, well adapted for use in an herbaceous border where late bloom and careless effects are desired. The more compact-growing, large-flowered forms are most desirable for cut blooms, while the tall-growing, open types are most useful in wild gardens or for screens. The vigor and ease of culture of the aster are factors which contribute to its popularity. Plants from seed sown in the open ground in May bloom in September and October, when the flowers are seen at their best. For July and August bloom, the seed should be sown in March in cold frame or in pots or boxes in the house. Cover the seeds one-half inch deep in rich, light soil and when the plants have three or four leaves transplant to other boxes or pots, setting the plants about two inches apart. After all danger of frost is past transplant to the permanent bed, setting them twelve to eighteen inches apart, according to variety. If manure is used it should be thoroughly rotted. Commercial fertilizers are best. Fresh manure, or even well-rotted manure in too large quantities, is often injurious to asters. They require rich, well prepared soil and plenty of water.

BALSAM (Lady Slipper)

A native of India, the garden balsam loves a hot sun, rich soil, and plenty of water. The young plants are quick, sure growers, and from seed sown in the open ground in May soon form handsome bushes thickly massed with large, rose-like flowers. Transplanting two or three times has a tendency to dwarf the plants into better shape and make the flowers more double. They should be given plenty of space to develop, and should not be planted closer than twelve to eighteen inches each way. The flowers are produced on the under side of the leaves or inside the plants and show to the best advantage when planted in the margin of groups or to crown a terrace. For early bloom the seed should be sown in March in a gentle hot-bed or in the house, and when large enough transplanted to other boxes or pots, and to the permanent bed when danger of frost is past. An abundance of light and water is required.

BELLIS (English Daisy)

A favorite half-hardy perennial border plant which will live outdoors over winter if protected with a light mulch. Pretty double flowers in white, pink and red are produced lavishly from early spring until well into the summer. They bloom the first year from seed, and best results are obtained by growing new plants each year. Plants may be started indoors in February or March, or the seed may be sown in seed bed or permanent bed early in spring, but it is best to sow the seed in September and winter the plants over in a cold frame. They thrive best in a moist soil and cool atmosphere. The plants should be set about six inches apart.

CALCEOLARIA

An ornamental tender perennial producing a mass of unique pocket-like flowers, and a great favorite for decorating the greenhouse or conservatory. The seed should be sown in a greenhouse or hotbed in a temperature of fifty to sixty degrees, and covered very lightly with finely sifted soil. When the plants have formed two or three leaves they should be transplanted one inch apart, and potted when large enough.

CALENDULA (Pot Marigold)

A hardy annual, about a foot high, blooming freely and earlier than the marigold. The coloring of the large, showy flowers ranges through all the shades of yellow from ivory to deep orange. Should be planted eight to ten inches apart in masses or borders. A moderately rich, light soil is most congenial to these plants, but they will thrive in poorer soil than almost any other plant. The seed may be sown in the open ground early in spring and will bloom continuously from early summer to late in the fall.

CALLIOPSIS (Coreopsis)

One of the showiest and most easily grown of garden annuals, with graceful long stemmed flowers well suited for boquets. The plants form perfect little bushes about two feet high and are a perfect mass of yellow, maroon and brown flowers from early summer until killed by frost. For early blooms the seed should be sown in cold-frame or in boxes in the house in March and transplanted to the bed in May, or it may be sown in the open ground in May and thinned to ten or twelve inches apart.

CANARY-BIRD VINE

A beautiful half-hardy annual climber growing ten to fifteen feet high and bearing charming little canary-colored blossoms. The plants may be started in boxes or pots, or in a hotbed early in spring; or the seed may be sown outdoors after danger of frost is past.

CANDYTUFT

The candytufts are among the best white flowers for edging beds, for planting in belts, beds, or massing, for rockeries, and for cutting. Several of the varieties are fragrant, and all are profuse bloomers. The seed should be sown outdoors in April where the plants are to bloom, and well thinned when they have grown about an inch high. Make a second planting a month later, and a third late in July for fall flowers. September sowings will give winter-blooming plants. The soil for best results should be rich, and the plants given an abundance of water. They branch freely, and if some are removed the flowers will be larger.

CANTERBURY BELLS (Campanula)

These fine old plants are rich in color, profuse in bloom, and of easy culture. For outdoor effects, when planted in quantity, they are glorious, and the finest full-blown specimens can be transplanted to pots for house decoration by soaking the soil about them with water and lifting them with a ball of earth. They are biennials, and bloom the second year from seed, growing about three feet high and bearing a profusion of double and single varieties of bell-shape blue, white, purple and red flowers. The seed should be sown outdoors early

in July, and the plants transplanted to cold-frame in October, setting them six inches apart. In May they should be transplanted to the permanent bed eighteen inches apart.

CARNATION (Dianthus)

These splendid half-hardy perennials reach their highest state of perfection when grown in greenhouses for winter cut flowers, but may be grown very satisfactorily outdoors in summer. For greenhouse culture the plants are generally grown from cuttings, for those grown from seed are more variable.

The seed may be sown in hotbed or in boxes in the house early in spring. The plants should be transplanted in small pots when they are large enough to handle, and shifted to larger pots as they grow. They should not be set outdoors until all danger of frost is past. If left outdoors during the winter they must be well protected. The Marguerite Carnations are probably the most satisfactory for outdoor culture, and may be treated as annuals. They require a rich soil and plenty of moisture.

CELOSIA (Cockscomb)

An odd and picturesque decorative feature of the garden. The dwarf varieties make novel and attractive borders; the tall ones form striking groups. For winter boquets they are cut before fully ripe, and dried in the house. They are hardy annuals. The seed may be planted in hot-bed or in boxes or pots in the house in March or April, and the young plants transplanted to the garden in May, or the seed may be planted in the open ground in May. Transplanting into rich soil about the time the combs begin to form will make the flower heads much larger. The dwarf varieties grow about six inches high, the tall varieties one foot. They are bright from midsummer until frost.

CENTAUREA

(Cornflower. Bachelor Button. Sweet Sultan)

In this are embraced several quite distinct hardy annuals. They are of the easiest culture, grow about eighteen inches high, and are excellent for beds, borders and cut flowers. The seed may be sown in seed bed or permanent bed either in fall or early spring. The plants should be set about four inches apart.

CHRYSANTHEMUM

The large-flowered types of chrysanthemums, which produce such gorgeous shows in the florists' stores, are not hardy, and must be grown in the greenhouse. The annual chrysanthemums bloom most satisfactorily if the seeds are sown early in a hot-bed or cold-frame and the young plants transferred to the open as soon as the soil has become sufficiently warm to keep them growing without check. They should be set ten inches apart in their permanent location. Somewhat less satisfactory results can be secured by sowing the seed in the permanent bed early in May, and thinning the young plants to eight inches apart. If the same care in regard to disbudding and pinching back is taken with the annuals as with the large-flowered perennials the work will be rewarded by the greatly increased size of the flowers.

CINERARIA

Tender perennial greenhouse and pot plants bearing profusely daisy-like flowers in white, blue, violet and crimson shades. The seed should be sown in flats in a greenhouse in January, merely pressing the seed into the soil and covering very lightly with finely sifted soil. Water with a fine spray. Transplant to small pots when large enough to handle, and shift to larger pots as the plants grow. They may be set outdoors in a shaded position when the weather is thoroughly warm.

CLARKIA

A pretty, hardy annual, native to the Pacific Coast and consequently blooming in its greatest perfection here. They are useful for bedding, borders, edging, and for hanging baskets. They grow about eighteen inches high, and bear a profusion of bright rose, purple and white flowers from midsummer until late fall. They thrive best in warm, light soil in partial shade. Seed should be sown outdoors in the fall or early spring.

COBAEA SCANDENS (Cups and Saucers Vine)

This is a rapid-growing, annual, climbing vine, easily grown from seed, and sometimes attains a height of forty feet in a season. The dark color and refined character of its foliage, together with its bell-shaped flowers, render it a very satisfactory vine for covering broad areas. The flowers are not conspicuous, because of their modest colors and because they are hidden by the foliage, their form, however, is pleasing, and they, unlike the moonflower, are open during the day. Seed should be planted in the hot-bed, and when the plants have developed their first true leaves should be transferred to three-inch pots and kept growing slowly until danger of frost is past, when they should be planted in their permanent position. The soil should be very rich, and they should have plenty of water. Poultry netting makes the best trellis, as they fasten themselves by their tendrils rather than by twining.

COSMOS

A favorite, late-flowering annual, especially adapted to the Pacific Coast, growing three to four feet high and bearing bright, bold flowers four inches in diameter. Most effective when planted in masses or background borders. Seed may be started in the house in March, or may be sown in the open ground in May, and the plants thinned to eighteen inches apart. Will thrive in ordinary garden soil.

DAHLIA

Dahlias are generally grown from bulbs, but may be grown from seed and will bloom the first summer and fall. For early blooms the seed should be sown in boxes or pots in greenhouse, hotbed, or in the house. Transplant one inch apart when the plants have developed three leaves, and set outdoors when danger of frost is past. In mild climates the bulbs may be left in the ground during the winter if protected with a mulch. In colder climates the bulbs should be taken up in the fall and stored in sand in a dry place. Plants grown from seed produce blooms in a great variety of shapes and colors, some of which are beautiful and others unique.

DAISY (Shasta Daisy)

This splendid hardy perennial grows two to two and one-half feet high and produces an abundance of showy flowers four inches in diameter with pure white petals and yellow centers. Sow the seed in seed bed or cold-frame in fall or early spring. Transplant to permanent bed about six inches apart. The seed should be soaked in warm water before sowing.

DIGITALIS (Foxglove)

The tall flower-stems of the foxgloves are particularly attractive when seen growing among shrubbery or in bold masses along walks or drives. They are perennials, blooming the second year from seed, growing three to five feet tall and producing long spikes of large flowers in various colors. Seed may be sown in the open ground in May and the plants transplanted to the permanent bed when large enough, or the next spring, setting them about two feet apart. When the center spike begins to fade it should be cut out, and the side shoots will then grow more vigorously.

ECHINOCYSTIS (Wild Cucumber)

A quick-growing hardy annual vine with dense bright green foliage and white flowers. Splendid for a quick temporary covering for trellises, fences, stumps, etc. Sow the seed in fall or early spring where the plants are to grow. The plants may be started in boxes or pots if desired.

ESCHSCHOLTZIA (California Poppy)

The eschscholtzia is the state flower of California, and an annual of striking character both as regards the form and color of its flowers, which are bright and rich in their

tints of yellow and orange. The plants average about a foot in height, have attractive, silvery foliage, and produce their large poppy-like flowers quite lavishly from early spring until frost. They are most effective when grown in beds of considerable size, over which the seed may be thinly sown broadcast and lightly raked in. These sowings may be made early in spring, or late in autumn for earlier germination and bloom the next spring. The eschscholtzia is also very useful as a pot plant and for cut flowers.

GAILLARDIA

The annual gaillardias are easily grown from seed sown in the open ground in May, but earlier flowers may be had by starting the plants in a hotbed or in the house in March, and transplanting outdoors early in May. They grow in a compact bushy form, about one foot high, and should not stand closer than one foot apart. They do best in light, well-drained, fertile soil, fully exposed to sun and air. There are also perennial varieties.

GODETIA

Free-blooming annuals, with widely opened flowers of satiny texture and delicate colors. Suited for beds or borders, for pots and to grow in shrubbery borders in shaded places. They grow about eighteen inches high and bloom from early spring until frost. Colors red, pink and white shaded and blended. Seed should be sown in the open ground early in spring, in rather light or sandy soil, and thinned to one foot apart. They may be treated as biennials by sowing the seed in July and transplanting the young plants to a cold-frame, to be placed in the open ground the following May.

GOURDS

The ornamental varieties of these half-hardy annuals are interesting on account of the variety of unique shapes of the fruits, and are useful for covering trellises, etc. The seed may be sown in spring after danger of frost is past, in the location where the plants are to grow, or the plants may be started in boxes or pots.

GYPSOPHILA (Baby's Breath)

Hardy annuals and perennials growing one to two feet high and producing a profusion of small star-shaped flowers, mostly white; useful for hanging baskets and for mixing with bouquets. Sow seed of the annual varieties early in spring, and at intervals for succession, either in beds, seed beds, boxes, or pots, and thinned or transplanted about one foot apart. Seed of the perennial varieties may be sown in spring, but it is better to sow in September and winter over in a cold frame.

HELIOTROPE

A half-hardy perennial, flowering during the whole season; highly perfumed and desirable for bouquets. It is a splendid bedding plant, or may be trained as a climber in the greenhouse or conservatory. Plants started indoors early in spring will produce blooms during the summer, or the seed may be sown outdoors after danger of frost is past.

HOLLYHOCK

These too frequently neglected old-fashioned perennials are most pleasing and attractive when seen in groups or long rows against hedges or shrubbery as a background, and, in turn, form a very satisfactory background for plants of lower growth. They are easily grown from seed, which should be sown in the open ground in May, and the young plants transplanted to the permanent position not closer than two feet apart. The plant is amenable to training, and if the tip of the main stalk is pinched off it may be kept at any desired height, and the side branches will then develop and form a bush.

HUMULUS (Japanese Hop)

Half-hardy annual climbers making a growth of twenty feet in a few weeks. They bear no flowers, but the foliage is dense and luxuriant and makes an excellent quick-growing temporary covering for verandas, trellises, etc. Heat, drought, and insects do not trouble them. The seed may be sown when danger of frost is past in spring, in the location where the plants are to grow, or the plants may be started in boxes or pots indoors. The seed has a very hard shell, and it should be filed thin on one side and soaked in warm water to soften it.

IPOMOEA
(Moonflower Vine. Evening Glory)

Rapid-growing half-hardy annuals quickly attaining a height of ten to fifteen feet, producing a dense mass of heart-shaped leaves and a profusion of beautiful large flowers which open at sunset and close in the morning. The plants may be started indoors early in spring, or the seed may be sown outdoors when danger of frost is past.

KOCHIA (Summer Cypress)

An easily grown annual forming symmetrical cypress-like bushes, attaining a height of three feet by midsummer, and splendid for temporary hedges or garden decoration. On the approach of fall the plant becomes a deep red. The plants may be started indoors early in spring, or the seed may be sown in seed bed or permanent bed when danger of frost is past.

KUDZU VINE (Pueraria Thunbergiana)

A hardy perennial which, when it has become established, makes a growth unequalled by any other ornamental vine, fifty feet in a season being not unusual. The plants die down in winter, but the roots throw up new shoots in spring. In this country it is a rather uncertain bloomer, but the foliage is luxuriant and beautiful. Plants are easily propagated from cuttings. They are not so easily started from seeds, but it can be done with proper care. The seed may be sown outdoors in spring after danger of frost is past, but it is best to sow the seed in September and winter the plants over in a cold frame. The plants do not make a great growth the first season.

LAVENDER

Well-known hardy perennials growing about two feet high and bearing long spikes of fragrant blue flowers. Sow the seed in fall or spring, preferably in a seedbed to be transplanted to permanent bed.

LARKSPUR (Delphinum)

The annual varieties are quite hardy, and the seed may be sown in the open ground in the fall, and will germinate very early in spring, or it may be sown early in spring. The tall varieties are suitable for shrubberies and borders, and the dwarf varieties for beds. Either are splendid for cutting. They bloom best in rather cool, moist soil. They should be thinned to stand six to eighteen inches apart, according to variety. There are also perennial varieties.

LINUM (Flowering Flax)

Effective and showy hardy annual bedding plants of long duration, growing one to two feet high. Sow the seed in spring after danger of frost is past, in beds where the plants are to grow; or the plants may be started in fall and wintered over in a cold frame.

LOBELIA

These charming little half-hardy annuals grow four to six inches high, forming compact little bushes literally covered with small bright flowers. For beds, edgings, baskets and pots there is nothing prettier. The seeds may be sown outdoors in early spring, thinning or transplanting the young plants four or five inches apart. There are also tall, perennial varieties.

LUPINS

Free-flowering easily grown annuals, about two feet high, with long graceful spikes of rich and various colored pea-shaped flowers. Valuable for mixed borders, beds, and for cutting. Does best in partial shade. Sow the seed in fall or spring in permanent bed.

LYCHNIS
(Rose Campion. Jerusalem Cross)

Handsome hardy perennials of easy culture. They grow about two feet high, are excellent for beds and borders, and will bloom the first year if sown early. Seed may be sown in September and the plants wintered over in a cold frame; or may be sown in spring, either in permanent bed or in seed bed to be transplanted.

MARIGOLD

There are two distinct types of these garden annuals. The French marigolds are the most compact and regular in growth, and are useful for bedding. The African marigolds grow two feet or more in height, and are better suited for planting in mixed borders or among trees and shrubs. The seeds of either type may be planted in the open ground in April, but earlier bloom may be had by starting the plants in the house.

MIGNONETTE

No garden is complete without a plentful supply of this hardy annual. The seed can be sown outdoors at any time after the middle of April, and if planted at intervals of three weeks until August, its fragrant, modest colored flowers may be gathered until November. It grows about one foot high, and should be thinned to eight to twelve inches apart.

MIMULUS

Showy, profuse-flowering, half-hardy perennials, growing about one foot high, preferring moist, shady situations, and fine for greenhouse or conservatory. Will bloom the first year from seed if sown early. Sow the seed in greenhouse or hotbed. If set outdoors the weather must be thoroughly warm and settled.

MINA

Half-hardy climbing annuals attaining a height of eighteen to twenty feet. The plants should be started in pots, indoors, very early in spring, and set outdoors when all danger of frost is past.

MIRABILIS
(Marvel of Peru. Four O'Clock)

A perennial in warmer climates, but here it is treated as a hardy annual. It is a quick-growing, erect, bushy herb, attaining to a height of two to three feet, and blooming during the late summer and autumn. The flowers open only late in the afternoon and on cloudy days. The seed should be planted in the hot-bed or in the house in March and transplanted to the open ground in May, setting the plants about one foot apart. They sometimes manifest their perennial habit of developing tuberous roots sufficiently large to be lifted and stored like those of the canna.

MORNING GLORY

These well known hardy climbing annuals are rapid growers and are well covered with foliage and pretty flowers, making them useful for covering summer-houses, verandas or other structures where quick effects are desired. The seed should be sown in May, in any good garden soil, in the location in which they are to remain, and thin the plants to one foot apart. There are also dwarf varieties, growing about one foot high, which are useful for bedding or borders.

MYOSOTIS (Forget-Me-Not)

These dainty little flowers are hardy perennials, love cool, moist soils, and, like pansies, bloom most freely in fall and early spring. They are good in borders, also satisfactory as winter-blooming plants in a cool room or cold-frame. Sow the seed in early spring in a warm, sunny border. They bloom freely in the first season, and profusely the second year. They grow about six inches high, and the plants should stand six inches apart.

NASTURTIUM

No other annual will produce such a profusion of flowers for so long a time with the same outlay of time and labor. They bloom profusely during the entire season from early summer until killed by frost, and will thrive almost anywhere, and under almost any conditions. They produce the best blooms if the soil is not too rich, and require very little moisture. Rich soil and too much water will produce luxuriant foliage at the expense of flowers.

The tall varieties grow about five feet high, and are splendid for covering fences, walls, steep banks, or other unsightly places. The flowers are a little larger than those of the dwarf varieties. They should be planted in spring, after all danger of frost is past, in the position in which they are to remain, planting the seed about one inch deep, and the plants thinned to six inches apart. They can also be grown as pot plants for winter flowering for screens, or as trailers for hanging baskets.

The dwarf varieties have a neat, compact, habit of growth, forming a small, round bush about a foot high, with attractive foliage, and a profusion of large yellow and brown flowers nestled in among the green leaves. The seed should be planted about one inch deep, after the weather is thoroughly settled in spring, in the position in which they are to remain. If the seed is planted thinly it will not be necessary to thin the plants, as they will stand considerable crowding. A few plants may be started in pots in the house in early spring, and transferred to the open ground when warm weather has come to stay, if early blooms are desired.

Nasturtiums are not troubled with any disease or insect pests. The seeds and pods may be pickled, and the leaves are used like cress, in salads.

NEMOPHILA (Love Grove)

Dwarf, compact, hardy annuals, growing about six inches in height, and bearing cup-shaped white and blue flowers about one inch in diameter, throughout the summer and fall. Valuable for bedding and for cut flowers. They do best in a moist loam, with partial shade. The seed may be sown in the open ground in April, and the plants thinned to six inches apart.

NIGELLA
(Love-in-a-Mist. Devil-in-a-Bush)

Compact, free-flowering hardy annuals growing in bush form about one foot high. The foliage is finely cut, and the flowers and seed pods are unique. Sow the seed outdoors after danger of frost is past, and at intervals during the summer for succession. For early blooms the plants may be started indoors early in spring, or the seed may be sown in fall and the plants wintered over in a cold frame.

NICOTIANA (Flowering Tobacco)

Handsome half-hardy annual bedding plants, growing two to four feet high, and valuable on account of long and free blooming. The seed may be sown outdoors when the ground is thoroughly warm and weather settled, or the plants may be started in boxes or pots, indoors, early in spring.

PANSY

The pansy is a hardy perennial, requiring a cool, moist climate, and for that reason attaining the highest state of perfection west of the Cascades, where the largest and brightest blooms are produced in the greatest profusion and continuously from early spring until late in the fall. It is a favorite with everyone, and gives satisfactory results with a moderate amount of care. For early outdoor bedding, the seed is sown late in August or early in September in rich garden soil, in a cool location, and as soon as the plants are large enough to handle they are transplanted four inches apart in cold-frames. On the Pacific Coast, during our ordinary mild winter weather, the cold-frames need not be covered, the sides affording sufficient protection, but in case of very cold weather they should be covered with canvas or burlap. Early in spring, they should be transplanted, not less than one foot apart, in permanent beds. After this the only winter protection they will need is a light mulch of manure. East of the Cascades, or

in other warm, dry climates, they should be planted on the north side of the house, or other shaded location; in fact, even on the coast, they do best in a partially shaded position. Satisfactory results for the home garden, although not as early blooms, may be had by sowing the seed in cold-frame in early spring, so that they will have a good root system before hot weather.

There are four essentials for best results. First, good, rich, loamy soil that will hold moisture well. Second, frequent cultivation, to keep a dust mulch on the surface and to allow circulation of air in the soil. Third, to pick all blossoms as soon as they are past their prime, as they will be larger and more perfect as the season advances if seed-pods are not allowed to form. Fourth, plant in a cool position. Frequent applications of bone meal, cultivated into the soil, will be very beneficial.

PETUNIA

A tender perennial, of several distinct types variously adapted for greenhouse and pot culture and for open air. The seed should be sown in March, in a gentle hotbed, cold-frame, or in a box in the house, and the seedlings transplanted about a foot apart, in rich garden loam, after all danger of frost is past, and the ground has become thoroughly warmed. The seed should not be covered, as most other seeds, but should be merely sown on the surface, and pressed slightly into the soil. The double varieties are more difficult to grow than the single varieties.

PHLOX

The annual phlox, sometimes called flame flower, is particularly useful and attractive when grown in masses or ribbon beds of contrasting colors. Few annual plants are more easily grown from seed, give a quicker return of bloom, or offer such a variety to choose from as do the phloxes. There are few desirable colors beyond their range, and if given good soil and plenty of water they furnish a supply of delicate flowers for cutting throughout the season. They are also useful in the window garden, and as undergrowth for tall, bare-stemmed plants. The first sowing of seed should be made very early in spring, and later ones in May, either where the plants are to bloom or in a seed bed, as the phlox transplants readily. In transplanting, set the taller kinds about a foot apart; if planted too thickly they suffer from mildew. The removal of flowers and seed-pods makes the plants more bushy and compact, and lengthens their blooming period. The tall varieties grow about twelve inches high; the dwarf varieties about six inches.

PINKS (Dianthus)

The large and varied genus of Dianthus contains some of our most beautiful flowers. The most of them are hardy perennials that bloom freely the first season, the plants remaining green all winter and blooming the next year if protected by a mulch. Old plants flower the earliest, but as young ones give the best flowers, new plants are usually grown each year. Seed is sown in the hotbed or in the house in March, and the young plants transplanted out of doors, six to ten inches apart, in May. They do best in a well-drained bed made up of turfy loam, leaf mold, and well-rotted manure, thoroughly mixed. They will not stand too much moisture, and are more liable to winter-kill from being planted in a wet place than from cold.

The Carnation Pink is the carnation of our florists, and although usually grown in the greenhouse, and propagated from cuttings, it may be grown from seed sown in the hotbed in March, and the plants frequently transferred to pots of increased size as they grow larger, until the weather is thoroughly settled, when they may be transplanted in the border where they are to bloom.

The Sweet William is one of the most satisfactory of this group for annual planting. The seed may be sown in the open ground in May, and the plants thinned to eight to ten inches apart, but for early bloom the plants should be started in the hotbed.

The Scotch Pink, or Grass Pink, is a hardy perennial, but is very satisfactory when treated as an annual, in the same manner as the Sweet William.

The flowers of all the plants of this group are most satisfactory for bouquets and table decoration because of the length of time they will keep in a fresh and attractive condition after being cut and placed in water.

POPPY

No other plants possess so bold and brilliant a flower, coupled with the same grace of stem, airiness of poise, delicacy of tissue, and earliness and continuity of bloom as the poppy. For beds and borders, with a background of green, there is nothing which will produce a more striking contrast. A sandy loam suits them best, and as their strong tap-roots are difficult to transplant, it is well to sow the seed where the plants are to bloom. The seeds should be sown thinly, covered very lightly, and the young plants thinned to one foot apart. A long succession of flowers may be had by planting the seed in the fall and at intervals during the spring.

PORTULACA (Sun Plant)

This bright-flowered, thick-leaved annual is unrivaled for brilliancy among plants of low growth. It flourishes under extremely adverse conditions, even in hot sun and light soil and with sparse water supply. It is satisfactory for beds, edgings and rockwork, and for filling up spaces in flower beds, also as an undergrowth for taller plants. It is particularly useful in the Northwest. The seed does not germinate until hot weather, and should be sown late. Beyond sowing the seed, no care or attention is required.

PRIMROSE

These half-hardy and hardy perennials are splendid for winter and spring decoration in the home or conservatory. The hardy varieties are used for beds and borders, and may be handled in the same manner as pansies. For winter flowering sow seed of the Chinese or Obconica varieties in boxes, indoors, from April to July, to insure blooming the next winter. The seed should be merely pressed into the soil and covered very lightly with finely sifted soil. Transplant to small pots when large enough, and shift to larger pots as the plants grow. Keep in a cool place so that the plants will grow slowly until ready for them to bloom.

PYRETHRUM

Very ornamental hardy perennial bedding and border plants growing one to two feet high. The seed may be sown outdoors as soon as the ground is in good condition to work in spring; or may be sown in fall, the plants wintered over in a cold frame, and transplated to the permanent bed when danger of frost is past in spring.

RICINUS (Castor Bean)

The castor-oil plant, commonly spoken of as the castor bean, is especially valuable because it is one of the few annuals which can be used to produce a semi-tropical effect. Its rapid growth and large size makes it valuable as the central object in groups where rich, luxuriant growth is required. When used in combination with cannas, caladiums, coleus, or scarlet sage most striking effects of contrast can be produced. As a background for lower-growing plants the castor bean has no equal among garden annuals. They may be started in the hot-bed or in boxes in the house in March, transferred to other boxes or pots as soon as the first true leaves have appeared, and transplanted out of doors late in May after all danger of frost is past. They should be planted two to three feet apart; if planted closer they will grow tall and spindling, and lose their lower leaves. They may be planted in the open ground at the time garden beans

are planted and by the middle of August will make a growth of four to six feet. It requires rich, warm soil, plenty of moisture and full exposure to the sun.

SALPIGLOSSIS (Painted Tongue)

Very showy half-hardy annual bedding or border plants growing two to three feet high and bearing richly colored funnel-shaped flowers. For early bloom, plants should be started indoors in March, and transplanted to the bed, one foot apart, when the weather is warm and settled. Seed may be sown outdoors when danger of frost is past.

SALVIA (Flowering Sage)

Scarlet Sage, Salvia splendens, bears spikes of flowers of the most intense scarlet, and the flowers of Blue Sage are the deepest blue. They are standard bedding plants where brightness of color is desired. They are also useful as pot plants, for window boxes, and for cutting. The seed should be sown in the hot-bed or in the house in March, and the seedlings transplanted outdoors late in May. They grow about two feet high, and should be set two feet apart. They are perennials, but will bloom the first season if started in the hot-bed. The seed may be sown outdoors after the first of June, but the beds must be protected from the hot sun, rain and wind.

SCABIOSA (Mourning Bride)

An old favorite hardy annual, growing about two and one-half feet high, coming into bloom early in July and continuing until late in fall. They make effective borders and beds, and the beautiful flowers in a variety of pleasing colors, borne on long stems, are excellent for cutting. The seed may be sown early in spring, either in a seed bed, to be transplanted, or in the permanent bed.

SCHIZANTHUS
(Butterfly Flower, Fringe Flower)

A hardy annual growing about eighteen inches high and especially adapted to bordering beds of taller plants; also used as house-plants for winter blooming. The seed may be sown outdoors early in spring; or, for early blooms, the plants may be started indoors in boxes or pots, and transplanted outdoors when danger of frost is past.

SILENE (Catch Fly)

An effective hardy annual forming compact bushes about one foot high, densely covered with white, pink, and red flowers during the summer. Used for beds and edgings. Sow the seed outdoors as soon as the ground is in good condition to work in spring. Thin the plants to four to six inches apart. For early blooms, the plants may be started indoors.

SMILAX

Charming tender perennial climbers for greenhouse, conservatory and window box. Sow the seed in boxes in greenhouse or hot-bed, transplant in pots, and shift to larger pots as the plants grow. May be set outdoors during warm weather.

STOCKS

The plants are vigorous, have a good habit of growth, fragrant flowers in various colors, are adapted to bedding, edgings, pot culture, house or conservatory use, and are splendid for cutting. They are hardy annuals, grow about two feet high, and should be planted about one foot apart. For early blooms, the seed should be sown in the hot-bed, or in the house, in March, and when the plants are one inch high they should be transplanted to another part of the hot-bed. Frequent transplanting during their early growth will give them a more dwarf and compact habit. They may be planted in the open ground early in May. Seed may be sown outdoors in May, and will produce blooms in July or August. If plants that began to bloom late are carefully lifted and potted in the fall, they will flower freely in a house or room that is rather cool and moist.

SUNFLOWER (Helianthus)

These tall-growing, bright flowered annuals have suffered the misfortune of having been cheapened by use as a burlesque. They are in reality very useful for backgrounds, or even for bedding. The tall, single variety, with but one immense flower on a plant, with which we generally associate the name, is only one of the many varieties. The dwarf, double, many-flowered varieties are really useful and artistic when skillfully employed. The seed should be planted in the open ground about the middle of May, and the plants thinned to stand two to four feet apart, according to whether dwarf or tall.

SWEET PEAS

These, most beautiful of the hardy climbing annuals, are very easy to grow, and thrive under ordinary garden conditions with very little care, but a little extra care will be amply repaid in larger and earlier blooms and brighter colors. The climate of the Pacific Coast is ideal for their best development, and in no other locality will they produce blooms in such wonderful profusion and perfection.

On the Pacific Coast, where the ground does not freeze to any depth, the best time to plant is in November. They will apparently make very little growth during the winter, and it is better if the tops do not show about the ground until spring, but they will make a remarkable amount of root growth which will induce a strong growth of vines very early in spring, producing better blooms and much earlier than if planted in spring. They may, however, be planted in February, March or April, and will do very well.

The location should be open, away from trees and shrubbery, where they will get plenty of sunlight and air. They will thrive on any good garden soil, but a rich clay loam will produce the brightest colors. The ground should be well drained, especially if planted in the fall. A heavy application of well rotted manure should be spaded under and thoroughly mixed with the soil, more to improve the mechanical condition and make it warm and porous than as a fertilizer, and after the seed is planted the ground should have a liberal top dressing of manure to protect it from the cold, keep it from packing, and to induce early growth in the spring. The seed should be planted about two inches apart in furrows; if planted in the fall the furrows should be six inches deep; if planted in the spring they should be from two to four inches deep; early plantings should be deeper than late plantings. Early in spring, if there is a hard crust on the ground, break it by raking over the rows. As soon as the plants are up cultivate frequently and thoroughly. An occasional top-dressing of well rotted manure, bone meal or commercial fertilizer will be beneficial.

East of the Cascades it is probably best to plant in the spring, as early as the ground can be worked properly, but in the eastern states fall planting is now practiced to some extent, and in some cases, at least, is successful. It is worth trying.

If this seems to be too much trouble, and you are not particular to have the largest, brightest and earliest blooms, they may be planted the same as garden peas, and given the same attention and cultivation, and will furnish a profusion of very satisfactory blooms during the greater part of the season.

As they grow about six feet high, they require a trellis of some sort, and six foot poultry netting makes the best support, and the easiest to construct. They require considerable water, and it should be applied to the roots only; do not sprinkle the foliage. All of the blossoms should be picked each day; otherwise they will go to seed, and stop blooming. The more flowers you pick the more you will have.

SWEET WILLIAM (Dianthus Barbatus)

Well-known, attractive, free-flowering, hardy perennials, producing splendid effects in beds and borders. Sow the seed outdoors early in

spring in seed bed or permanent bed, and transplant or thin the plants to about six inches apart; or the seed may be sown in fall, and the plants wintered over in a cold frame. Although they are perennials, flowers will be produced the first summer, and best results will be had by growing new plants each year.

THUNBERGIA (Black-eyed Susan)

Tender perennial climbers, but generally grown as annuals. They quickly attain a height of six to eight feet, densely clothed with neat, green foliage, not affected by insects. Small single flowers in various colors are produced freely. Start the plants in boxes or pots indoors and set outdoors when the weather is thoroughly settled and danger of frost is past; or the seed may be sown outdoors late in spring.

VIOLET

These little hardy perennials are unexcelled for borders and for cutting. The plants are hardy, requiring the same care as pansies, but they are rather difficult to grow from seed. It is best to sow the seed early in fall, wintering the plants over in a cold frame.

VERBENA

The Verbena is a low-growing, creeping annual, and is useful in beds, borders, mounds, window boxes, and for bouquets and table decoration. The seed should be sown in March, in the hot-bed or in the house, and the plants transplanted outdoors after all danger of frost is past, setting them ten to fifteen inches apart in well-drained garden soil and a sunny position.

WALLFLOWER

Well-known, deliciously fragrant, half-hardy perennials, producing spikes of beautiful flowers early in spring. The seed should be sown early in the fall, the plants wintered over in a cold frame and set out when danger of hard frost is past in spring.

ZINNIA

A half-hardy annual, growing about eighteen inches high, and producing a multitude of large double flowers of a great variety of colors and shades, valuable for groups, beds, borders, or hedges, and for bouquets. The seed may be sown in the open ground in early spring, and the plants thinned to two feet apart. They will be at their best in August, and will continue to bloom until late in the fall.

FLOWERING PLANTS GROWN FROM BULBS OR ROOTS

HYACINTH

Hyacinths are easy to grow, and there are few things that will give more pleasure than a bed of perfect blooms in the garden early in spring, or a few choice specimens in the house during the winter.

For outdoor culture the bulbs are best planted in October or November, but are sometimes planted later, or very early in spring. Any rich garden soil is suitable, but it must be well drained or the bulbs are liable to rot during the winter. Bone meal is the best fertilizer for bulbs, and large quantities thoroughly mixed with the soil will produce larger and more perfect blooms. The bulbs should be set six to eight inches apart, with the top of the bulb four inches below the surface.

If it is desired to remove the bulbs from the bed during the summer, they should be taken up after they are done blooming, without removing the tops, and replanted or healed in in an out-of-the-way corner of the garden to mature; after which they should be spread out in a cool, dark, dry, airy place until time to plant the next fall.

For indoor culture, in pots, for winter blooming, plant one bulb in a four-inch pot, as early as possible, from September to December. The bulb should be set so that the top will show above the surface of the soil. Water thoroughly and set the pots in a cool, dark place in the cellar, covering the pot with sand or ashes, until well rooted. This will require about six weeks. They will bloom soon after being placed in a light, warm place. Time of blooming can be regulated by placing them in the light at the proper time.

For glass culture, fill the glass so that the bottom of the bulb will just touch the water, and set away in a cool, dark place until well rooted. Change the water frequently.

The secret of successful indoor culture is keeping the bulbs in a dark, cool place, and not placing them in the light until they are thoroughly rooted.

TULIP

The culture of tulips is practically the same as for hyacinths, except that they may be set a little closer together and need not be covered quite so deep. Pot culture is the same as for hyacinths, except that three or four bulbs may be set in each pot.

NARCISSUS, DAFFODIL, JONQUIL

The various forms of narcissi are among the most beautiful and satisfactory flowers, and after being planted require little or no care for years. Ordinary garden soil is suitable. If stable manure is used for fertilizer, it should be well-rotted and applied as long as possible before the bulbs are planted. Bone meal is the best fertilizer for this purpose.

The bulbs should be planted as early in the fall as possible, but may be planted as late as December. They may be set six to twelve inches apart, and covered about three inches deep. The bulbs will multiply rapidly.

Indoor culture is the same as for tulips.

CROCUS

The crocus is the first flower to bloom in spring, and is especially pleasing and effective when planted in clusters in the lawn. They will be done blooming before it is necessary to mow the lawn, and after that will not be seen again until the next spring. They should be planted in October, November, or December. All that is necessary is to make a small hole in the sod and insert the bulb.

PEONY

While the peony will exist in almost any soil, it will produce only inferior flowers in a shallow, sandy or gravelly soil, and in such soils the surface of the bed should be dug out to a depth of twelve or fifteen inches, and filled in with six inches of well-rotted cow or horse manure, which should be thoroughly spaded into the sub-soil. The balance of the excavation should be filled with rich loam to which should be added a liberal quantity of coarse bone meal. If the soil is very heavy, a large quantity of well-rotted manure should be spaded in and thoroughly mixed with it, to lighten and enrich it, as the peony is a gross feeder, likes a rich loam, and will not thrive in a poorly drained, sticky soil. The plants should be set at least four feet apart each way, as they require this amount of room for full development.

While peonies may be planted in late winter or early spring, the best time for planting is as early after the middle of August as the bulbs become ripened, not later than the first of October. When planted at this time they will mature a year earlier than if planted in the spring.

In setting the plants, the crowns should be three to four inches below the surface of the soil, and the soil should be pressed firmly around the roots. The center of the bed should be slightly crowning, so that water will not stand on it. After the bed is planted, it should be mulched with three or four inches of coarse, strawey manure. During the blooming period, if weather is dry and plants need water, supply it by irrigation; do not use a sprinkler. Peonies prefer a sunny position, and are excellent for use by the side of walks, back of a border.

GLADIOLUS

The new large-flowering varieties have been so improved that they are very different from the old-fashioned gladiolus, and among the most popular and satisfactory of our garden flowers grown from bulbs. They thrive and bloom in ordinary garden soil, with little care and attention, and make a display which is unexcelled. The flower stalks are two to three feet long and are covered with flowers, three to four inches in diameter, the coloring of which is magnificent, and they will last a week or more after being cut. They bloom continuously from the last of July until killed by frost.

They will thrive in any ordinarily rich soil, but a liberal application of bone meal will improve the quality of the bloom and the colors. The soil should be well drained. They should have full exposure to the sun, and should not be watered excessively. They make the best display in beds or in clusters among shrubs, roses or paeonies, care, of course, being taken that the colors harmonize.

Large bulbs will produce flowers the first season. Plant at intervals from April to June, three inches deep and six inches apart. In the fall, before the ground freezes, dig up the bulbs, cut off the stalks and store in a cool, dry place. The bulbs increase rapidly, so if you start with one bulb of each of the best varieties you will soon have an abundance.

DAHLIA

Dahlias will thrive in any good garden soil, but do best in light, well-drained soil, with full exposure to the sun. They may be planted any time after the ground is in good condition to work until the latter part of June; early planting is preferable. Large quantities of stable manure and commercial fertilizers may be used advantageously.

In dividing the clumps of roots the crown or stem must be split in such a manner that each tuber bears a short piece of stem on which there is at least one eye. The eyes are not on the tubers, as is the case with potatoes, but are on the crown just above the tubers. Sometimes the eyes are difficult to distinguish, and it may be necessary to place the clumps of tubers in a warm, moist place for a short time to start the sprouts before dividing.

There are several ways of propagating dahlias, but the most satisfactory method, for amateurs at least, is to plant the large roots or tubers. The tuber should be planted on its side with the crown covered about six inches deep. They should be set two to four feet apart.

Ordinarily dahlias need not be watered, but if they show signs of requiring moisture, the ground should be thoroughly soaked to a depth of a foot or more, without watering the plants. When the ground has become dry enough to work it should be cultivated to prevent baking.

All but one or two of the best shoots should be removed, and each plant should be trained to a stake to support it. If the plant becomes too bushy, the surplus branches and foliage should be pruned off. The buds are usually formed in groups of three. The two outside buds should be pinched off, causing the remaining bud to make a much finer specimen.

When the foliage is destroyed by frost the stems should be cut off close to the ground and the roots dug. They should be exposed to the sun for a few hours to dry, and then stored in a dry cellar or other place where the temperature will remain at about fifty-five degrees. They should be watched during the winter and if they show signs of shriveling they should be covered with papers and the papers should be sprinkled slightly. Starting to sprout indicates that they are getting too much moisture.

ROSE

In no other place are roses grown in such perfection and so easily as on the Pacific Coast, and although they are produced in great profusion, if we fully appreciated our great advantage over our less fortunate neighbors, we could find many wast places in which to plant more.

In Western Washington or Western Oregon they may be planted either in the fall or early spring; east of the Cascades it is better to plant in early spring; and in California they should be planted in the fall.

Good roses may be grown in almost any soil and position, but the best quality is produced on a rich clay loam, in an open, sunny position, sheltered from cold winds, and clear of all roots of trees and shrubs. The ground must be well drained, either naturally or artificially, so that water will not stand within two feet of the surface at any time during the year. Roses require considerable moisture, but the roots must not be submerged in water.

It will be worth while to give considerable care to the preparation of the bed, for it will be occupied for many years, and during that time little can be done to improve it except top-dressing. The extra trouble will be amply repaid in blooms which you may be proud of. An excavation should be made about two feet deep and filled in to a depth of one foot with bones broken in small pieces, charcoal and good soil; then fill balance of excavation with clay loam in which has been mixed a liberal quantity of bone meal, well rotted manure (cow manure preferred), slacked lime, and, if the soil is heavy, a little sand. Then soak the bed thoroughly with water, to settle it, and let it stand a few days until dry enough to work properly, when the surface should be thoroughly loosened and pulverized before planting.

Select strong, healthy plants with good roots. Get two-year-old plants if blooms are wanted the first season. One-year-old plants will be just as good eventually, but they should not be allowed to bloom until the second year. The tops are usually cut back sufficiently when received from the nursery. Remove any damaged roots, and cut ends of roots back a little. Plant about two feet apart, making holes large enough so that the roots may be spread out in their natural position, setting the plant a little deeper than it stood in the nursery row; fill in the earth, tramping it firmly around the roots as it is filled in, and leave a little loose soil on the surface. After planting is completed smooth the bed nicely with the rake and apply a top-dressing of well-rotted manure and bone meal; the manure to serve as a mulch and the bone meal as fertilizer. Bone meal is the best fertilizer for roses, containing a large amount of phosphoric acid in the best form and producing the most perfect flowers and delicate colors.

Unless a good mulch is maintained the bed should be cultivated once a week and after each rain. In any case it should be thoroughly cultivated as soon as the ground is in proper condition in the spring. If well mulched it will only be necessary to pull the weeds and cultivate in case the ground becomes hard, cultivating the mulch into the soil and applying a new mulch. Water when the soil two inches below the surface will not pack when pressed between the hands, giving it one good soaking rather than continual sprinkling.

If flowers are wanted for individual beauty and perfection remove all buds except the terminal bud on each shoot; if for bedding effects little or not thinning is necessary.

The strong-growing varieties should have all canes cut back to about three feet in the fall to prevent being whipped by winter winds, which, unless staked, would loosen and break the tender feeding roots. The principal pruning should be done in spring before growth starts. If quantity of bloom for garden effect is the object sought, four or five canes may be left three feet in length, and all old or weak growth cut away entirely. After the plants are through blooming in the spring the canes should be shortened back at least one-half to induce another season of bloom.

If quality of bloom is desired, all weak growth should be removed, and the remaining canes cut back in proportion to their development, the weaker ones to about four inches from the root, and the stronger ones eight to nine inches. Canes should be cut off about an eighth of an inch above an outside bud; this will cause the plant to grow in an open head, as the buds usually grow in the direction which they first take. Roses pruned in this way will need no staking up or summer pruning, the cutting of flowers with long stems being sufficient. The Tea and Hybrid Tea vareities should not be pruned until they show evidence of growth, indicated by the buds beginning to swell, when dead or unhealthy wood may be readily detected, making it easy to see what should be cut away and what should be retained. They do not need as severe pruning as that described above for Hybrid Perpetuals, and all wood that looks promising should be left on.

Climbing roses require no pruning in the spring beyond the cutting out of old or dead wood and the shortening of the laterals and long canes to make the growth conform to the space to be covered, but a severe pruning directly after they have finished flowering is beneficial. Cutting away at that time all old flowering wood will encourage a vigorous growth, which will give an abundance of flowers the following season.

Rose bushes have several enemies which must be watched closely. For Rose Beetles, hand picking seems to be the only remedy. For Slugs, which eat the leaves, spray with arsenate of lead. Green Aphis is the most common pest. To destroy the eggs, spray with lime and sulphur solution before the leaves open; later, as soon as aphis are discovered, dust with tobacco powder or spray with a tobacco solution. Mildew is the most difficult disease to contend with. It is the result of severe fluctuations in tempertaure or stagnant air or soil conditions. Some varieties are more susceptible to it than others. Dust the foliage in the evening with sulphur or spray with potassium sulphide, one ounce to two gallons of water, or with tree spray.

THE LAWN

WESTERN WASHINGTON should be noted for its splendid lawns, for our climate is ideal for them, and with a minimum of labor and expense we can produce those fine, velvety, carpet-like lawns which are the envy of our friends in less favored sections.

A perfect lawn cannot be made or maintained in the careless, half-hearted manner that is too often employed, but if we are willing to bestow upon it a comparatively small proportion of the care necessary to obtain the same amount of satisfaction in almost any other line, we will be rewarded with a lawn to be proud of.

We will not attempt a treatise on the arrangement of the lawn, for that is the work of a landscape gardener. However, we will suggest that it should not be dotted with trees, shrubbery and flower beds, but that they should be massed in corners and around the sides; also that, especially if the lawn is a large one, natural contours are usually more beautiful than a formal, uniform grade; and that curved walks and roads are more effective than straight ones.

The best soil for a lawn is a deep, rich loam, containing considerable clay. This will retain moisture better than a light sandy or gravelly soil, and is less inclined to heave in winter. If the soil is not naturally of this nature, it should be made as nearly so as possible, and it should be the same in all parts, to avoid a spotted appearance. If it is not naturally well drained, it must be drained artificially, for not even a fair lawn can exist on wet, sour land. Do not attempt to make a lawn on the sub-soil which has been excavated from the basement when building the house.

Fertilizers should be used liberally. Large quantities of well-rotted stable manure should be turned under to a depth of at least eight inches. The idea is to have a thick layer of the manure to act as a sub-soil. If the lawn is being built up, the manure may be spread on the ground and eight inches or more of good soil placed on top of it. If the soil is

inclnied to be sour, about fifteen hundred pounds per acre of air-slaked lime or ground lime rock should be harrowed or raked into the top-soil. This will improve the texture, and will be beneficial whether the soil is sour or not. Bone meal should also be thoroughly mixed with the top-soil at the rate of about one thousand pounds per acre.

If possible, the soil should be prepared a considerable time before the seed is to be sown, the longer the time the better. The best lawn would be obtained by preparing the soil a year before sowing the seed, and working it frequently to destroy the weeds and make the seed-bed in perfect condition. Unless this is done you should bear in mind that though no seed of any kind is sown, a multitude of weeds and coarse grasses will spring up from the seeds which are in all soil. Sowing grass seed will not prevent these seeds from germinating, so if you have purchased high-grade seed, do not condemn your seedman if weeds appear in the lawn.

Just before sowing the seed, a commercial lawn fertilizer should be sown broadcast, and thoroughly raked in, at the rate of about five hundred pounds per acre.

If well-rotted stable manure cannot be procured, a crop of vetch or red clover may be grown on the ground and turned under when in blossom. In this case more of the commercial fertilizer should be used.

The seed should not be sown until the soil is in perfect condition, not only perfectly smooth and finely pulverized on the surface, but in the same condition to a depth of eight inches or more. If the seed is to be sown during a dry season, the ground should first be thoroughly soaked with water, and then, when it is not sticky when pressed in the hand, it should be carefully raked.

In the Puget Sound country the seed may be sown any time if plenty of water is available, but we prefer to sow late in spring. This will allow time for weeds and native grasses to make a start and be destroyed before the grass seed is sown. Of course this would not apply to hotter climates, or where water is not plenty. It should be sown when there is no wind blowing, and can be sown more evenly by sowing very lightly in one direction and then in other directions until the proper amount of seed is sown. Use plenty of seed, at least one pound of mixed lawn grass seed to each three hundred square feet of lawn, and it would be better to sow twice that amount. Do not economize on seed, either in quantity or quality; it is the least expensive part of the lawn. After the seed is sown, roll the ground with a light roller. If the seed is raked in at all, it must be raked very lightly.

Commence mowing as soon as the grass is two inches high, but never, at any time, cut it very short. Leave the clippings where they fall. Many lawns are ruined by removing the clippings. They make a splendid fertilizer, help to form a thick turf, and will not be unsightly if mowed frequently.

A good lawn cannot be maintained without the frequent use of a roller, especially in early spring. It compacts the soil after winter heaving, preventing loose soil about the roots for air to circulate in, discourages moles, makes a smooth surface for the mower, and induces a healthy and uniform growth of grass.

Never turn the lawn into a barnyard by covering it with stable manure. It is offensive to the eyes and nostrils, is tracked onto the walks and into the house, and it contains weed seeds. A commercial lawn fertilizer should be sown broadcast on the lawn at least once each year, at the rate of one hundred pounds to each twenty-five hundred square feet. It would be better to apply one-half or one-third of this amount two or three times each year, with one of the applications in August. It may be applied at any time, but if applied during warm, dry weather, the lawn should be sprinkled soon after. If the lawn turns yellow, or has an unhealthy appearance, an application of this fertilizer will rejuvenate it almost immediately. Commercial fertilizers do not contain any weed seeds. This is an important item, for it is difficult enough at the best to keep weeds out of the lawn.

There are weed killers on the market which are effective when properly applied. They are preparations containing sulphate of iron, and will kill all broad leaved weeds in a lawn without harming the fine leaved grasses. They are liable to kill clover, but that is not a serious matter, as clover in a lawn is only valuable as a nurse crop and to make a showing while the grasses are getting started. A really fine lawn should not contain any clover.

When irrigating it is better to give the lawn a thorough soaking, and not irrigate again until it shows signs of needing water, than to be continually sprinkling.

The seed to be sown is a matter of choice and utility. We recommend sowing a mixture of many different grasses. The high-grade mixtures are mixed according to formulas prepared by men who have made a study of grasses and their uses. They consist of grasses which will make a fine, tough turf, not damaged by tramping, will remain green the entire season, and are of a uniform color. We do not approve of clover in a high-class lawn, although it is desirable when quick effects are wanted, and in mixing with the hardier grasses.

Old lawns require reseeding about every third year. They should be thoroughly raked, and the soil loosened up as much as possible, about half the quantity of seed sown as is required for a new lawn, and rolled with a heavy roller. It is necessary to reseed for the reason that the grass is mowed, and not allowed to reseed itself, as it would under natural conditions. If the lawn is very weedy, or in bad condition, it is generally best to turn it under and start new.

It never pays to start a lawn by sodding. It is seldom that sod composed of desirable grasses is available, the crevices are apt to open up and the grass about them die out, and it is never as satisfactory and seldom less expensive than a seeded lawn.

Lawns are frequently disfigured by moles. Rolling will help to drive them away, but the only effective remedy is a mole trap. They generally have a home in some protected place, from which they burrow in various directions. Some of the burrows are used regularly, and some only once. Of course it would be useless to set a trap on one of the burrows which are used infrequently, and to ascertain which are the little animal's regular highways, press the ridges down in various places, and the next day note which have been again raised.

FRUIT

PRUNING APPLE TREES.

Washington State Agricultural Experiment Station Popular Bulletin No. 24. By W. S. Thornber, Horticulturist.

In care of the experimental orchard at this station exceptional opportunity is offered for comparative studies of different methods of orchard management which are suggested or used in this and adjoining states. For several years past, the regular pruning of the trees of all ages in this orchard has been planned as to afford a comparison of various methods of summer and winter pruning and various methods of training young trees. The experiments are not yet completed, but certain principles and practices are so clearly superior to all others that a brief popular presentation of them at this time in this bulletin is fully warranted.

Pruning is one of the most important and yet least understood crafts that is practiced in the growing of fruits. There are many erroneous notions and theories practiced every year in the orchards of this state, some of them entirely contrary to nature and the best good of the orchard, while others are vain attempts at securing results that can be easily attained.

Every tree is a rule unto itself and no two trees can always be pruned exactly the same. The pruner should be quick to detect the weaknesses as well as the strong marks of a variety or individual. He must be elastic in thought and perception as well as the application, or he will ruin many a valuable tree. His duty is to make the best of every individual tree regardless of its condition or shape.

While it may be possible to grow a successful orchard in some places without pruning, it is an absolute impossibility here in the West. The successful grower must prune and prune every year at least once if he would have perfect trees.

When to Prune. There can be no best time to prune all varieties and ages of trees in all climates. The vigorous growers and shy bearers on rich moist soil should be summer pruned as well as winter pruned, or at least summer pruned; while the slow growers and heavy bearers should always be pruned during the winter. One must constantly remember that heavy winter pruning tends to exhilarate wood growth, while summer pruning tends to develop fruit buds and consequently fruit.

The essential thing in a young tree is that it makes strong, rapid growth, and so it should be pruned during the dormant or winter season to induce this growth. As soon as it becomes large enough and old enough to bear, this winter pruning may or may not be modified or even supplemented by summer pruning. The essential thing in an old tree is that it produces fruit, and so it should be pruned in such a manner that it will produce fruit. In Eastern Washington and most of the irrigated valleys the trees produce fruit too young and tender to overbear, while in Western Washington the reverse is true. With these facts before us it is easy to see why it is best to prune the young trees and most of the old ones in the central and eastern parts of the state during the winter, and all of the bearing trees in Western Washington during the summer season.

How to Prune. Pruning is an operation that should not be done carelessly or hurriedly. The pruner should study each tree as he prunes it and each branch as he removes it.

When heading back young trees or cutting off the tops of last year's growth out of older trees, the cut should be made slanting away from and about one-sixteenth of an inch above the first bud that is intended to grow. A longer stub than this will dry, crack and form an entrance for fungi, bacteria, etc. A shorter stub will usually result in the death of the first bud.

When pruning trees that have a dense upright habit of growth, like the Wagner, Rome Beauty, etc., cut to strong outer buds in order to spread the naturally narrow, compact top, but when pruning spreading or slender growing trees, cut to buds that point towards the center of the tree in order to throw the limbs inward and upward.

Weak growing trees or weak branches in strong trees may be compelled to produce strong growths by severe winter pruning. In the removal of lateral branches from either young or old trees cut parallel with and close to the main stem. Never leave stubs from one to two inches long in hopes that they will develop into large fruit spurs, since less than 5 per cent. ever become fruit spurs and the other 95 per cent die, dry up and leave excellent gateways for the entrance of disease into the wood of the tree. Young lateral branches when shortened back, specially after the spring growth has taken place, very frequently develop fruit buds and spurs.

In the removal of large branches from old or bearing trees always make the cut parallel with the branch or main stem from which the one is removed. This frequently means a larger wound than it would make if the cut is made at right angles to the limb that is to be removed, but such wounds will heal quicker and are less injurious to the tree than the much smaller ones that leave the collar of the branch to be covered with healing tissue. Do not hesitate to remove large, useless or superfluous limbs from the trees, but always make smooth, clean cuts with a saw, and if necessary to prevent splitting the stem or peeling the bark, make two cuts—the first from 6 to 12 inches out from where the limb is to be finally cut off. Nothing can be applied to the wound to hasten the healing. Wounds an inch or less in diameter need not be treated, while larger wounds may be advantageously treated with a thick coat of lead paint. Cheap mineral paint or tar should not be used upon fruit trees, as it kills the young, tender bark, while grafting waxes crack and peel off before the wound has healed. Any antiseptic that will keep the moisture out makes an excellent coating.

The early training of young trees is very essential, since it is necessary to develop a good frame while they are young if it is ever to be developed. It is almost an impossibility to make a first-class tree out of an old, neglected one. One of the differences between Eastern and Western fruit-growing is in the method of the training of the young trees. In the East the high-headed tree is the rule, while in the West it is the exception. Practical fruit men no longer strive to head their trees high enough for the average horse to work under, but head their trees low and then secure extension tools in order to till all the ground.

The low-headed tree has many advantages over the high-headed tree. As a rule, no apple tree should be permitted to start its head farther than 18 inches from the ground; nor closer than 6 inches from the ground. A tree with more than 18 inches of stem places its fruiting plane almost entirely out of reach of the average man for thinning, harvesting, etc., while the tree with less than 6 inches of stem is very apt to have trunk rot or to readily split when heavily loaded with fruit. If the West desires to continue to lead in the production of fancy and first-class fruit her orchardists must keep the fruit planes of their trees within easy reach of the ground for thinning, spraying and harvesting. Our expeirments and observations teach that the following methods give the best results for the training of young apple trees:

First Year. Prune the newly planted one-year-old tree in the spring just before growth begins to a straight whip unless it means the removal of a large number of buds from that part of the stem between 12 and 24 inches from the ground; in the latter case, cut the laterals back to short stubs from one to three buds in length. The smooth pruning gave the best results where it was possible to practice it. After pruning to a whip, cut the top off just above a bud from 18 to 24 inches from the ground. Varieties like the Jonathan may be cut at 18 inches or less, while varieties like the Rome Beauty and Wagner should be headed a little higher. It is frequently difficult to secure sufficient well placed branches upon a large one-year-old transplanted Wagner if it be cut off closer than 24 inches from the ground. If the lower buds start to grow they should be rubbed off early in July unless the stems of the trees are slender and need to be thickened when the buds should be permitted to grow until August or even the following spring, unless they form very strong growths.

Second Year. Select from three to five of the best placed limbs to become the frame work of the tree, securing as many as possible that point in all directions and that are as far apart on the main stem as possible. Cut off the others close to the main stem and prune the selected ones back to from one-third to one-half of their original length, leaving the most central one as a leader, which should be cut from four to six inches longer than the others. In the case of upright growing varieties prune to outer buds, while in the case of spreading sorts prune to inner buds and thereby correct the evil. In windy exposures turn as many limbs as possible toward the wind; also prune the branches very severely on the windward side.

Third Year. Select from two to three limbs per branch of the frame, remove the broken, diseased and superfluous branches, and cut the selected ones back to from one-half to two-thirds of their original length. The leader should still be maintained and the top carefully balanced in order to avoid undesirable growth. It is sometimes necessary to remove one or more of the framework branches to open the top. This is always allowable and frequently advantageous in the forming of the top.

Fourth and Fifth Year. Select from one to three limbs per branch that were left the preceding year, remove crossing, diseased and superfluous wood and cut the selected limbs back from one-half to two-thirds of their original length. Thin the top and center as much as possible without leaving it entirely open. In the case of long growths, cut back severely to a branch if possible. In fact, all pruning from now on should be of a thinning and topping nature. In the fourth to fifth year, summer pruning should begin to be practiced in sections west of the Cascades and may be advantageously used with shy or tardy bearers anywhere.

The Pruning of a Bearing Tree. An old apple tree that is in full bearing should be carefully pruned every year, Care should be exercised to keep the top open, balanced, free from crossing or rubbing limbs and from getting too high. A top can be lowered or raised at will if the pruner will study his branches. Always back to a branch, and never leave a long stub unless water sprouts are desired. If the tree has been neglected for years, remove the superfluous wood by degrees about one-third of the total amount to be removed each spring and summer until the desired top is reached. Pruning is a matter of common sense and should be practiced as such. The young tree is elastic and can be easily shaped, while the old tree is established and must be compelled by severe methods.

CURRANTS

By W. S. Thornber, Horticulturist.

Washington State Agricultural Experiment Station Popular Bulletin No. 26.

Soil. Almost any good rich soil of sufficient depth and fertility to produce a good crop of grain will produce crops of currants. While this class of fruit may be grown in hot, dry soil the best results are secured on cool, moist soils. A well-drained, rich, sandy loam with considerable humus in it, or even a clay loam properly treated, will give excellent results if there is plenty of available plant food. When the soil becomes very hot and dry during the summer it is sometimes advisable to mulch with coarse litter in order to hold the moisture and keep the temperature down. It is difficult, however, to grow good, clean fruit under these considtions. As a plant the currant is a heavy surface feeder and so should receive heavy annual dressings of well rotted manure or a substitute for manure in the form of commercial fertilizers.

Planting. One or two-year-old plants from cuttings or layers give better results for the permanent plantation. Most planters prefer a one-year-old plant, as it is easier to handle than large two-year-old plants.

Early fall planting gives good results where the plants are mulched before the cold weather comes on, but for general planting early spring gives the best results, especially where the stock is secured in the fall or winter and is set out just as soon as the ground is ready to receive the plants in the spring. Late spring planting is not satisfactory since the rootlets and shoots of the currant begin to form early and are easily damaged in handling.

The same care should be exercised as in transplating a fruit tree. All broken or bruised roots should be removed, the top thinned and cut back and the plant set from one to two inches lower than it stood originally in the nursery.

The square planting plan of 6 x 6 feet is commonly used. However, it does not give sufficient room for the bushy sorts, especially after they begin to bear and the limbs become weighed down with the heavy crops of fruit. A better plan would be to place the rows eight feet apart and the plants six or even eight feet in the row. This would allow room for thorough cultivation.

Cultivation. If the plantation has received an application of well rotted manure during the winter this should be worked into the soil as early as the ground is ready to work in the spring. This may be done by shallow plowing or deep, double shovel work. After thoroughly working the manure into the soil the surface should be left smooth and as near level as possible. Regular surface cultivation should continue until picking time. After the crop is harvested, the plantation should again be thoroughly cultivated and then the plants permitted to become dormant and ready for winter. Late summer or fall growths should always be discouraged, as there is danger of fall or winter injury resulting from the unripened condition of the shoots.

Pruning. The current will bear some fruit every year whether it is pruned or not, but, if fine, large fruit is desired, pruning is necessary. There are two general types of training current plants, i. e.: the tree form and the bush form. The tree form is developed by cutting away all the shoots but one and the removal of the lower buds and branches from this shoot for from twelve to twenty-four inches from the ground, which results in a little tree. This method does very well for the amateur or the novice, but is not practical from a commercial point of view, on account of the unproductiveness of the plant and the danger of a borer destroying a whole plant instead of one cane, as is frequently the case with bush grown plants. The bush form is the more common method used not only in commercial but in home gardens as well, and results in the development of a well formed bush of from six to eight, two to three-year-old, fruiting canes and from two to four young shoots or one-year-old fruit canes. The common difficulty with the currant bush is that there is too much wood left annually upon the plant and so it is compelled to produce a great number of small berries instead of an equal or greater weight of fine, large fruit. While currant wood will produce fruit for an indefinite period of time, yet after it passes its fourth or fifth year it ceases to be valuable on account of the inferior quality of its fruit. Good, healthy wood produces its best fruit during the second and third years of its life and should be replaced by young shoots before it reaches its fifth year.

In ordinary field culture, from five to eight bearing canes on a plant will give better results than a greater number, especially where these canes have been summer pinched in order to develop strong lateral buds. If these shoots have produced strong, lateral shoots they should be cut back to from there to four inches in length. For market purposes it is better to remove too much wood and produce a small quantity of fine fruit than not enough and produce an unsalable crop of small fruit. Pruning may be done in the fall or early in the spring. Ordinarily it is best to do it just before the plants start into growth in spring.

GOOSEBERRIES

By W. S. Thornber, Horticulturist

Washington State Agricultural Experiment Station Popular Bulletin No. 25.

The gooseberry, unlike most American fruits, is sorely neglected here in the west even though very attractive financial returns have been realized from this crop. Two causes are apparent for this neglect—one the difficulty of picking the fruit and the other the almost universal, but erroneous, belief that gooseberries are good only when used in their green state. Rarely or never do we see ripe gooseberries upon the market, yet there is no better fruit grown for canning, spicing and preserving than our large, rich gooseberries.

Both the English and American sorts do well in most sections of the state, but in a few places gooseberry mildew does some damage to some of the English sorts, yet it can be successfully controlled by thorough spraying at the proper season.

Soil. A north or northeasterly slope is better for gooseberries than a southern slope on account of the advantages of late spring, more moisture and a richer, deeper soil. The gooseberry is very partial to a moist, rich, deep soil and prefers a thoroughly enriched, deeply tilled, well drained, strong clay to a light sandy loam. However, it will do very well, even on a gravelly, sandy soil. The general tendency is toward light crops on sandy soils, but the reverse is not always true on heavy clay soils. Gooseberries are especially adapted for the inter-croppage of young orchards since they will cheerfully submit to partial shade, providing it does not become so dense as to seriously encourage the gooseberry mildew.

Planting. One year old plants from layerage will give better results than either younger or older plants. A well-rooted plant even though the top is small is far better than a large top with a poor root. The early ripening of the wood in the summer and the long leafless or dormant period preceding winter weather combine in making fall the ideal time to transplant gooseberries. The early shoots and root formation in spring, and the ease with which these are seriously injured makes late spring planting very unwise. If for some reason early fall planting is impossible, then

very early spring is the next best time for planting.

The same special care should be used in transplanting gooseberry plants as is used in the transplanting of larger plants. The roots should be well spread out in a roomy hole and never crammed down in a slit in the ground made with a spade. The soil should be firmed about the roots to prevent drying out and when completed the plant should stand one to two inches deeper than it formerly stood in the nursery.

One of the serious difficulties of most plantations is that they are planted so close together that development of the plant is practically impossible. The square planting plan of 6x6 feet gives very satisfactory results except where the soil gets very dry during the summer and where the heavy annual rainfall produces an abnormally large wood growth. Under such conditions it is better to plant the rows seven or eight feet apart and still maintain the six foot space between the plants in the row.

Cultivation. Gooseberries are shallow rooted plants but very heavy feeders and so must be treated accordingly. Most of our soils need an abundance of well rotted nitrogenous material to make them ideal for this class of fruit. Barnyard manure is one of the essentials for successful culture. The shallow rooting habits of these plants makes deep tillage close to the plants not only impossible but dangerous and should never be practiced after the plant has become established. Just as soon as the ground is dry enough in the spring the plantation should be thoroughly worked with a cultivator or disk, tilling as deep as the roots will permit close to the plants. The subsequent tillage should consist of thoroughly working the surface with a shallow-working tool like an acme, spike tooth or spring tooth cultivator every ten days or two weeks until harvest time and then one or two good cultivations afterwards, when the tillage should cease for the season.

A heavy mulch of rotting straw is a good thing to hold the moisture and keep the soil cool, but attracts field mice and moles so seriously that the station had to dispense with it entirely. As a conserver of moisture clean tillage or the dust mulch is far superior to the straw mulch system.

Pruning. If first-class, fine, large berries are desired the bearing wood of a plant must never be permitted to become old, weak or inactive. The essential thing is to keep the wood vigorous and not permit wood to accumulate in excess of the amount that a plant can thoroughly support. Weak growing plants and shoots should be severely cut back to compel strong growth.

Since it is impracticable to practice regular fruit thinning on gooseberries, a system of thinning when pruning should be practiced. This is accomplished by reducing the number of bearing canes from the large number usually found to from eight to eighteen, depending entirely upon the vigor of the plant. A shoot should not be permitted to bear more than four crops of fruit, after which its place should be taken by a younger, more profitable cane.

The pruning may be done in the summer after the crop is harvested, but our best results have been secured by very early spring pruning, which produced a more vigorous wood growth than summer pruning and gave better fruiting spurs and wood. Proper pruning does much to simplify picking, and if for no other reason the plants should be thoroughly pruned every year.

BLACKBERRIES AND RASPBERRIES

By W. S. Thornber, Horticulturist

Washington Agricultural Experiment Station Popular Bulletin No. 18.

The soil temperature and general conditions of many parts of the State of Washington are admirably adapted to the commercial growing of practically all kinds of small fruit. This is particularly true of raspberries, blackberries and loganberries. Several localities west of the Cascade Mountains have already become famous as berry-growing districts. Probably nowhere in the United States do these fruits grow to a higher degree of perfection than in these districts. With the opening up of large tracts of land for orchard purposes comes the demand for an early yielding, highly profitable crop that can be grown among the trees without danger of injuring them, and so for this reason large acreages of these plants are annually being planted in many parts of the state.

Soil. While raspberries and blackberries are more or less cosmopolitan as to their likes and dislikes of soil, yet they prefer a deep rich, moist (but not wet), sandy loam abundantly supplied with humus and nitrogen plant foods. However, they can be successfully grown on basaltic and volcanic ashy soils after humus has been added, provided there is sufficient moisture during the growing and fruiting season. Some of the soils of the irrigated sections of the state are not adapted to these fruits until one or more crops of green manure have been plowed under.

Drainage. One of the essential features of a good berry soil is thorough drainage, not only during the growing season, but also during the winter months. Soil that becomes saturated with water and remains so for even a short time is not adapted to berry culture and should not be used until artificial drainage has been provided. Much trouble from root rot and root fungus can be avoided by providing good drainage. The factor of air drainage should also be considered in the making of a berry plantation. Good air drainage minimizes the danger of late spring frosts and materially lessens the injuries caused by some of our plant diseases.

Cultivation. Nothing can take the place of good thorough tillage in the berry patch. A heavy mulch may keep down the weeds and hold the moisture, but it does not liberate plant food like cultivation. The spring cultivation should start as soon as the soil is dry enough to be worked and should be deep enough to loosen up the soil, yet not so deep as to injure the feeding roots of the plants. The summer tillage should be shallow but frequent and continue regularly until the crop is safely harvested, and afterwards only frequent enough to maintain growth and keep the suckers and weeds down.

Harvesting and Shipping. The perishable nature of berries make them one of the most difficult fruit crops to market that is commonly grown. However, if they are picked just as they are turning red, taken at once to the packing or cooling shed and handled with reasonable care they will be in their prime from twelve to twenty-four hours. Berries picked in the morning ship better than those picked in the heat of the day and under no circumstances should fruit be picked when the leaves of the plants are wet with dew or rain.

When berries are not grown in sufficient quantities to warrant the use of refrigerator cars the Pony refrigerators should be used. Over-ripe fruit should be consigned to the cannery and never be permitted to be sent to distant markets.

Planting Plans. The difference in the growth of varieties makes it necessary to use different plans to get the best results for all varieties.

For the convenience of this discussion I group all of these fruits into two classes, i. e.: "Upright Growers," or such plants as produce erect canes, and "Viny Growers," or such plants as the Logan and Phenomenal berries and Evergreen, Himalaya Giant and Early Mam-

moth blackberries, which produce long prostrate vines or canes.

The two general planting plans: "Hill" and "Continuous Row" systems are about equally used in the commercial fields of the state. Each has advantages as well as disadvantages and if not crowded will give good results. The Hill system affords the best opportunities for cultivation, air drainage, sunlight on all sides of the plants and ease of harvesting the crop, while the Continuous Row system permits the planting of more plants per acre without serious crowding.

The "Upright Growers" may be profitably planted according to either system, but "Viny Growers" must be grown in hills or they become a dense hedge, making satisfactory harvesting an impossibility.

Planting Distances. The one common fault of practically all amateur fruit growers is the over-planting of their land. The fertility of the soil, annual rainfall or irrigation, and variety materially govern the distance apart plants should be planted. On the rich moist soils of Western Washington where heavy growth is a certainty, or dry soils of Eastern Washington, where the conservation of the moisture must be practiced, the "Upright Growers" should be planted not closer than six feet apart each way in the Hill system; or three by eight in the "Continuous Row" system. In irrigated sections, where moisture can be supplied at will, the plants may be planted closer. However, it is not advisable, since what may be the additional number of crates per acre is frequently lost by the grade or quality of the fruit. On similar soils the "Viny Growers" should be planted in rows eight feet apart and the plants from sixteen to twenty-four feet apart in the row, using the alternate system and thereby affording a greater feeding area for the roots of each plant.

Training and Staking. The "Upright Growers" where planted in hills can best be staked by a single strong stake from four to six feet in height and the canes loosely but securely fastened to the stake. Some growers prefer to set two stakes about fifteen inches apart at each hill of blackberries with the idea of training the fruiting canes on one and the growing canes on the other. Where the "Upright Growers" are planted in a continuous row they may be trained to and supported by a two-wire trellis consisting of a single row of posts four to five feet high with a single No. 10 wire stapled to the top and another from eighteen to twenty-four inches from the top. The more common method, however, is to set a single line of posts four to five feet high in the row, nail an eighteen-inch cross-arm three feet from the ground and another at the top of the posts, and to the ends of these arms staple heavy wires, thus forming firm lateral supports for the canes.

The four-wire trellis, with the addition of notched cross pieces to lay on the lower wires, makes an excellent support for the "Viny Growers," the purpose being to suspend the growing canes by means of small cloth strings under the upper wires for the first year and at pruning time lower them to rest on the notched pieces on the lower wires for their fruiting period. This makes an easy system to work and keeps the growing and fruiting canes separate, thereby simplifying the picking.

Pruning. In sections where there is danger of winter injury the old fruiting canes should be left until spring, while in other sections they may be removed and the plant cleaned up immediately after they are through fruiting. The cutting back of the tops and final thinning of the canes should be done late in the winter or early in the spring after all danger of winter injury is past. The "Upright Growers" should be cut back to the sound wood from three to five feet in height, while the "Viny Growers" should be cut back to canes from six to twelve feet in length, depending upon their condition and strength.

The number of canes to be left per plant must be determined largely by the variety and the vigor of each plant. Strong, upright plants will support from four to seven canes, while weak ones should not be expected to support more than two or three. Four canes per plant is the most satisfactory number for the "Viny Growers."

GRASSES AND CLOVERS

ALFALFA (Medicago Sativa)
By Byron Hunter, in Farmers' Bulletin No. 271, U. S. Dept. of Agriculture.

At the present time the growing of alfalfa (Medicago sativa) west of the Cascade Mountains is only in the experimental stage. Small areas are to be found in various places, some of which are doing reasonably well. Most of these have not been planted long enough and have not been studied sufficiently to justify definite conclusions as to the future usefulness of alfalfa in this region. There are many localities with well-drained soils, however, in which it will unquestionably succeed if given proper treatment. In regions in which the rainfall is as great as it is at certain seasons west of the Cascade Mountains, alfalfa requires a loose, permeable subsoil, and seems to thrive best on the sandy loams along the water courses. The best alfalfa fields noticed

were on the sandy alluvial soils on the Willamette and Columbia rivers. The water table of land secured for alfalfa should be at least 4 feet below the surface, and the land should not be subject to overflow. Alfalfa will stand considerable flooding, provided the water is running, but it is usually destroyed if stationary water covers it for a few days.

There are two important difficulties to be overcome in the successful production of alfalfa in this region. In the first place bluegrass, English rye-grass, Italian rye-grass, velvet grass, couch-grass, and many other grasses and weeds have a strong tendency to crowd out the alfalfa. This difficulty is largely overcome by eradicating these plants, so far as possible, before the seeding is done. Thorough disking and harrowing at a time when the alfalfa has made but little growth, or just after cutting a crop of hay, tends to keep it vigorous and holds the weeds and grasses in check. The disk harrow should be weighted to make it cut deep and should be set about as straight as possible, so as not to cut off the crowns of the alfalfa plants. Although these grasses, when growing with alfalfa, actually decrease the total amount of forage produced, they also decrease the danger of bloating when the field is pastured to sheep, goats, or cattle. In fact, grasses are frequently sown with alfalfa for this purpose. Secondly, the first and last crops of alfalfa mature at seasons of the year when it is very difficult to make hay on account of the damp weather. This objection is obviated by using the first and third cuttings for ensilage, soiling, or pasture.

Methods of Sowing

This must be governed largely by local conditions. Land that is naturally well drained or that is tilled at least 3 feet deep should be selected for this crop. If barnyard manure is available, put on from 12 to 20 tons per acre in the fall and plow it under 8 to 10 inches deep. In the spring, when the land is in good working condition, cut it up thoroughly with a disk harrow and work it down fine. Let it lie for a week or ten days; then give a good harrowing so as to destroy all weeds. Sow about 15 pounds of clean seed per acre and cover with a harrow. If the soil is inclined to be dry, finish with a roller. About the time the seed is sown, put on 70 to 100 pounds of land plaster to the acre.

Inoculation

The failure of alfalfa west of the Cascade Mountains is frequently due to the lack of nodule-forming bacteria in the soil. If the land to be sown has never grown alfalfa before, it is the safest plant to artificially introduce these organisms. This may be done in two ways:

(1) From 300 to 500 pounds of soil, the more the better, may be hauled from a field that has recently produced alfalfa with nodules on the roots, and scattered evenly over the surface of the new field. This should be done just before the alfalfa seed is sown and the soil should be thoroughly mixed with that of the new field by harrowing or disking. It is quite expensive to inoculate large fields in this way and there is always a possibility of transferring plant diseases from one field to another.

Of scarcely less importance is the danger of disseminating noxious weeds and insect pests through this plan of inoculating by means of natural soils. Even though weeds may not have been serious in the first field, the great number of dormant seeds requiring but a slight change in surroundings to produce germination is always a menace. If soil is to be used, however, whether obtained from nearby fields or shipped long distances, the evidence should be clear that the soil is free from the objections metioned above.

(2) Pure cultures of the proper bacteria may be used. The Bureau of Plant Industry of the United States Department of Agriculture has isolated the different organisms for the different legumes, is growing them in pure cultures, and furnishes them to farmers whose soil conditions seem to indicate that inoculation is necessary.

Those desiring inoculating material should write to Soil Bacteriology Investigations, Bureau of Plant Industry, Washington, D. C., for an application blank. To avoid delays, requests should be on file several weeks before the material is to be used.

Should weeds tend to crowd out the alfalfa during the first year, they should be mown often enough to hold them in check. The cutter bar of the mower should be set about 5 inches high in order that the young alfalfa plants may not be cut too closely. If the crop mowed would be sufficient when dry to make a third of a ton or more of hay (and dried weeds) to the acre, which it usually will be in spots, it should be removed from the field; if less than this it may be permitted to lie where it is cut.

ALSIKE (Trifolium hybridum)

By Byron Hunter, in Farmers' Bulletin No. 271, U. S. Dept. of Agriculture.

Alsike clover (Trifolium hybridum) has a much wider range of adaptability in Western Oregon and Western Washington than red clover. It thrives not only on soil adapted to the latter—upland clays and well-drained soils —but also on lowland clays, alluvial bottoms, and many soils too wet and cold to grow red clover. Its stems are much finer and more recumbent than those of red clover, and its leaves are not so numerous. The yield of the first crop is very satisfactory, but it is disposed to make but little growth after a crop has fully matured for hay. If cut early, however, it is said to make a very satisfactory second growth. A delay of only a few days in the time of cutting the first crop makes a very marked difference in the growth of the second.

Alsike clover makes a very good quality of hay and is well suited to sow with timothy, since these two crops mature at the same time. It is a perennial, stands grazing well, and seems to be much less susceptible to the attacks of the clover root borer than is red clover. Since alsike clover is so nearly the equal of red clover in nearly every way it should be given a thorough trial in all localities west of the Cascade Mountains where red clover may have failed.

From what has been said it is evident that alsike clover is eminently adapted for sowing on land that is too cold and wet for red clover, in mixtures for permanent pastures, and on forest burns and burnt slashings that are to be used for pasture for several years.

The seed of alsike clover is quite small and 5 or 6 pounds per acre will be found sufficient when it is sown alone. With this exception, all that has been said regarding the seeding of red clover applies equally well to alsike clover.

BERMUDA GRASS (Cynodon dactylon)

A most valuable grass for our southern states, both for pasture and lawn. It is of dwarf habit, with long creeping stems, rooting at the joints and covering the ground with a mat of fine turf, which no amount of tramping can destroy. As it cannot endure frost, it is of no value north of California. It thrives in the poorest and sandiest soil, and resists extreme drought and the most intense heat.

BLUE GRASS, CANADIAN (Poa Compressa)

Many people have a wrong idea in regard to Canadian Blue Grass, thinking that it is the same thing as Kentucky Blue Grass, only grown in Canada instead of in Kentucky. Others think that it is a worthless grass.

Canadian Blue Grass is of the same general family as Kentucky Blue Grass, only it is somewhat different in habit of growth and in

texture. The seed is almost identical with Kentucky Blue Grass—in fact one cannot tell the difference without a good glass. It is coarse and has a larger leaf than Kentucky Blue Grass and in a good many instances is more valuable. It makes an exceedingly strong turf, as it has extensive creeping root stocks. It is a more decided blue in color, has strongly flattened stem and lower habit of growth, and will grow in a great many varieties of soil and in many places where Kentucky Blue Grass will not thrive.

It is particularly valuable on thin or poor land or dry soil, of course making a better yield on good land. It makes a valuable addition to dairy pastures as cows feeding on it yield the richest milk and finest butter. It grows sufficiently tall for hay and as it is a hard grass and shrinks very little in drying, the hay is heavy in proportion to its bulk. It should be more largely used than it is, as it is well adapted to the gravelly land of Western Washington and Oregon. The seed is generally very reasonable in price. For pasture sow about 20 pounds to the acre, and for lawns 1 pound to about 300 square feet.

BLUE GRASS, KENTUCKY (Poa pratensis)

Kentucky Blue Grass is one of the best known lawn grasses and is also valuable in the pasture lands of Western Washington and Oregon. In making a lawn Kentucky Blue Grass makes a good firm sod and can be sown either alone or in a mixture with other grass. It grows slowly at the start and there is, therefore, an advantage in mixing it with other quicker growing grasses. It is rather a shallow rooter and on lawns that are made on gravelly soil, high and dry, it is best to have some other grass with it. Many of the imported grasses, such as fine-leaved Fescue, and Creeping Bent, mixed with Kentucky Blue Grass, add very much to the beauty of the lawn. Kentucky Blue Grass and White Clover can be sown together in about two-thirds of Blue grass to one-third of White Clover. The clover will come up quickly, making a fairly good lawn the first year and will protect the Blue Grass. After a year or so the Blue Grass will develop a solid turf and will gradually clean out the White Clover, leaving a pure Blue Grass lawn. For lawn purposes it requires about 1 lb. of seed to 300 square feet, and the heavier sowing the better lawn will be produced. Remember that in sowing a lawn the weeds and grass which you spade under stand a good deal better chance of growing than the seed which you are sowing, and it will, therefore, pay you to keep the ground sprinkled and cultivated several months before sowing the lawn, thus getting rid of a good proportion of weeds that are in the soil. This is easier than pulling them out of the lawn afterwards. Blue Grass should be covered only very lightly. If buried too deeply it will not come up. The best way is to rake the ground, sow the seed on a very quiet day when the wind is not blowing, and then roll the ground. The rolling will cover the seed sufficiently without any breaking. If the seed is sown during the hot summer months it will be necessary to shade the ground somewhat with brush or excelsior. Do not use straw or hay that contains too many weed seeds. Kentucky Blue Grass for pasture should be sown about 20 lbs. to the acre. We would not recommend sowing it alone, but it is a very useful addition to pasture mixture.

BROME GRASS (Bromus inermis)

Also known as Smooth Brome Grass and Russian Brome Grass.

This has been highly praised and exploited during the last few years, and for certain locations it is certainly a very valuable grass, but we would not advise using it in Western Washington, or Western Oregon, as there are a number of other grasses that are more useful. In the semi-arid regions of the Northwest it is a very useful grass as it requires but little moisture and quickly makes a thick, firm turf. It seems to stand an almost unlimited amount of dry weather and it thrives well on dry, loose soils, but of course will give a greater yield on better soils. It is not as high in feeding value as many other grasses and is somewhat difficult to eradicate when once established. It makes a fairly good pasture and grows tall enough to cut for hay. Sow 35 to 40 lbs. per acre.

CLOVER, CRIMSON (Trifolium incarnatum)

Crimson Clover is an annual, useful principally as a cover crop to prevent winter rains washing the land. It does not succeed well north of Portland, but can be grown fairly well in Willamette Valley and very successfully in California. However, we have some other plants that are more successful, as, for instance, the vetches, which make a larger growth, are easier to start and which are cheap, so that we do not advise the planting of Crimson Clover on the Pacific Coast, except in rare instances.

CLOVER, MAMMOTH RED (Trifolium Medium)

This variety grows five or six feet high, is so coarse that it is of little use for forage, and is used almost exclusively as a soiling crop, to be plowed under, for which purpose it is valuable on account of its deep-rooting habits and its ability, as with other legumes, of drawing nitrogen from the atmosphere and distributing it in the soil. Sow 12 to 20 lbs. to the acre.

RED CLOVER

By Byron Hunter, in Farmers' Bulletin No. 271, U. S. Dept. of Agriculture.

Considering the region as a whole, red clover (Trifolium pratense) is easily the leading forage plant west of the Cascade Mountains. It thrives best on rich, well-drained upland soils. Many of the low lands that are too wet and cold for red clover become adapted to it when properly drained. If allowed to develop naturally, this crop matures for hay early in June. Rains are not infrequent at this season of the year, and it is a common practice to pasture red clover in the spring until about the first of May to retard the development of the crop, so that haymaking will occur during good weather. Red clover begins to grow in the early spring and, unless the soil is very poor and the summer very dry, remains green and furnishes excellent pasture until early in December.

Generally speaking, red clover reaches its highest development on the coast and the region about Puget Sound, where, under favorable conditions, it may be cut three times during the year. To give three crops it must be grown on rich lands and must not be pastured in the early spring. The first crop should be cut for hay or ensilage early in June, the second for hay in August, and the third for ensilage late in the fall. In the Willamette Valley difficulty is often experienced in getting red clover established, especially on land that has produced cereal crops exclusively for years. This difficulty is probably due to the methods of seeding, the dry summers, the poor texture of the soil, the lack of available nitrogen, and possibly the lack of nodule-forming bacteria. Red clover also frequently runs out in a short time. It is believed by farmers that this is due to the ravages of the clover root borer. In spite of these difficulties, however, red clover is one of the leading forage plants of the Willamette Valley. It is not unreasonable to assume that these hindrances to the growth of red clover are largely responsible for the important place that common vetch occupies in the agriculture of Western Oregon.

In the Willamette Valley it is a common practice to apply land plaster to clover in the spring, during March and April. From 40 to 60 pounds per acre applied on the surface of the ground in the early spring are said to double the yield of both hay and seed. Land

plaster has the same effect when applied to other leguminous crops in this region, but it is essential that it be applied early enough to receive an abundance of rain.

There are many methods in use for sowing red clover in Western Oregon and Western Washington, some of which are given below:

(1) Clover with early-sown winter wheat.—From 8 to 12 pounds of clover seed per acre are sown in the early fall with winter wheat on land that has been summer fallowed or from which an early cultivated crop has been removed. The seed is usually sown broadcast and covered with a harrow. If the clover fails to catch it can be sown again in the spring, about the 1st of March.

(2) Clover with late-sown winter wheat.—Early in the spring, about the 1st of March, when the ground is heaving slightly from alternate thawing and freezing, from 8 to 10 pounds of clover seed per acre are sown broadcast on late-sown winter wheat. If the ground is dry enough when the clover seed is sown it may be covered with a harrow.

(3) Clover with spring oats or wheat.—With this method a good seed bed is essential. The land should be plowed deep in the late fall or winter, and as soon as in good working condition in the spring it should be cultivated until it is in perfect tilth. If the soil is inclined to run together it may be necessary to replow in the spring. Instead of plowing in the fall or winter it may be done in the early spring and the seed bed prepared immediately. After drilling in a full crop of oats or wheat, from 10 to 12 pounds of clover seed per acre are sown and covered with a harrow. In Western Washington this is the usual method, with the exception that either timothy, English rye-grass, or orchard grass is usually sown with the grain and clover. On wet land alsike clover often forms a part of the mixture.

(4) Clover alone.—When clover is sown alone in the spring the land is plowed early and worked down fine. About the 1st of May it is again thoroughly cultivated to kill weeds and prepare the seed bed. From 10 to 12 pounds of clover seed per acre are then sown and covered by harrowing. The clover may be pastured during the first season, but should not be cropped too closely during the driest part of the summer. This is becoming quite a popular method in the Willamette Valley and very satisfactory stands are secured, but the use of the land is almost lost the first year.

Clover may be sown alone also in the late summer or early autumn. Although this method is seldom used it is probably one of the most satisfactory ways of sowing clover west of the Cascade Mountains. If sown with grain in the fall, clover does not make a crop the next year, but if sown alone in the late summer a full crop is secured the next summer. It is essential, however, that the seeding be done early, for if sown in the late fall it is liable to be winter killed. Only crops, then, that can be removed early should precede clover sown in this way.

(5) Clover with rape.—Sowing clover with rape is a very successful and popular method with many farmers who are engaged in raising sheep and goats. With the land prepared as indicated for sowing clover alone in the spring, from 10 to 12 pounds of clover seed and from 2 to 4 pounds of rape seed per acre are sown broadcast about the 1st of May and covered with a harrow. If the ground is rough and cloddy, it should be finished with a roller. If this mixture is sown on a thoroughly pulverized and compact seed bed, the rape develops rapidly and frunishes excellent pasture for sheep, goats, calves or swine in from six to eight weeks. The tramping of the animals while feeding during the summer, principally on the rape, forms a dust mulch on the surface of the ground. In this way soil moisture is retained for the use of the clover during the dry summer season. If a hay crop is desired the second season, the rape is killed by pasturing it closely with sheep during the late fall or winter. Sheep eat off the crowns of the plants close to the ground and the rape then dies. If the rape is not killed it will go to seed the next summer, and the stalks will give some trouble in the hay. If the clover is not cropped too closely the first summer, this method gives an excellent stand.

Failures occur frequently, especially in the Willamette Valley, when clover is sown by any one of the first three methods described. With rich, moist soil of good texture and with frequent rains during the summer these methods are usually successful. But with soils that are inclined to puddle and dry out quickly—soils that have produced grain crops exclusively for a number of years—they often give poor results. Under such conditions the grain shades the clover too much, and robs it of the moisture necessary to carry it through the first summer.

Since the first crop of clover is seldom used for seed it is cut for hay or ensilage about the 1st of June to enable the second crop to make a good growth before the dry season begins. Instead of cutting the first crop for hay or ensilage, clover is sometimes pastured until late in May, and the first crop is then used for seed. By mowing the first crop, however, the second one comes on more evenly than when the first is pastured.

When the heads of the seed crop are pretty well dried and are dark-brown in color the clover is cut with a self-raking reaper, or with a mower with a buncher attachment. Bunches of the size of an ordinary wheat bundle are dropped in rows. When the heads are dry enough to powder when rubbed in the hands five or six bunches are thrown together by hand or bunched with a hayrake in the morning when damp with dew. The thrashing is done when possible with a clover huller, and the clover is hauled to the machine in tight-bottomed racks in order that the shattered seed may not be lost.

CLOVER, SWEET

It is only very recently that the value of sweet clover has been recognized. It has been grown for bee pasture, for which it is unequaled, but on account of its bitter taste and the tendency of the stems to become woody when mature it has been considered of little value as a forage plant, for stock do not relish it until they have developed a taste for it.

Stock soon learn to like it, and its use as a pasture, hay and soiling crop is steadily increasing. It is especially valuable as a fertilizer, and the fact that the bacteria on its roots are capable of inoculating alfalfa makes it a valuable crop to occupy the land before seeding alfalfa where it is difficult to get a stand of alfalfa on account of the lack of bacteria. Sweet clover, being a legume, draws nitrogen from the air and distributes it in the soil for the use of future crops, and the large roots do much toward breaking up and aerating the sub-soil.

It prefers a soil of limestone origin, but will thrive on almost any soil, even poor and run-down lands on which other crops will not grow, making it exceedingly valuable for fertilizing such lands.

The seed bed must be well prepared and very firm. Many failures are on account of the ground not being sufficiently compact. Ground that has borne a cultivated crop, and does not require plowing, is suitable after being thoroughly harrowed.

The seed may be sown either in fall or spring. Best results are obtained when sown alone, but good stands will usually be had when sown with a nurse crop. Seed should be sown at the rate of twenty to thirty pounds per acre.

There are several varieties of sweet clover, but the following are the most generally grown,

White Sweet Clover (Melilotus alba) (Bokhara)

An erect, branchy, stemmy, biennial plant with uniform, ascending stems not thickly supplied with leaves. During its second season it makes a growth of from five to twelve feet, produces numerous flowers, and dies when it has matured its seed. The first season it makes a growth of eighteen to thirty inches and in addition stores up in a very large root reserve food, material for a rapid and vigorous growth early the following season. When young the plant resembles alfalfa, but can readily be distinguished by the bitter taste of its foliage. When in bloom it can easily be identified by the long, loose racemes of white flowers and its open coarser growth. Unlike alfalfa, the seeds are borne singly in each pod. In common with other legumes it possesses the power of storing up nitrogen in the nodules on its roots, thus adding one important element of soil fertility to the land.

Yellow Annual Sweet Clover (Melilotus indica)

This small yellow blossomed species is a low-growing, erect, early-flowering plant. It is an annual, while the white variety is a biennial. It makes a slower growth than the white variety, and is not considered so valuable.

CLOVER, WHITE (Trifolium repens)

This is also called White Dutch Clover. It is a perennial plant, making growth of from four to ten inches, according to the land on which it is planted. It is an excellent plant for lawns as it will grow under almost any conditions, is easy to start and will make a nice lawn within six weeks from the time of planting. It will grow on almost any kind of soil and in the deep shade or the brightest sunshine. In sowing lawns it is always advisable to use grass seeds with the white clover, as after about two years the clover will become ragged if sown alone. White clover is also excellent for pastures, especially in Western Oregon and the Puget Sound region. It produces a forage that is well liked by all stock, is sweet, very nutritious and makes lots of milk. For pastures it should be sown at the rate of 6 to 8 lbs. to the acre in addition to other grasses. It makes a good mixture with Italian Rye Grass, Orchard Grass and Red Top. In sowing large lawns or parks use from 25 to 100 lbs. per acre. The more seed the better the turf and finer lawn you will have.

CREEPING BENT, or FLORIN (Agrostis stolonifera)

The distinctive feature of this species is its compact, creeping, rooting stems. Although it prefers a moist soil it will stand considerable drought. It is of rapid growth and spreading habit, forming a strong and enduring turf that is positively improved by constant tramping, which together with its fine texture and deep green color, makes it one of the very best lawn grasses. It is included in all of the best lawn mixtures. Also very valuable in pasture mixtures. Height 20 to 25 inches. If sown alone use about 50 lbs. to the acre.

CRESTED DOG'S TAIL (Cynosurus cristatus)

A very hardy perennial grass with stoloniferous root stocks, thriving on either good soil or poor light soil and hillsides, or in shade. It is a valuable grass in pasture or lawn mixtures, and is especially relished by sheep. Should be used in mixtures only. Sow at the rate of twenty-five pounds per acre if sown alone, or in that proportion if mixed with other seeds.

FINE-LEAVED FESCUE (Festuca tenuifolia)

Grows only 15 to 20 inches high, in small tufts, with few stems, but a large amount of bottom foliage. It will grow on very dry and inferior soils, and its dwarf habit and fineness of leaf render it not unsuitable for dry slopes on lawns. Sow 30 lbs. to the acre.

HARD FESCUE (Festuca duriscula)

This is a variety of Festuca ovina, dwarfer and less vigorous in growth. It is emphatically a grass for dry lands, doing well on sandy and shallow silicious soils. For permanent pastures on poor lands it is especially valuable; may also be used in meadow mixtures, for well manured clay soils. Not recommended for lawns. Height 1 to 2 feet. Sow 30 lbs. to the acre.

JOHNSON GRASS (Sorghum halepense)

A perennial of luxuriant growth. Has strong roots that penetrate to a considerable depth, enabling it to stand a hot dry climate. It belongs to the Sorghum family and is sweet and nutritious and much relished by stock. Is of no use in the Northwest, and its sale is prohibited in California, on account of its spreading habit and the difficulty of eradicating it.

MEADOW FESCUE (Festuca pratensis) From Farmers' Bulletin No. 271, U. S. Dept. of Agriculture, by Byron Hunter.

Although meadow fescue (Festuca pratensis) is grown but little west of the Cascade Mountains, it is highly prized by those who know it. Like orchard grass, it is adapted to practically all of the tillable soils of the region except those that are gravelly or very wet. It is a perennial; lasts much better than timothy; is relished by all kinds of stock; makes a good quality of hay; and, when once established, stands tramping and grazing well. It does not begin to grow so early in the spring as orchard grass, but remains green during the summer and makes a good growth during the fall. It is especially adapted to a place in meadow and pasture mixtures that are to occupy the land for a number of years. One of the leading dairymen of the Willamette Valley sows the following mixture in the spring: Meadow fescue, 10 pounds; English rye-grass, 10 pounds; timothy, 4 pounds; red clover, 4 pounds, and alsike clover, 2 pounds. This mixture is used for hay for two years, and then for pasture three years. Of the grasses in this mixture, meadow fescue is his favorite.

Meadow fescue may be sown in the early fall or spring. When sown alone, from 15 to 20 pounds per acre of the best seed should be used.

MESQUITE—MEADOW SOFT GRASS, or VELVET GRASS (Holcus lanatus)

Of little agricultural value, except for pastures on light sandy or marshy soil where other grasses will not thrive. It is not relished by stock, and on account of its spreading habit and difficult eradication is liable to become a nuisance.

OAT GRASS, TALL (Avena elatior) From U. S. Department of Agriculture, Bulletin No. 66, by Jared G. Smith.

This is a perennial species which grows in loose tufts and throws up an abundance of leaves and tall stalks. It is well adapted to rich, upland soils, and when once well established is one of the best drought-resistant cultivated grasses. In Iowa and California its cultivation has been especially recommended on account of its ability to live through the hottest and driest seasons; but while valuable in mixtures it is not suitable to plant alone unless grown for seed. The forage is bitter, and when green is not readily eaten by cattle, except where it occurs in small quantities mixed with other grasses. The hay, however, is of fine quality and is relished by stock. It blooms early, and should be cut as soon as the first blooms appear, because after flowering the stems become hard, woody, and indigestible. It is a deep-rooted grass, and requires deep and thorough preparation of the soil. Like alfalfa it is quickly killed by standing water or bad drainage. It makes its heaviest growth the second year, and thrives better on southern exposure than on cold northern ones. It may

be sown alone or in mixture with other grasses. In mixtures the quantity of tall oat grass should not exceed one-fifth of the total amount sown. The seed weighs about 10 pounds to the bushel.

ORCHARD GRASS (Dactylis glomerata)
By Byron Hunter, U. S. Dept. of Agriculture, in Farmers' Bulletin No. 271.

Orchard grass (Dactylis glomerata) thrives remarkably well on all tillable soils west of the Cascade Mountains, except those that are very wet. It is the earliest grass to start to grow in the spring; it revives quickly after it is cropped by stock or cut for hay, especially if the soil is moist; it remains green during the summer and fall, and is relished fairly well by all kinds of stock; it stands grazing and tramping much better than timothy, and lasts for a number of years when given proper care. It is, therefore, eminently adapted for pasture purposes and should form an important part of every permanent pasture mixture.

Orchard grass makes an excellent quality of hay if cut before or just after the blooming period. If the cutting is delayed but a few days beyond this period orchard grass has a strong tendency to become woody, and the hay is then of poor quality. It ripens with red clover, and under favorable circumstances it may be cut twice during a season. It is, therefore, especially well fitted for sowing with red clover when intended for hay. It grows in bunches and does not make a smooth sod; for this reason it is seldom sown alone. Orchard grass is a little early, and is often ready to cut before good haying weather has begun. This fact and its tendency to become woody immediately after blooming are the chief drawbacks to its culture west of the Cascade Mountains. Its earliness is an advantage, however, when it is used for ensilage or soiling.

The seed habits of orchard grass are very satisfactory, and the yield is from 15 to 18 bushels of seed per acre. The seed weighs from 14 to 18 pounds per bushel. When sown alone 20 to 25 pounds of seed per acre will be sufficient. It is sown either in the fall or spring. If sown in the early fall, without a nurse crop, it should make an excellent crop the next year.

RED, or CREEPING FESCUE (Festuca rubra)

A creeping rooted species, forming a close and lasting turf. It resists extreme drought, and thrives on very inferior soils, gravelly banks and exposed hillsides. Valuable for binding shifting sands and for shady places in lawns. Grows 25 to 30 inches high. Sow 30 pounds to the acre.

RED TOP (Agrostis vulgaris)
From U. S. Department of Agriculture, Bulletin No. 66, by Jared G. Smith.

This grass is a native, ranging across the northern portion of the continent. In the North it is the standard grass for wet meadows. It has been determined as a result of experiments, notably at the Rhode Island Experiment Station, that red top makes its best growth on sour soils; in other words, on soils showing a distinctly acid reaction. Red Top grows naturally on marshy meadows and is best suited for cultivation in such places. While the application of lime is often recommended as an improving preliminary treatment of land which is to be seeded down to meadow grasses, it has been found that red top is an exception, and will not make a favorable growth upon soils which are neutral or alkaline.

There are a great number of forms or varieties, which differ in height, leafage, and the manner of growth, so that great variability may be expected. Opinions differ widely in regard to its value because of this diversity of forms. It is a perennial, provided with long creeping stems and underground runners, and is one of the best bottom grasses, bearing large numbers of fine root leaves. Because of this and its creeping habit of growth it is one of the best grasses to use in mixtures with erect tufted species, such as orchard grass and timothy, filling in between the clumps and producing a continuous turf. The weight of the seed varies according to the quality from 8 to 30 pounds to the bushel, averaging perhaps not more than 10 or 12. Mixtures of red top and alsike clover are largely used for low, wet meadow lands and pastures. The creeping habit of this grass makes it less liable to injury from trampling by stock than is the case with the tufted, bunchy grasses.

Red top, or certain forms of it, sometimes becomes a bad weed in cultivated land, because of its tendency to form stolons or creeping root-stocks, which are as difficult to entriely remove as are those of quack grass. In Scotland and the Norwegian countries red top is placed in the same category as quack grass as a weedy pest, especially on cold, marshy soils; but it is to be remembered that it does not thrive on alkaline soil, and so may be destroyed by the application of lime to the land, changing the soil from acid to alkaline.

REED CANARY GRASS
(Phalaris arundinacea)

A very hardy perennial, preferring stiff, wet land. Grows well in ditches and by riversides, where its long creeping rootstalks render it valuable for binding the banks. Its seed affords food for trout and wild fowl. When young it may be cut for green forage for cattle. One of the very few grasses that will live on overflowed land. Grows six feet high. Sow 40 pounds to the acre.

RYE GRASS, PERENNIAL (Lolium perenne)

Very generally known as English Rye Grass. Also the same thing grown largely in Australia and known to the trade as Australian Rye Grass. It has been very largely used on the Pacific Coast, especially during the last few years, and for the territory west of the Cascade Mountains is an exceedingly valuable plant, as the climate here is especially well adapted to its growth. It prefers a moist and rich loam or clay but will grow and do well in almost any locality and almost any kind of soil. It is better used in a mixture with other grasses and it produces both hay and pasture, as the grass is of high feeding value. It should be sown about 30 pounds to the acre when sown alone or the same proportion with other grasses.

RYE GRASS ITALIAN (Lolium Italicum)

This grass is only supposed to live about two seasons, but in Western Washington and Western Oregon it will re-seed itself and will last almost indefinitely. We consider it one of the most valuable pasture grasses for the Pacific Coast, as it makes a quantity of green feed late in the season after the other grasses are past their prime. After being cut down it makes a very rapid growth and will produce more green pasture in mid-summer than any other grass we know of.

In Europe it is considered as an excellent hay grass and produces a dense turf and is well liked by all kinds of stock. It is one of the best grasses for soiling. Should be sown about 30 pounds to the acre. Is a valuable grass for sowing on logged-off lands or burns and may be planted either in the fall or spring.

SHEEP'S FESCUE (Festuca ovina)

Grows 20 to 25 inches high, prefers dry uplands, and thrives in poor, shallow, gravelly soils where other grasses would fail. It is very hardy, resisting extreme heat and cold. Though of dwarf growth, it grows thickly, yielding a large amount of very nutritious herbage, which is much relished by sheep. In grass mixtures for pastures on high and dry lands it is especially valuable. Though a "bunch grass," it may be included in lawn mixtures on account of its fine foliage and dwarf, dense growth. Sow 35 pounds to the acre.

SUDAN GRASS (Andropogon Sorghum)

Sudan Grass was introduced from Egypt by the U. S. Department of Agriculture. It is recommended for hot, dry climates, but has been

grown quite successfully west of the Cascade Mountains. It is an annual, and like millet, sorghum, etc., the seed must be sown each spring. In appearance it is similar to Johnson Grass, but differs in being an annual, does not have creeping root stocks, and is not difficult to eradicate.

It is sensitive to frost, and seed should not be sown until all danger of frost is past. It may be sown in rows and cultivated, in which case it grows six to nine feet high, and only six to seven pounds of seed is required for an acre; or it may be sown broadcast, requiring sixteen to twenty-four pounds of seed per acre, and growing four to six feet high.

The stems are small and leafy and it makes excellent hay, greedily eaten by all kinds of stock. It yields one to two tons of hay at each cutting and from two to four cuttings may be had in one season. It should be cut as soon as the grass is full headed. It is also good for silage and for feeding green.

SWEET VERNAL, True Perennial (Anthoxanthum odoratum)

For a mixture with pasture grasses, it is valuable on account of its vernal growth, and also for continuing to throw up root foliage until late in the Fall. For meadow its chief merit is the fragrant odor, sweetening the hay. It is a condiment, rather than a grass of much nutritive value. Sow 2 to 3 pounds to the acre with other seeds.

SWEET VERNAL, Annual (Anthoxanthum odoratum, Puelli)

An annual, entirely distinct from the perennial. Of little agricultural value.

TIMOTHY

By Byron Hunter, U. S. Dept. of Agriculture, in Farmers' Bulletin No. 271.

Timothy (Phleum pratense) is the standard grass in Oregon and Washington west of the Cascade Mountains. It is shallow rooted and naturally adapted to moist lands. But the abundant rainfall of this region, distributed as it is through so many months of the year, makes it possible for it to succeed on practically all classes of soils except sands and gravels. There are individual farmers who like other grasses better, but timothy is the one grass that is universally known and grown. It has been the standard market hay so long and has so many valuable characteristics that it will require years for any other grass, even with superior qualities, to become as popular as timothy in this region.

There are many reasons why timothy enjoys this popularity. It has the best seed habits of any of our cultivated grasses. The seed is usually cheap, has a very high percentage of germination when properly matured, is easily harvested, and retains its vitality remarkably well. The hay is easily cured, stands handling well, and is relished by all kinds of stock. Unlike many other grasses, a few days' delay in the time of cutting makes but little difference in the quality of the hay—a very important point in a region where showers are not infrequent during the haying season.

West of the Cascade Mountains timothy is most frequently grown with winter wheat and the clover added in the spring, during February or March, when the ground is thawing and freezing. Another method is to prepare the ground in the spring and sow the timothy and clover with or without a nurse crop. Still another way is to sow the clover in the spring with a nurse crop and in September, after the grain has been harvested, sow the timothy on the stubble. When sown with a nurse crop, timothy and clover are shaded too much, especially if the nurse crop is allowed to mature for grain, and unsatisfactory stands are often obtained in this way. Perhaps the most satisfactory way of sowing both timothy and clover is to sow them without a nurse crop in the late summer or early fall on land that is as free as possible from weeds. Good stands are secured in this way, and they give excellent yields the first year. Timothy is two or three weeks later than red clover, and when they are grown together for hay either the timothy must be cut a little immature or the clover allowed to become too ripe. For this reason some other grasses are better suited than timothy for sowing with red clover. When sown alone from 6 to 10 pounds of timothy seed per acre are sufficient. For a seed crop timothy yields much better when the stand is comparatively thin. A much finer quality of hay is produced when it is thick. It is the general rule to cut timothy for hay just at the end of the blooming period. Cattle prefer the hay when cut at this stage, while horses seem to relish it better if it is a little more mature.

VELVET GRASS

By Byron Hunter, U. S. Dept. of Agriculture, in Farmers' Bulletin No. 271.

The only part of the United States in which velvet grass occurs to an extent worthy of notice is on the Pacific Coast west of the Cascade Mountains, from Northern California to the Canadian line. In that section it is indifferently called velvet grass and mesquite. The latter name should never be applied to this grass, as it is used for several other very different grasses in the Southwest.

It is generally regarded as a pest on the Pacific Coast, particularly on lands that are very wet in the winter and very dry in summer. This is especially the case with both sandy and peaty soils on the coast. It is not utilized for feed in many localities, but on the extensive areas of sandy land around the mouth of the Columbia River and at one or two points inland it is the chief reliance, both for hay and pasture. It yields ordinarily about half a ton of hay per acre. The hay is remarkable for its lightness, a ton of it being much more bulky than a like weight of other kinds of hay. Horses nearly starve before they acquire a taste for velvet grass, but when the taste is once acquired they thrive upon it remarkably well, showing that it is highly nutritious. The whole plant is covered by a growth of wood-like hairs, from which fact the name is derived. It is unworthy of attention except on the classes of soils above mentioned. On these soils it drives out all other grasses.

Velvet grass (Holcus lanatus) is frequently a pest in meadows. The seed matures very early, is light, and shatters readily. When clover, rye-grass and timothy are ready to cut for hay the seed of velvet grass is usually mature enough to germinate. The wind blows the seed, and wherever the hay is hauled or handled the seed is scattered. If a meadow that is infested with velvet grass is cut a little early for either hay or ensilage, the seed can not be spread in this way. Velvet grass gives no trouble in the second crop of clover. Fence rows and waste places beside meadows should be mown early enough to prevent seed from maturing. If these precautions are taken the grass can be prevented from becoming very troublesome.

To eradicate velvet grass cut it early, before the seed is ripe, generally from the 10th to the 20th of June. About the 1st of July give it a thorough but shallow disking. Repeat the shallow disking every week until the 1st of August and then spring-tooth and disk again. This shallow cultivation during the driest season will kill the roots and leave the ground with a very fine mulch on top and plenty of moisture in the subsoil. The land may then be reseeded to clover or planted to any crop desired.

MEADOWS AND PASTURES

By Jared G. Smith, U. S. Department of Agriculture, Farmers' Bulletin No. 66.

The improvement of farm lands by the cultivation of grasses alone without the aid of other thorough cultivation, or without the use of barnyard manures and commercial fertiliz-

ers, would be a slow and tedious process. The land would improve, but it might take half a lifetime to recover the full measure of its original fertility. The indispensable humus may be supplied gradually, or it may be rapidly increased by the judicious use of farm manures, clovers, cowpeas, vetches, peas, alfalfa, or any crop that will yield a large bulk of organic matter.

The subject of commercial manures for grass lands is one on which there is much difference of opinion. So many factors enter into the problem that it is quite impossible to recommend any hard and fast rules as to what to use, how much to apply or when to apply it. We can only state what has been found good for certain soils and certain crops. Soils differ widely in their composition, physical and chemical, even in adjacent parts of the same field, and hence their needs are extremely varied. Pasture lands and hay meadows require different treatment. Land deficient in lime or rich in lime, clay soil and sandy soil, upland and lowland, must each be fertilized according to its needs and the requirements of the crop to be grown. The general theory in fertilizing is this, that certain amounts of the essential elements, nitrogen, potash and phosphorus, must be supplied at the time when needed, and in an available or soluble form. Nitrogen is the most important and at the same time the most expensive. It is also the least stable, and hence should be applied only at such times as it is needed and in quantities no greater than can be used by the crop.

Except in the case of moist soils rich in lime, the use of too much nitrogen at one time is an extravagance, for the surplus rapidly leaches out, or decomposes and passes into the air in the form of ammonia. There is a considerable amount of nitrogen in barnyard manure, and where this is available, as in the neighborhood of towns and cities, it is often the cheapest source of nitrogen and humus. Other sources of nitrogen are ground bone and bone meal, fish scrap, tankage, dried blood, bran, cotton-seed meal, and peanut meal, and leguminous plants such as clovers, vetches and beans grown as green manurial soiling crops. Nitrate of soda is often recommended for grass lands, but is expensive, and so readily soluble that a single hard rain may wash out in a few hours all that has been applied to the land. Bad results follow its use when too large an amount is applied. It has been found by experiment that an application of nitrate of soda does not have much influence on the total amount of nitrogen in a crop of clover or peas, so that in case of either of these crops a heavy application of nitrogenous fertilizer is undesirable. In growing hay for market, bone meal and tankage certainly increase the yield very materially. Ground bone is immediately valuable, not, as has been generally believed, for its content of phosphoric acid, but for its nitrogen, which is in such form that it becomes gradually available during several months, and so acts as a continuous stimulant to the growing crop. Cotton-seed meal has much the same effect, and where it can be obtained at reasonable rates is a good substitute for bone. Tankage, fish scrap, and dried blood are all rich in nitrogen, and nearly approach bone and cotton-seed meal in chemical composition and effect on the growing crops.

Phosphoric acid may be best applied as superphosphate or acid prosphate. Fertilizers containing potash are wood ashes, cotton-hull ashes, kainit, muriate of potash, and ground tobacco stalks. In a clay soil deficient in humus, the surplus of either potash or phosphoric acid does not leach out in the same way as a surplus of nitrogen would, but enters into combination with the clay and is held for the benefit of future crops. Upon the addition of organic matter, lime, or salt to the soil, this surplus of potash or phosphorus is generally broken down and is again transformed into soluble plant food.

The first requisite in starting a permanent meadow is to have the land in good condition. A good meadow ought to last from four to six years and yield an average of three or four tons of hay per acre each year. To get such results it is necessary to put the ground in the very best condition before sowing the seed. In the case of corn, potatoes, or cotton, the crop receives numerous cultivations during the growing season, and the upper soil layers are constantly stirred and loosened to admit air and water. In preparing a field for grass, all of this stirring and mixing and opening of the soil must be done before the seed is planted, and enough of it must be done to last through the full term of years. All weeds must also be got rid of before the grass seed is planted, because there is no satisfactory method of cleaning the weeds out of a meadow, except that of breaking up the sod and reseeding. A fall seeding is most desirable, because the grass may then follow a grain crop, and the soil after plowing may be harrowed and stirred until the weed seeds are all brought to the surface, germinated, and destroyed. The land should be plowed deep, from six to nine inches, and the subsoil should be loosened with a bull tongue or other subsoiling plow to an additional depth of six to twelve inches. Thus the soil will be thoroughly loosened to a depth of twelve to twenty-one inches without turning down the rich surface layers or turning up the sour and sterile subsoil, which is unfit for sustaining plant growth.

The chief advantage of deep plowing and thorough preparation of the seed bed is the consequent thorough aeration of the soil. If available, a large amount of composted barnyard manure should be applied before plowing. Where the meadow is to be a permanent one, a dressing of from twenty to thirty tons per acre of barnyard manure, or as large an amount as is available, may be profitably applied. This seems an enormous quantity to recommend, and would be too expensive were the crop to occupy the land for only one year; but, considering the term of years through which the influence of this amount of organic fertilizer will extend, it will not prove wasteful in the long run. The common method of sowing grass seed with small grain is not a profitable one. It never pays to try to grow two crops on the same land at the same time. Each takes something from the other. All know that when sown with grain the grass crop often fails to catch. The tender young grasses are overshadowed by the nurse crop, and are just as effectually robbed of air and sunshine as if a crop of weeds were grown for protection. The best way is to grow the grain and grass crops separately. The grasses are, unlike the clovers, surface feeders, and thrive best and make the most luxuriant growth when the surface soil is heavily enriched. The deeper the preliminary cultivation and the larger the amount of stable manure or green manure that can be applied to the meadow the greater will be the annual yield and the longer the period during which the meadow will be profitably mowed without breaking up the sod and reseeding.

After plowing, which may take place as early in summer as the ground is free from the preceeding crop, the field should be harrowed and reharrowed until the surface of the soil is worked fine and every weed which has sprung up since the ground was broken has been destroyed. If the farmer does not have the necessary subsoiling plows and cannot stir his field to the depth of twelve to eighteen or twenty inches, the next best thing is to plow as deeply as he can and to make up for deep plowing by thorough mellowing and pulverizing as deep as his turning plows and cultivators will go. It is folly to sow the tame grasses on poorly prepared land, and, worse than that, it is a waste of good seed. The difference between

good and thorough preparation, on the one hand, and shallow plowing and scanty harrowing, on the other, serves as a very good indication of what the yield and the profits will be. The best of seed, of the best varieties, planted on poorly prepared land will give only moderate yields for one or perhaps two seasons. If the same seed had been sowed on a field which, previous to seeding, had been given a deep plowing and the surface thoroughly harrowed and mellowed for the reception of the seed, not only would the yearly yield be larger and the profits greater, but the profitable life of the meadow would be extended through several seasons. The greater cost of good cultivation is thus all concentrated in the first year, and a yield of four tons of hay per acre the first season will cover it. The average yield of hay throughout the middle East does not exceed one and one-half tons to the acre, but under this method of intensive farming, where more attention is paid to the preparation of the seed bed, and where the farmer gives to his hay meadow the same care as to his orchard, or to his onion or potato crops, yields of from four to six tons of hay per acre for half a dozen years in succession have been obtained.

Low-lying, cold and heavy clay soils should be well drained, and if the field is at all swampy there should be a liberal application of lime to improve the texture of the soil and correct any acidity which may be due to the water having driven out all the air. Some form of potash salts should also be applied, as newly reclaimed swamp lands are always deficient in this fertilizer. There are many grasses which will grow on wet soils, but few that will thrive where there is stagnant water. To get best results there must be a circulation of water in the soil. Hence, the surplus should be carried off by drainage. The application of lime helps materially. Besides improving the physical condition of the soil, it unites chemically with decaying vegetable matter and preserves certain valuable plant foods which otherwise would be leached out and lost.

Fallowing and the plowing under of heavy crops as green manure are no longer considered the best and most profitable methods of farming. Turning under large amounts of succulent green forage often proves positively injurious by causing the soil to burn, or sour, through the rapid formation of organic acids. Moreover, there is much needless waste of valuable forage, which might be used to better advantage if it were fed to farm animals. The feeding value of any crop is greater than its fertilizing value. When a crop is pastured or cut and fed in the stable instead of being turned under green, there are two sources of profit to the farmer: (1) The gain in weight or in milk production of the animals fed, and (2) the fertilizers which are returned to the soil. A crop of grass or clover pastured or cut for hay and fed on the farm will not only support enough farm animals to pay for the use of the land, but when the grass sod or clover stubble is finally turned under there will be a large addition to the amount of organic matter in the soil and a resulting increase in fertility due to the fresh supply of humus. The clovers are of great value on the farm, and whether they precede grass, grain, tobacco, or potatoes, the most profitable results are to be obtained by feeding them instead of turning them under as green manure.

Having put the seed bed in the best possible condition, the grass seed should be sown broadcast without a nurse crop. The field should be gone over twice, in two directions, using half of the quantity each time, so that an even seeding may be secured. The ground is then dragged with a light brush harrow and finally rolled. The use of the roller is very important. The packing of the dirt around the seed insures a higher percentage of germination, and the firming and packing of the surface prevents the rapid escape of water and hence loss by drying out of the seedlings.

As in the cultivation of other crops, the quality of the seed has much to do with the success or failure of a meadow. Grass seed as purchased from seedsmen is expensive and sometimes of poor quality, but we believe that many of the failures in establishing meadows, lawns, and pastures have been due as much to the poor preparation of the seed bed, to sowing the seed on lumpy ground when it was too dry or too wet, as to the inferior quality of seed.

Grass seeds are mostly small; they germinate readily and rapidly at the right temperature and in the presence of sufficient moisture. The young seedlings are very quickly affected by abrupt changes of temperature. They require sufficient moisture and an even temperature to make their best growth. No hard and fast rule can be made as to the best time to sow grass seeds, and there is wide variance in practice. It is, of course, useless to sow unless the ground is moist; so that the time will depend much upon the season, whether it be August, September, or October. The seeding should be late enough to escape the intense summer heat and drought and early enough to allow the seedlings to get well established before severe cold weather sets in. In the north, where the rate of annual precipitation is high, the change from winter to summer is gradual, the winters long and severe, and the growing season short, spring sowing is often better than autumn; but farther South, where the change from winter to summer is more abrupt, it is better to sow the seed in autumn, so that the young plants may have the advantage of such growing periods during the winter as will enable them to become well rooted and withstand the spring doughts. Spring seeding on land which is at all weedy does not pay, because the weeds choke out a great deal of the grass. The best treatment of a weedy field would be to plant some hoed crop and get rid of the weeds before trying grass.

SEEDING BURNS AND SLASHINGS

From Farmers' Bulletin No. 271, U. S. Dept. of Agriculture, by Byron Hunter

Dense forests of evergreen timber cover a very large portion of Western Oregon and Western Washington. During the dry season of the year forest fires overrun large areas, killing practically all vegetation, and leaving a loose blanket of ashes on the surface of the ground. These burnt areas if left unmolested for a few years usually produce a dense growth of young trees and brush and are practically worthless for grazing purposes. In clearing land it also frequently happens that the timber and brush are slashed and burnt several years before the stumps are removed. By properly seeding these burnt areas they may be made to produce excellent pasture. Since the stumps are in the ground and there is therefore no chance to cover the seed, the seeding should always be done in the fall before the ashes have settled. The first rain that comes will then cover the seed sufficiently to insure good germination.

Since there is little chance to improve or renew the stand on account of the stumps and timber remaining on the land, only seed of those plants should be sown that last a long time, stand close cropping, and yet produce as much growth as possible. If the seed is sown in the unsettled ashes as indicated, little difficulty will be experienced in getting good stands of white clover, alsike clover, red clover, orchard grass, meadow fescue, timothy, and English rye-grass. A mixture of 1 pound of white clover, 3 pounds of alsike clover, 10 of orchard grass, and 10 pounds of meadow fescue per acre should give satisfactory results when sown in the unsettled ashes in the early fall. Timothy will also do well for this purpose.

GRAIN AND FORAGE CROPS

OATS

By Prof. E. F. Gaines, Cerealist, Washington Agricultural Experiment Station

The oat plant grows along at a moderate rate until it begins to head out, then doubles its length and rushes to maturity in less time than any of the other cereals. It has a vigorous, spreading root system, and will do better on sod or newly cleared land than either wheat or barley. It is best to fall plow, then disk in spring and seed with a drill. Oats may be broadcasted with better results than wheat or barley. Some farmers sow them on stubble land and then plow them under, but this is not considered advisable, for oats will respond to thorough seed bed preparation by increased yields which will well pay for the extra labor. Oats cannot be grown in arid sections where wheat and rye will still produce a crop.

Four to six pecks (40 to 60 lbs.) of seed per acre will produce more grain on the drier uplands than heavier seeding, but eight to ten pecks (80 to 100 lbs.) may be used with profit on the bottom lands. Where the season is shortened, either by cold or drought, the early varieties such as Sixty Day or Kearson will give the largest returns. The later varieties such as Swedish Select or Abundance produce the heaviest crops on the bottom lands. Oats are considered the standard grain for horses the world over, and oat hay is excellent for all stock.

OATS WITH PEAS OR VETCH

By Alf. Christianson

Oats is considered the best grain to sow with peas or vetch for green feed, ensilage or hay. They may also be left to ripen and the oats can easily be separated from the peas. Some farmers who have tried growing peas mixed with oats claim that under certain conditions and on some soils they get a better crop than by growing pease alone. However, the principal reason for mixing them is to form a support for the peas so that they will stand up better and can be more easily cut with the mower, and when used for green feed or ensilage they make a more correctly balanced food.

The proportions of seed to sow depends upon what the crop is to be used for and the condition of the soil. If for grain on bottom land, about eighty pounds of peas and sixty pounds of oats per acre should be sown; on upland less seed should be sown. If to be used for green feed or ensilage the peas and oats should be sown in equal quantities. When vetch is sown with oats, not more than fifty pounds of vetch should be used per acre.

CORN

By Prof. E. F. Gaines, Cerealist, Washington Agricultural Experiment Station

Corn requires more time to mature than wheat, oats or barley. The greatest danger is from cold weather and frosts. The corn plant develops a great number of small fibrous roots just below the surface of the ground which spread in all directions for several feet. Because of this habit corn should be laid by when it is two feet high and the last cultivation should be rather shallow, not to exceed three or four inches.

The field for corn should be plowed in late fall, about eight inches deep, and left rough. If it is not possible to fall plow, early spring plowing should be somewhat shallower and should be harrowed at once. Just before planting, a seed bed should be prepared with disk and harrow to a depth of about three inches. It is important to do this just before planting to give the corn an even start with the weeds.

Corn should not be planted until the ground begins to get warm. The average date to plant is May 10th. This may vary from April 15th to June 1st in different sections of the Northwest. For silage some prefer to drill the seed in rows 3½ feet apart with plants 8 to 15 inches apart in the row. Better cultivation can be given if the corn is planted in hills 3½ feet apart each way. For seed production there should not be over two or three stalks in a hill.

It is important to use only home grown seed, as seed from Illinois or Missouri either will not mature or will produce an inferior yield. Reed's Yellow Dent and Leaming have become acclimated in the warmer valleys of the Northwest, but for the greater part of the country the earlier maturing varieties must be used.

The corn field may be harrowed once or twice before the corn is large enough to cultivate. This will keep the soil loose and kill small weeds as they are coming up, and will reduce the number of cultivations required.

Corn is raised in the Northwest primarily for silage, but it may be shocked and fed as fodder or cribbed and fed as grain in the sections of longer seasonal growth.

CORN IN WESTERN WASHINGTON

By Byron Hunter, U. S. Dept. of Agriculture, Farmer's Bulletin No. 271

The climatic conditions in Western Oregon and Western Washington are not well adapted to the growing of corn. The nights are too cool for its best development, and unless very early varieties are grown difficulty is often experienced in bringing it to maturity. Nevertheless corn fills an important place in the cropping systems of this region, particularly on dairy farms; i. e., for ensilage and for feeding green during August, September and October. While it may be impracticable to grow corn for the grain, it is possible by selecting very early varieties and using seed grown near by to grow a good quality of ensilage corn. The aim should be to grow those varieties that reach as near maturity and yield as much grain as possible. The large southern varieties produce very little grain here, and are so immature when put into the silo at the end of the season that too much acid develops.

Ripe corn yields five times as much dry matter per acre as corn that is fully tasseled; two and two-thirds times as much as corn fully silked; and nearly one and three-fourths times as much as corn in the milk; hence the importance of growing corn for ensilage that will mature.

In order that ensilage may keep well, corn should be cut about the time the kernels are well glazed and dented. If it is cut too green, as stated, too much acid develops; if cut too ripe it does not settle properly and the air is not sufficiently excluded to prevent spoiling. The ripest corn should always be cut first and placed in the bottom of the silo, because the great pressure near the bottom will tend to exclude the air.

If planted on rich, mellow, well-drained land between the middle of May and the first of June, corn should be ready for feeding green from about the first to the fifteenth of August. As previously stated, early varieties should be planted, and seed grown west of the Cascade Mountains succeeds better than eastern seed.

WHEAT

By Prof. E. F. Gaines, Cerealist, Washington Agricultural Experiment Station

Wheat is the standard grain crop of the Northwest. It is grown under wide variations of temperature, elevation and rainfall. Fall wheat should be drilled in at the rate of from three to six pecks (45 to 90 lbs.) per acre on a rather loose cloddy seed bed. Spring wheat does better when drilled in early on a seed bed that is rather firm below the first two or three inches. Harrowing wheat is of doubtful value unless the ground is badly crusted or foul with mustard or other weeds.

There are fifty or more varieties of wheat grown in the Northwest, but most of them are inferior and should be discarded. The country seems to be in a transition stage just now as is shown by the introduction and sudden popularity of several new strains as Marquis (hard red spring), Early Baart (soft white spring), and some of the Club Hybrids. As a rule, winter wheat yields more than spring wheat. For silage or hay wheat should be cut in the dough stage, but for grain it should be well matured.

RYE IN WESTERN WASHINGTON

By Prof. E. B. Stookey, Agronomist, Washington Agricultural Experiment Station

Rye is often considered as a last resort crop to be grown on soils too poor to grow anything else. It is always a vigorous growing crop and in this section is at its best. The large amount of growth it will produce and the many uses to which it can be put are causing it to be more widely grown in Western Washington each year.

Rye is adapted to a wide range of soils, but like most other crops does best on the more fertile areas. It is well suited to Western Washington generally and one trial will usually show it to have some place in the cropping scheme. There are very few farms where it will occupy a prominent place, but on many farms it will be found to have considerable merit.

Uses. The principal uses to which rye is adapted may be enumerated as follows: Winter cover crop, green manure, early green feed (soiling), late fall and early spring pasture, silage (seeded with spring vetch), hay and grain.

Winter cover crop and green manure. These two uses may well be considered together. For such purposes rye is especially valuable as it is a quick-growing crop and will make considerable growth during the late fall and early spring months when most other crops are dormant. While rye is not capable of adding more plant food to the soil than is used in its growth, it is a real conserver of plant food as it uses the available plant food at a time when other crops cannot, and thus prevents this plant food from washing or leaching away. If the growth is plowed under it builds up the organic matter content and thus improves the physical condition of the soil. The orchardist, the berry grower, and any other farmer who is accustomed to allowing his soil to lay bare during the winter, will do well to seed down to rye if the physical condition of his soil will be improved by the addition of humus. This is particularly true where the organic matter cannot be supplied by barnyard manure. For this purpose winter rye should be seeded at the rate of one and one-half to three bushels (84 to 168 lbs.) per acre as soon as the soil can be put into shape after the crop is off, or any time after September first. The growth should be plowed under early enough in the spring so there will be sufficient moisture to bring about decay. This sort of procedure is more applicable to bottom land than to upland. The upland farmer will usually seed what crops he can in the fall or prepare his land so he can do very early spring seeding. For cultivated crops, however, that cannot be seeded until early summer, a crop of rye to be turned under for green manure will be found to be of considerable value.

Early green feed (soiling crop). An early soiling crop is of great importance to the dairy farmer. Perhaps no crop grown in Western Washington is ready for green feed as early in the spring as rye. Seeded early in the fall

rye can usually be expected to be two feet or more high by the middle of April, and by the first of May it should be heading. A small field of rye will furnish green feed when it is badly needed. When cut early in the spring the rye comes on again at once. A better second crop for green feed or pasture will be secured if twenty to thirty pounds of spring vetch per acre is seeded with the rye.

Fall and early spring pasture. Fall-seeded rye can often be pastured without injury to the crop if the soil is not injured by pasturing and if it is not pastured too close. If a crop is expected from the rye it should not be pastured after it starts to joint. Where the rye is to be used primarily for pasture on the better soils one or two pounds of Dwarf Essex Rape to the acre will add to the value of the pasture, but on ordinary upland soils it will not be of much value. Rye should be seeded a little heavier for pasture than for other purposes. Seeded between the corn rows just previous to the last cultivation, rye will afford considerable pasture after the corn is harvested.

Silage. One of the uses made of rye in Western Washington is for fall seeding with spring vetch for silage purposes. A crop of kale or some other crop may often be grown after the silage crop is taken off. The rye is ready for silage when it is in the milk. This will usually be before the last of June. A practice very often recommended is to allow the crop to wilt for some little time in the field before it is cut into the silo. The rate of seeding should vary with different soils, but a good general recommendation is one and one-half to two bushels (84 to 112 lbs.) of rye and twenty to forty pounds of spring vetch. The principal objection to the mixture of rye and vetch is that the vetch does not mature as early as the rye.

Hay. Rye is not used for hay to any considerable extent in Western Washington. It should be cut for hay at about the time the blossoms fall. For fall-seeded rye this will be about the middle of June, and hay weather does not generally prevail at that time. More and better hay will probably be made from spring-seeded oats or oats and peas.

Grain. Rye is not yet raised to any extent in Western Washington for grain, but some sections are beginning to grow it for that purpose. Where more rye is grown than is needed for other purposes it may very well be left for seed.

Varieties of rye are not very distinct, but there are varieties of both the fall or winter and spring types. The winter varieties are the only ones that are much used in Western Washington.

Seeding. The rate of seeding varies from one and one-half to three and one-half bushels (84 to 196 lbs.) per acre. Generally speaking, the more fertile the soil the heavier the seeding. On some of the upland one and one-half bushels (84 lbs.) is a great plenty, and on the heavier, more fertile bottom land heavier seeding may well be used, particularly if the seed is quite large.

RYE

By Prof. E. F. Gaines, Cerealist, Washington Agricultural Experiment Station

Rye is one of the hardiest of the cereals. There are both spring and winter varieties. Winter rye sown in the spring makes an abundance of green pasture all summer long. Rye grows a great amount of straw and chokes out weeds better than other grains do. It is the only crop in the arid sections that can compete with Jim Hill Mustard and Russian Thistle. Less care need be taken in preparing a seed-bed than for other crops, although it responds to good cultivation quite readily.

Rye shatters badly if allowed to stand until it is over-ripe. It should be cut for hay when the grain is in the milk as the beards become stiff and barbed shortly after this time, and the straw is more fibrous.

EMMER

U. S. Department of Agriculture, Bulletin No. 139

This grain is incorrectly called by various names. Even in certain reports of results of experiments with emmer it is sometimes called spelt. The names "spelz", "speltz", and "spiltz" are also often used. True spelt is a radically different sort of grain, and is not grown at all in the United States.

Emmer is a species of wheat known botanically at Triticum diococcum (T. amyleum). The plants of this species are pithy or hollow, with an inner wall of pith; leaves sometimes rather broad and usually velvety hairy; heads almost always bearded, very compact, and much flattened on the two-rowed sides.

One of the characteristic qualities of this cereal, which commends it at once to cultivators, is its ability to make a good crop with almost any condition of soil or climate. It will thrive also on poor lands, in stony ground, in forest regions, and on the prairies. There are, however, certain conditions of soil and climate under which it always gives the best results. In general, the best emmer is produced, and in largest quantities, in prairie regions having a dry climate with short, hot summers.

From the trials so far made with emmer, both at the experiment stations and on farms, as well as the plat experiments of this department, one may draw the following conclusions with respect to its success in cultivation in this country: (1) it is most successful in the Great Plains region, particularly the northern portion, in the Palouse country, and in northern portions of the irrigated districts; (2) in other parts of the country, however, it will often compare well with other crops, and is especially able to escape damage from continued wet weather at harvest time; (3) it stands up well in the field; (4) it is usually very resistant to the attacks of leaf rust, smuts, and other fungi; (5) it is very resistant to drought; (6) in districts where it is otherwise adapted it gives excellent yields; (7) true winter varieties, of which there are many, resist rather hard winters.

The uses of emmer are yet in an experimental stage in this country, but the indications so far are that it will become a regular and valuable crop for stock feeding. The grain is said to compare well with oats and barley for this purpose, while the straw is considered by some to be of much value.

Very little need be said on the cultivation of this grain. It is probably the least exacting of all cereals in methods of cultivation. It will occasionally be found to be of particular advantage as a sort of intermediate crop when the soil has become exhausted by the growth of other exacting crops. In the North the usual methods of cropping with spring grains should be followed. As with other grains, it will, of course, give better results on ground plowed the previous summer. A summer fallow, however, is not required, and would simply be wasteful. The seed should always be drilled, and at about the same rate per acre as for oats.

EMMER

By Prof. E. F. Gaines, Cerealist, Washington Agricultural Experiment Station

Emmer is a variety of wheat which retains the hull when threshed. It is considered more hardy than other varieties of wheat, but it is not grown much commercially. The same cultural practices may be used for emmer that are used for wheat. The crop is of questionable value and will probably not increase in popularity.

BARLEY

By Prof. E. F. Gaines, Cerealist, Washington Agricultural Experiment Station

Barley may be planted either in fall or spring. It winter kills more easily than wheat, however. The straw is somewhat weaker than that of wheat or oats and for that reason it is liable to lodge when seeded on moist rich bottom lands. On the average it yields three hundred pounds more per acre than wheat and two hundred and sixty-four pounds more than oats. The counties of greatest barley production in Washington are Columbia, Garfield, Whitman, Lincoln and Walla Walla, ranking in the order named.

For winter barley, plow seven inches deep and drill in without working the soil, as a rough winter surface holds the moisture better than a thoroughly pulverized one and it will not run together so with the winter storms. For spring barley the soil should be plowed in the late fall or early spring, six to eight inches deep, and a good seed bed prepared by harrowing or disking till the surface is loose but the sub-surface down two or three inches is reasonably firm. Spring barley should be seeded as early as the ground is fit to work. This varies from the middle of February for the drier uplands to May 1st in the wetter lowlands. One bushel (48 lbs.) per acre is sufficient to sow in the drier sections of the Northwest, but as much as two bushels (96 lbs.) should be seeded in the fertile lowlands of the coast. The six-row bearded varieties yield the most grain, but for hay or for hogging off the Nepal or beardless varieties are more satisfactory.

Barley should be cut for grain when the joints of the stems begin to turn brown, but for hay it should be cut when the grain is in the dough stage. Barley is principally grown for grain, but it may be grown to a good advantage for either hay or silage, or may be planted with peas or vetch and hogged off.

VETCH, COMMON OR SPRING

By Byron Hunter, U. S. Dept. of Agriculture, Farmer's Bulletin No. 271

The common vetch (Vicia sativa) is perfectly adapted to conditions west of the Cascade Mountains in Oregon and Washington and thrives on very poor soil. It has been grown in the Willamette Valley for many years, and is rapidly replacing red clover in many localities. It is an annual legume of great value as a nitrogen gatherer, as a green manure, and as a soiling, hay, and pasture plant. It is also a very valuable cover crop in orchards when sown in the early fall. It makes excellent ensilage, and dairy cattle prefer the hay to that of red clover. The yield of cured hay is from 1½ to 4 tons per acre. A seed crop yields from 15 to 30 bushels per acre, the yield depending quite largely upon the efficiency with which the seed is saved. A bushel of clean seed weighs a little more than 60 pounds.

Common vetch stands the winters admirably in Western Oregon and Western Washington, and is sown in the autumn from the last of August to the last of November. It is sown also in the early spring, but fall seeding usually gives the largest yields. The stems of this vetch are not strong, and heavy crops are inclined to flatten out on the ground. When in this fallen condition it soon begins to mold and is very difficult to harvest. To furnish support for it and keep it up off the ground a bushel of oats, wheat, or rye, and a bushel of vetch per acre are usually sown together. Oat hay, especially for dairy purposes, is usually prefererd to that of wheat or rye, and for this reason oats are usually sown with vetch, winter oats being sown in the fall and spring oats in the spring. It is a common practice with vetch growers to sow winter oats and vetch broadcast in the early fall on land that has raised a spring crop to cover the seed with a disk harrow. If the land is loose and easily worked, this method gives good results, but like most other crops vetch gives much better yields if sown on a well prepared seed bed. If the ground is packed, or if the seeding is done in the spring, the land is usually plowed and a good seed bed prepared.

Sown with rye the last of August or early in September, common vetch should be ready for soiling, i. e., feeding green, from April 15 to May 1; sown with winter oats or wheat October 1, it should be ready about May 1; sown with winter oats or wheat in the late fall, it should be ready about June 1; sown with oats in February, it should be ready about June 15. When cut in the early spring for soiling a second crop may be cut or pastured, or the land may be plowed and planted to some other crop.

Since fall-sown vetch matures for hay in June and rains are not infrequent at this season of the year it is quite a common practice to pasture it in the early spring—March and April—to keep the growth from becoming so heavy that it will fall before it is cut and to retard its development so that haymaking will occur after the rains are over. If the crop is heavy and falls during bad weather it is best to make ensilage of it immediately.

When the seeds are just appearing in the first pods is usually considered the best time to cut vetch for hay. Some cut it earlier than this, while others allow the first seeds to become pretty well mature. If the crop is not too heavy it may be handled in the ordinary way, but it should be put into cocks before the leaves are dry enough to be broken off during the handling. When very dry it falls more or less, and usually in some prevailing direction. When in this fallen condition the rear of the sickle bar of the mower is usually raised and the guards tilted down. Sometimes a man follows the mower with a strong pitchfork and when the vetch clogs he sticks the tines of the fork into the ground just behind the sickle bar and pulls the vetch loose.

Others cut vetch in but one direction, the opposite way from that in which it is leaning, driving the mower back idle each trip. Men with forks throw each swath out as it is cut, so that the mower can get through without the vetch clogging on the sickle bar. Another way is to cut a swath and with forks roll it on the uncut vetch; cut another swath and roll the two cut swaths on the uncut vetch; cut again and roll out the three cut swaths. This process forms windrows of three swaths each.

With the vetch fallen in one prevailing direction, others cut one way only, driving the mower in such manner that the fallen vetch will point forward and away from the direction driven at an angle of about 45 degrees. A little experience will enable one to determine the proper angle. When the cutting of a swath is finished the sickle bar is raised and the mower thrown out of gear and driven back on the swath just cut to mash it down and make a path for the shoe of the sickle bar with the wheel of the mower. With the rear of the sickle bar raised, the guards tilted down, the vetch lying in the direction indicated, and the last cut swath lapping up on the uncut vetch and mashed down by driving the empty mower back over it, the inner wheel of the mower, as the next swath is being cut, runs upon the swath just cut and holds it so that the shoe of the sickle bar slips over with little or no clogging. In this way the swath upon which the wheels of the mower are running is cut in two again and another clean swath is also cut at the same time. Cutting each swath in two makes the handling of the hay much easier. After being cut the hay may be cured and handled in the usual way.

VETCH, HAIRY OR WINTER

By Prof. E. F. Gaines, Cerealist, Washington Agricultural Experiment Station

Winter vetch (Vicia villosa) is a biennial, as the name suggests, and should be planted in the fall. It is usually seeded with winter wheat, rye or barley, thirty pounds per acre, drilled in with from thirty to sixty pounds of grain. The seed bed should be rather rough and preferably freshly plowed. The vetch seed should be inoculated just before planting with nitro-culture from some reliable firm or state institution to insure nodule formation on the roots, so essential for the upbuilding of the soil and the increase in protein of the crop growing with it.

A vetch and grain mixture makes excellent hay for stock. Winter vetch seeded in August or September makes one of the best cover-crops for orchards. Plowed under in the spring it adds greatly to the fertility of the soil. It is essential to cut it before it becomes over ripe, for seed production, as it shatters very easily. It may be harvested with the mower with the lifter-buncher attachment, and threshed with a threshing machine in much the same way that field peas are handled.

PEAS, FIELD

By Byron Hunter, U. S. Dept. of Agriculture, Farmer's Bulletin No. 271

Field peas (Pisum arvense) are well adapted to the conditions of Western Oregon and Western Washington. They do well on a large variety of soils, but are especially adapted to clay soils and alluvial bottoms. They are grown for grain, hay, ensilage, and soiling. Peas are nutritious, and the hay and ensilage are eaten with relish by most kinds of stock. When grown for hay about 2 bushels of peas and 2 bushels of oats per acre are sown together as early in the spring as the condition of the ground will permit. When sown at the same time the oats often choke out the peas. This may be largely avoided by sowing the peas first, preferably with a drill, since the seed is difficult to cover, and when they have sprouts on them about 2 inches long drill in the oats. This will give the peas the start and they will hold their own much better. If sown broadcast they should be well covered with a disk harrow. Peas should be cut for hay when the seeds in the first pods are just ready for table use. Sown in the early spring they mature for hay from the 1st to the 15th of July. The yield is from 1½ to 4 tons per acre. When harvested for seed the yield is usually from 25 to 30 bushels per acre. Peas are often sown alone and harvested when mature by swine turned into the field.

The pea weevil often does considerable damage to the pea crop, especially when grown for seed. When sown late, peas suffer much more from the ravages of this pest than they do when sown early. Since they stand considerable frost they should be sown as early in the spring as the season will permit. Of late years peas fail in some localities from other causes than the weevil. They assume a pale, sickly appearance and yield and quality of the hay are very unsatisfactory. In localities where this happens common vetch and pearl vetch should be grown instead of peas, for they are sure crops and are equal or even superior to peas in practically every way as a forage plant.

THE FIELD PEA

By Dr. Jas. Withycombe, Director Oregon Experiment Station

This is a forage plant that is greatly neglected in the Northwest. There is undoubtedly a wide field of usefulness for this forage plant in the strictly wheat producing section east of the Cascades. Peas should be sown occasionally as a rotation crop with wheat. This will bring up the organic matter and thus insure the continuous production of good crops of wheat. With plenty of humus in the soil there will be much less danger from injurious results from drought. Humus improves the moisture-holding capabilities of the soil. There is nothing better for adding humus to soil than a pea crop. The field pea may be utilized for hay, or silage, and the pea is one of the very best hog foods grown.

Peas flourish in a cool, moist climate, hence east of the Cascades they should be sown very early in the spring, just as soon as the land can be worked. Sow about two bushels per acre, drilling them in about three inches deep.

FIELD PEAS IN IDAHO

By Prof. N. S. Robb, Cerealist, Idaho Agricultural Experiment Station

The field pea requires a cool growing season, and is, therefore, adapted to the regions of the state with high altitudes and cool nights. Light frosts, except at time of blossoming, do not injure it. A hot growing season is not favorable to its development and if excessively hot weather occurs during the latter stage of its growth the yield may be seriously affected. It succeeds best in regions with fifteen inches or more of rainfall, but some varieties are better adapted to dry land conditions than others.

A fairly fertile soil is best suited to the crop, especially if it is desired for seed. Where the soil is excessively rich and there is an abundance of moisture, the crop will tend to produce a heavy growth of vine and a small amount of seed; on poor soils and soils lacking in moisture the growth of the vine will be short and the yield of seed small. The land should be well drained and neither too acid nor too strongly alkaline. On poorly drained soil or where water stands late in the spring the crop will be a failure.

Because of the generally favorable climatic conditions, it may be said that the field pea is adapted to any portion of the state where there is sufficient moisture. It can be successfully grown under irrigation.

Field peas may follow any crop in rotation provided the land is not seriously infested with weeds, especially with wild oats. It is advisable to plow the land for peas in the fall and then to disk early in the spring. This not only allows early seeding, which is so essential in obtaining a large yield of seed, but provides a greater storage capacity for soil moisture. If the land is plowed in the spring, the plowing should be done as early as possible, otherwise seeding may be delayed. While a well prepared and finely pulverized seed bed is not so essential for peas as for small grain, such preparation aids greatly in obtaining a large yield of seed.

Where field peas are grown on land for the first time, one should not fail to inoculate the field or seed before palnting, as this treatment tends to increase the yield greatly.

The time of seeding is one of the most important factors governing the yield of the crop. The seed should be planted as soon as the heaviest frosts are over. If delayed the yields will be greatly reduced. Results of trials at the Experiment Station at Moscow with early, medium (ten days later), and late (twenty-one days after the early) plantings, show for the year 1915 a difference in yield of ten bushels to the acre are in favor of early seeding. The late seeding did not produce enough seed to warrant harvesting. The same suggestion applies where the crop is to be grown for forage. The time of planting recommended

for the northern section of the state is from April 1st to 15th.

The size of the seed greatly influences the rate of seeding. Best results are obtained by seeding the small seeded varieties as White Canada, Bengalia, and Carlton at the rate of from sixty to eighty pounds to the acre. Varieties with medium-sized seed as Kaiser and Blue Prussian should be seeded at the rate of eighty-five to ninety pounds to the acre.

In the drier sections of the state the rate of seeding should be decreased from ten to twenty per cent. When the crop is grown for hay or forage purposes, the rate of seeding may be slightly increased. Where too small an amount of seed is used the stand will be so thin that weeds will become troublesome. When planted too thick the yield of seed will be decreased.

Results from recent trials at the Experiment Station show that drilling is one of the best methods of seeding, but the seed may be broadcasted and disked or harrowed in with fair results. A method which is used in ease spring plowing has been delayed is to sow the seed broadcast on the field and then to plow under to a depth of four or five inches. In fairly light soils this method gives good results as it allows an earlier seeding. The use of the harrow sometimes results in poor covering of the seed and a consequent lack of uniformity in the stand. If the seeds are covered much deeper than five inches many of them will fail to send sprouts above the ground.

Where the field is very weedy, and particularly where wild oats infest it, it may be advisable to seed the peas in rows fourteen to twenty-one inches apart. This permits of cultivation and the eradication of the weeds. In such fields it is also well to disc before seeding, and if the weeds start before the crop is up, harrowing is advisable. Cultivating the crop at an early date is of advantage in holding the weed growth in check. Where peas are planted in rows they do not yield as well as drilled peas in the northern section of the state. In the southern portion in some instances as good yields have been obtained from the seed planted in rows as from those seeded with a drill. If profitable yields can be obtained by growing peas as a cultivated crop they will be of value in eradicating weeds and as a summer fallow crop in regions of scant rainfall.

The ordinary grain drill set for sowing one bushel of oats will seed one bushel (60 lbs.) of medium-sized peas. If set for two bushels of oats it will sow two bushels of medium-sized peas. If set for intermediate amounts of oats the seeding of peas will vary accordingly. One should always take into account the size of the pea seed before setting the indicator.

In growing peas for forage, and particularly where a hay or silage crop is desired, they are generally sown with a small grain crop. Where peas and oats are seeded the rate of seeding is generally about seventy pounds of medium-sized pea seed and thirty-two pounds of oats. Good results are obtained by seeding the peas seven to ten days ahead of the oats and then drilling the small grain crosswise. This, however, is a more expensive method. Where small grain is seeded thicker than the above, the grain tends to crowd out the peas, thus reducing the yield. The mixture should be cut when the small grain is in the dough stage to obtain the largest yield of forage.

The crop when grown for seed should be harvested when the seeds are beginning to harden in the pods. If the harvesting is delayed too long a great deal of the seed will be lost by shattering. As the pea vines mature they fall down and that makes it difficult to cut the crop with an ordinary mower. It is advisable to use a pea harvesting attachment. This attachment lifts the vines above the sickle bar and allows practically all the vines to be cut. The attachment also windrows the vines, and that results in the saving of a great deal of seed which would otherwise shatter or be trampled out by the hoofs of the horses. It is well to handle the crop as little as possible after cutting in order to prevent shattering. If the vines are in windrows, or bunched, they can be hauled directly to the machine for threshing when cured.

The crop can be threshed with a common threshing machine. To reduce to a minimum the percentage of cracked seed, the larger portion of the teeth should be removed from the concaves of the machine, and the speed of the machine reduced. Where the crop is to be sold for seed, exceptional care should be used to prevent cracking. In regions where peas are grown extensively, special pea-hulling machines are used.

The field pea as a crop can be used in many ways. The seed has a very high feeding value when ground and fed mixed with small grains. It is better to mix peas with some other feed, as barley, the meal being too heavy to feed straight. As the seed is high in protein, it is excellent feed for dairy cows and for young growing stock.

The straw is of value for roughage during the winter. The crop can be pastured or hogged off very successfully. During the past season the Animal Husbandry Department of the University hogged off a field of peas that yielded eighteen to twenty bushels to the acre and obtained very satisfactory returns.

Peas can be grown for a hay crop either alone or with a mixture of small grains. The feeding value of the pea hay compares favorably with alfalfa hay, and when grown in a mixture the yield is generally larger than for timothy in many sections of the state.

The growing of field peas as a seed crop has been very profitable on many farms where the seed has been kept pure. Conditions which have made this practice profitable may continue for several years. But one is not warranted in making it one of the main crops. The seed is sometimes used the same as beans for food. Where peas are grown mixed with small grain, the crop can be used as a silo crop. The yields run six to ten tons to the acre. The mixture makes a better balanced ration, is harvested more easily, and keeps better than when the pea crop is siloed alone.

The field pea is an excellent cover crop for an orchard. One of the chief reasons that has prohibited the more general use of it in this manner has been the high price of seed.

When peas have been grown in rotation the following or succeeding crops have been given a large increase in yield. Where summer fallowing is practiced the field pea could be grown on the fallow and greatly increase the returns besides adding to the fertility of the land. This is a practice that should be encouraged over the dry land regions of the state.

BEAS

By Alf. Christianson, Field Man, The Chas. H. Lilly Co.

While the value of beans and peas as food for man and stock has been known for many generations, it is only recently that the value of these crops as soil renovators and fertility restorers has been definitely proved. Beans planted as a rotation crop will secure a sufficient quantity of nitrogen from the air to replenish that taken from the soil by other agricultural crops.

As beans are among the few leguminous plants that provide food for man and animals and at the same time increase the fertility of the soil, they are one of the most desirable crops to grow in the farm rotation. This crop is especially beneficial and profitable in Eastern Washington where, to give the soil a needed rest, much of the land must be summer fallowed. By growing beans or peas on this

land the land will be made better for the following years crop of grain and at the same time will produce a profitable crop. This is of special advantage to the farmer who has only a small acreage, making it unnecessary for any part of the farm to lie idle.

There are two important divisions of the bean industry; namely, the production of garden beans and the production of field or dry beans. In the former is involved the growing of podded beans for market, string or snap beans for the cannery, and growing beans for seed. When growing for seed it is essential to have a contract with a seed house, for seedsmen require that the seed stock must be furnished by them and that they have supervision over the growing.

Garden beans are divided into bush and pole types, and these into kidney and lima types. The kidney type is the best known and most successfully grown in the Northwest, and is divided into two groups, wax or yellow podded and green podded.

The varieties of field beans best known and most successfully grown in the Northwest are the Small White or Navy Bean, the Large White or Lady Washington, and Bayos or Brown Bean. There are numerous other varieties, some of which have been grown in this country with more or less success, as Broad Beans, Soy Beans, Pea Beans, and Cow Peas. Cow Peas more closely resemble beans than peas, both in habit and appearance.

While the successful growing of field beans is to a very considerable extent determined by soil and climate, the production of garden beans is not so much influenced by these factors. If the location is such that a ready market can be had for green beans or beans for canning, the farmer or gardener is enabled to take advantage of that portion of the year when the climate of his location is most favorable for the production of this crop.

In the localities where beans are most extensively grown commercially in this country, the soils, as a rule, carry large quantities of lime and considerable potash, phosphoric acid, and organic materials. It is therefore not strange that this crop which is able to gather nitrogen from the air should thrive well upon soils having an abundant store of phosphoric acid and potash. While beans do well upon strong clay soils, yet the clay loams, shales, and gravelly soils are better adapted to the production of this crop. The volcanic ash soils of Eastern Washington and Idaho are ideal for bean growing.

The bean, being a warm season crop, should not be planted until all danger of frost is past. This gives the grower opportunity to do late cultivating, thoroughly working the ground into a mellow condition and fitting the land for the seed. By late cultivating, the weeds can be more successfully destroyed. The field should be made smooth and fine so that the drill or planter can be used economically. A good plan is to use a heavy roller before planting. In addition to making a smooth surface, this will help to retain moisture in case dry weather follows planting.

A bean planter or double row corn planter is the proper tool to use for planting, but a grain drill may be used by stopping all but two or three tubes to make the rows thirty to thirty-six inches apart. The quantity of seed required per acre varies with the size of the beans from about thirty pounds of the small varieties to sixty pounds of the large garden varieties. The depth of planting varies according to soil and season. In heavy soil they should be planted comparatively shallow, about one and one-half inches; on light soil and early in the season they should be planted about three inches deep.

Frequent shallow cultivation is required, stirring the soil to a depth of two or three inches, to destroy weeds and conserve moisture.

For harvesting large acreage a bean harvester should be used, cutting two rows at a time and throwing them together. With a machine of this kind there is hardly any loss by shelling. When dry they are bunched and hauled to the stack or thresher. Care must be taken that the beans are sufficiently dry so that they will not mold.

Small fields may be threshed with flails, but a bean thresher should be used when they are grown extensively. An ordinary threshing machine will not do for it will split the beans too badly.

For cleaning beans, a good fanning mill may remove dirt, sticks, and some split beans very satisfactorily, but a specially constructed bean cleaner is necessary to clean them thoroughly.

MILLET

By Prof. E. F. Gaines, Cerealist, Washington Agricultural Experiment Station

Millet is used as a catch crop where some other crop has failed, as it is one of the quickest crops to mature. It requires hot weather to germinate, and produces a good crop when planted as late as June or July. It should be planted shallow, about one inch deep, on a rather firm seed bed.

Millet makes very rich hay if cut just as the last heads are out of the boot. For seed it should be cut rather green (the leaves and stems are still green after the seed is mature) and allowed to cure in the bundles, which should be shocked in bundles two and two.

FETERITA

By Prof. E. F. Gaines, Cerealist, Washington Agricultural Experiment Station

This interesting grain sorghum refuses to head out at Pullman, Wash., but produces a great number of leafy stems much like winter wheat planted in the spring. Down along the banks of the Snake River, at two thousand feet less elevation and an average of fifteen degrees higher temperature, it matures well and has been known to produce as much as forty bushels of seed per acre.

Feterita should be seeded about ten days later than corn, and given frequent shallow cultivation. It is more drought resistant than corn and has some promise where the climate is too dry for corn. It should be planted in rows three and one-half feet apart and the plants should be about eighteen inches apart in the row for seed or about six to ten inches apart if the crop is to be cut for fodder or silage.

KAFFIR CORN

By Prof. E. F. Gaines, Cerealist, Washington Agricultural Experiment Station

Kaffir is one of the largest of the grain sorghums. It requires a longer, warmer season to mature than Feterita or Milo, but produces a greater yield under favorable conditions. It is important to have a well compacted seed bed with a three inch freshly worked mulch when the seed is planted. Frequent shallow cultivation until the time to lay it by should be given. It may be harvested and fed as fodder much like corn, or it may be headed and threshed with an ordinary threshing machine with part of the concaves removed to prevent cracking.

BROOM CORN

By Prof. E. F. Gaines, Cerealist, Washington Agricultural Experiment Station

Broom corn will mature a crop in a colder climate and on less rainfall than any of the other sorghums. The soil should be worked in early spring to conserve moisture, then again just before planting to destroy weeds. It is usually planted about ten to fifteen days later than corn. It should be planted rather thin to get a uniform salable product. One and one-half pounds of viable seed should be sufficient to plant an acre. The cultivation should be much the same as for corn; shallow, flat, frequent cultivation is best, as the large feeding roots lie near the surface.

SORGHUM

By Prof. E. F. Gaines, Cerealist, Washington Agricultural Experiment Station

The forage sorghums are still in the experimental stages in the Northwest. There is some indication that some of the earlier maturing varieties will become acclimated and prove of value in the drier, hotter valleys of this country. Seed bed preparation and cultivation is the same as for corn; i. e., a well compacted soil with a two to four inch mulch worked just before planting. If the soil is fall plowed it should be harrowed in early spring to kill weeds and conserve moisture, then again as the spring rains cause the surface to become crusted. Harrowing is preferred to cultivating until the sorghum is three to four inches high. This should be followed by frequent shallow cultivations. Sorghum hay or sorghum fodder is more difficult to cure than other hay, therefore more time must be given for curing.

BUCKWHEAT

By Prof. E. F. Gaines, Cerealist, Washington Agricultural Experiment Station

Buckwheat may be grown on rough, poorly prepared land, but will respond to better treatment with an increase in production. The land should be plowed early to allow time for the vegetation or manure which is plowed under to decay. Occasional harrowing before planting is advisable to conserve moisture. Seeding should be delayed until the soil is warm, as buckwheat is very sensitive to frost. June is the month to seed. Shallow seeding with a drill, four pecks (52 lbs.) per acre, gives the best results. The variety known as Japanese Buckwheat is hardier than other varieties for the Northwest. The crop is usually harvested with a binder shortly after the first blooms have matured seed. It is well to cut in early morning or on cloudy days to prevent shattering. This crop is used principally for bee pasture, but the meal from the seeds makes excellent hot-cakes.

SOY BEANS

By Prof. E. F. Gaines, Cerealist, Washington Agricultural Experiment Station

Only the earliest varieties of soy beans are grown successfully in the Northwest, as they are very sensitive to frost and require a relatively hot season to mature, much like the sorghums. Soy beans do best when planted in rows and cultivated. Much the same method of culture is used for soy beans that is used for raising common beans. The stems are woody and of questionable value for roughage, but the seeds are rich in oil and are considered a very concentrated food. Soy bean oil is extracted from the seeds and is used as a substitute for linseed oil in the preparation of paints. Soy bean meal is the basis of many choice dishes served by the Chinese and Japanese.

FLAX

By Prof. E. F. Gaines, Cerealist, Washington Agricultural Experiment Station

Flax is easily injured by frost but is adapted to the cool northern part of the temperate zone. The seed deteriorates rapidly, and heats in the bin unless very well cured and thoroughly dry.

The land for flax should be plowed as long before seeding as possible to allow the seed bed to settle together. Just before seeding the ground should be harrowed so that a shallow mulch about an inch deep is obtained. The seed should be drilled one to two inches deep at the rate of two to four pecks (28 to 72 lbs.) per acre for seed, or four to eight pecks (56 to 112 lbs.) for fiber. It should be planted about the same time as corn or slightly later.

KALE, THOUSAND HEADED

By Prof. H. B. Scudder, Agronomist, Oregon Experiment Station

A deep, well drained rich loam soil is best for this crop hence the ordinary valley silt loam soil, if well drained, thoroughly tilled, and heavily manured, will produce excellent yields. A long, narrow, slightly sloping field running alongside a piece of sod ground, or a wide sodded fence row, or one of the farm lanes, is preferable, as the hauling then may be done on the firmer ground during the wet winter weather. The kale should not be planted on the sod ground itself, however, as this often leads either to injury from cutworms or from drying out of the soil where the sod is not thoroughly broken down.

The kale ground should be heavily manured and deeply plowed in the fall if possible, and replowed once in the early spring and again before trans-planting. If fall plowing cannot be done, manuring during winter and spring and deep early spring plowing and discing, repeated twice before transplanting, will put the ground in good shape. Following the second plowing and discing the ground should be kept clean of weeds and thoroughly mulched to conserve moisture by frequent light harrowing until transplanting time.

For transplanting the seed should be sown in drill rows about three feet apart, as early in March as it is possible to get on the ground. If possible a strip of the best drained ground on the farm should be used for growing the young plants, and this should be manured and plowed in the fall so that it need only be replowed and worked down at once for seeding in the early spring, thus getting the plants started as early as possible. On sandy loams the seeding need not be done so early, unless very early fall feed is desired. One pound of seed will furnish more than enough plants for an acre.

Transplanting should be done during June if possible, when the plants are from 6 to 12 inches high. Generally the larger sized plants will recover more quickly after transplanting. Transplanting done later than June is liable to be held back by the dry weather so much as not to be ready for cutting in October. With the ground in fine tilth, and the rows marked off, transplanting of small acreages can be done rapidly by hand with a long bladed spade. The spade is forced deeply into the soil, pushed to one side, thus opening a deep, narrow slot in which the kale root is placed, the spade then being pulled out, and the mellow soil permitted to close around the plant. Care should be taken not to injure the roots when taking them up from the drill row and replacing them in the new ground. A wet gunnysack may be thrown over the roots to prevent their drying out after being taken up.

The leaves need not be stripped for transplanting. The plants should be placed three feet apart each way, covered four or five inches deeper than in the drilled row, the soil firmed around them with the foot and later when wilted down, the whole field may be rolled. Where the soil is very dry it has been found decidedly beneficial to haul a barrel of water along the row on a sled and give each plant a few quarts after it is set. Plants should be left every three feet in the original drill rows and all extra plants saved for replacing those that may not survive transplanting.

Transplanting of large acreages may be done by plowing and placing the plants three feet apart in every third furrow, covering the roots and lower part of the stem with the next furrow turned, and following the day's work with a roller. Missing plants may be replaced later by hand. On large fields a regular transplanting machine may be used. For the most successful use of such a machine, a steady, slow-walking team, and a good driver are required and considerable practice in placing the plants will be needed before it can be done accurately.

Instead of transplanting the seed may be dropped in hills, three feet apart each way, as early as the ground can be prepared. Later each hill should be thinned, leaving one vigorous plant. As a rule this method does not give as good yields as transplanting.

After transplanting or thinning, the field should receive frequent shallow cultivations to destroy weeds and conserve moisture until the plants branch out so far as to prevent further tillage. A six-shovel riding cultivator is an excellent machine for this purpose.

In October or November, after the green corn has been fed out, the kale, although not fully grown, will be ready for feeding. The plants should be cut off at the ground, tossed onto the wagon or sled and hauled to the feeding place. Enough may be cut at one time for one or several days' feeding. Frozen kale should be allowed to thaw out before feeding. Where it is thought that the older plants, late in the spring, may taint the milk this can be avoided by feeding immediately after milking. Thirty-five pounds of kale per day with twenty pounds of good hay, such as vetch and oats, clover or alfalfa, fed in two portions, makes an excellent ration for milch cows, very little mill feed being needed. The kale may be fed clear through the winter until April or later, when the early fall-sown rye and vetch may take its place as green feed. To all classes of stock the kale is fed as it comes from the field without chopping. Fed to hogs through the winter it proves excellent in keeping up the growing stock and with grain added makes a first class fattening ration. Kale fed in small amounts to sheep that have no winter pasture, has a marked effect in improving their condition. As winter feed for poultry, the kale is unexcelled in maintaining egg production, and improving the quality of the egg and the health of the chickens.

For summer feeding kale seed may be fall-sown and transplanted early in the spring, being ready under favorable conditions for cutting during July, August and September Unless the ground is irirgated, however, the yields are not so heavy at this season. Where early frosts destroy the young fall-sown plants, a small cold-frame with well prepared soil may be thickly seeded in late winter or early spring and early transplants for summer kale obtained in this way.

In Eastern Oregon the winter weather is too cold to permit the growing of winter kale. By starting the plants in a cold-frame summer kale may be successfully produced, especially wherever it can be irrigated.

Feeding this plant by stripping off the lower leaves is not recommended as a regular practice as it is extremely laborious, especially during wet weather, puddles the soil badly and causes the stripped plants to suffer from frost. However, where the green feed runs short in September the larger lower leaves of the kale may be stripped off for feeding at this time. Later, as wet weather comes on and the plant grows larger, it pays to abandon stripping and cut the entire plant.

MARROW CABBAGE

By Prof. L. J. Chapin, Agronomist, Washington Agricultural Experiment Station

Marrow cabbage is a hybrid secured by crossing kohl rabi, thousand headed kale, and the Jersey chou. It resembles kale very closely when young, but as it grows older the stalk enlarges, reaching a diameter of from three to six inches at the largest part. The stalk varies in height from two to four feet, depending upon the richness of the soil, and often weighs ten or more pounds. It has a solid pith, or marrow, and it is from this that it takes its name. A peculiar natural habit of the marrow cabbage is that the lower leaves enlarge and then turn yellow and fall off. Then the next lower leaves enlarge and in due time turn yellow and fall, and so on until the stalk becomes bare for two-thirds or more of its length. These leaves may be pulled off and fed just before they begin to turn yellow. It is this habit that makes the marrow cabbage an especially suitable soiling plant for poultry during the summer and fall months. The large leaf stalks will not be eaten by poultry unless they are cut up, but they may be gathered up after the tender part has been eaten and fed to hogs or cattle. The lower branches of the thousand headed kale may also be stripped in somewhat the same manner without destroying the plant, but these do not fall off naturally. They should be cut off near the stem of the plant, whereas the leaves of marrow cabbage may be easily and neatly removed by a quick downward jerk, being held only by a few thread-like fibers.

Marrow cabbage is much relished by all farm stock, and, while no scientific feeding tests nor chemical analyses have been made, a great many good feeders have pronounced it in every way the equal of kale; it is even preferred to kale by some. It is more likely, however, to blow down than kale, owing to the greater size of the stalks, and it is more easily injured by frost. It is believed, however, that a more frost resistant strain can be secured by careful selection.

The cultural methods of kale and marrow cabbage are practically the same, each requiring the same general treatment as common cabbage. For best results they require a rich loam soil. They do well on the heavier soils if well drained and thoroughly tilled, or will do well on light soils if made rich and moisture is abundant. They will not do well on soil that is poor and dry. Peat soils, if properly drained, are especially well adapted to kale and marrow cabbage culture. For best results the heavier soils should have from ten to fifteen tons per acre of barnyard manure well incorporated with them at the time of preparation in spring. These plants require an abundance of moisture during the hot growing season. It is essential, therefore, to plow deep, at least eight inches, and to thoroughly prepare the soil if the best results are to be obtained. Frequent shallow cultivation during the summer is necessary in order to conserve the sufficient moisture for the normal growth of the plant and to hasten nitrification. A spike-tooth cultivator, set to run about three inches deep, is an excellent tool for this work. For early planting the seed may be sown in a greenhouse or in cold frames about the middle of February or the first of March and the plants set out in the field as soon as ready. For later planting the seed may be drilled in

the field the middle of May or later and transplanted when the plants are from four to six inches tall. If the plants are large when transplanted the lower leaves should be nipped off, leaving only two or three leaves at the top. The earlier planting of marrow cabbage will be ready to strip by the middle of July or a little earlier.

If the soil is very rich and the moisture conditions are good, the plants should be set two and one-half feet apart in rows three feet apart. This will provide ample room for early cultivation but none too much for the mature plants. If the soil is not so rich the plants may be set two feet apart in rows two and a half feet apart.

The most satisfactory method of setting plants of this kind on a medium large scale is with a small hand machine known as Master's Plant Setter, which sets and waters the plants at one operation. Soluble, and therefore readily available, plant food may be added at the same time if the water used be leached through a barrel of fresh manure. By simply pressing a valve the desired quantity of water is applied at the roots of the plants where it is needed.

RAPE, DWARF ESSEX

By Byron Hunter, U. S. Dept. of Agriculture, Farmer's Bulletin No. 271

Rape (Brassica napus) has been grown in the Willamette Valley with excellent results for twenty years. It is a succulent, nutritious forage plant, admirably adapted to the moist, mild climate of the Pacific Coast. It stands considerable freezing, and is seldom winter-killed west of the Cascade Mountains. It does best on deep, warm, well-manured loamy soils. It succeeds well also on peaty soils, but is not adapted to very light sandy or heavy clay soils. It is a heavy feeder, and must not be expected to succeed on poor, worn-out land.

Rape is an excellent crop for pasture or soiling, i. e., for cutting and feeding green for hogs, sheep, goats, and poultry. Fed to dairy cows it causes a large flow of milk, but to avoid tainting the milk it should be fed immediately after milking, at the rate of 30 to 50 pounds per day, in two feeds. On account of danger of bloating, sheep, goats, and cattle should never be turned on rape for the first time when they are hungry, or when the rape is wet with dew or rain. They should have planty of something else to eat first, and plenty of salt at all times. It is a good plan to give them access to hay or a grass pasture to prevent overloading on rape. When sheep have become accustomed to it they may be left on it continually with but little danger.

Rape is grown and utilized west of the Cascade Mountains in several different ways:

(1) When grown for early summer use, the largest yields and the best results are secured by making a succession of plantings at intervals of two or three weeks, beginning in the early spring as soon as the ground can be put into perfect tilth. The ground should be well manured and the seed planted in drills 24 to 36 inches apart at the rate of about 23 pounds per acre. A common garden drill may be used in planting small areas, but for larger fields a grain drill, with some of the feed hoppers closed to make the rows the desired distance apart, answers the purpose best. As soon as the plants are sufficiently large they should be cultivated often enough to control the weeds and keep the soil in good tilth. The cultivation will retain the soil moisture and tend to keep the plants growing vigorously. Unless cultivated during the dry portion of summer, growth almost ceases until the fall rains come. Rape grown in this way may be used either for pasture or for soiling.

When rape is used for soiling purposes it should be cut at least 5 inches high, so that the plants will have a chance to grow again. In from six to eight weeks after planting it should be large enough to cut; by making a succession of plantings green, succulent feed should be on hand throughout the summer. If rape is used for pasture, the best results will be secured by having a number of small fields which are pastured alternately. It may be fed in this way also by means of movable fences. Rape should be from 12 to 14 inches high before it is used for pasture, and hogs should be prevented from rooting while in the field. When rape is removed by cutting or pasturing closely, the evaporation of soil moisture is rapid, and it should be cultivated as soon as possible if a second growth is desired. If sown in drills, stock will walk between the rows while feeding, and much less will be broken down and destroyed than if they were feeding upon rape that was sown broadcast. A larger yield is also secured by planting rape in rows and cultivating it.

(2) Another favorite way of growing rape is to sow it broadcast at intervals in the spring. The land is plowed and thoroughly worked in the early spring, as soon as it is in good working condition, and then allowed to lie until the seeding is done. Just before each piece is sown the ground is cultivated thoroughly again and from 3 to 4 pounds of seed sown and covered with a harow or cultivator. Instead of sowing the seed broadcast it is sometimes planted with a common grain drill. Rape sown the 1st of May should be ready for pasture the 1st of July; if sown the 1st of June, it should be ready for pasture by the 1st of August. Grown in this way rape makes excellent pasture during the summer, fall, and early winter.

(3) Another method of raising rape that is popular with many farmers, especially those who raise sheep or goats, is to grow it with clover. The method of doing this has already been fully described in the discussion of red clover.

(4) Rape is sometimes sown with oats in the spring on a thoroughly prepared seed bed. The oats are used for either hay or grain. The rape grows but little until the early fall rains come, after which it is soon ready for pasture. From 2 to 4 pounds of rape seed per acre are sufficient when sown in this way.

(5) From 3 to 4 pounds of rape seed per acre are also sown with corn just before the last cultivation. The seed is then covered by the cultivator and the rape comes on and makes good pasture as soon as the corn is harvested. It may also be sown with potatoes, but it does not succeed so well with them as with corn, for the digging of the potatoes destroys much of the rape. Sown after early potatoes are dug, it gives good pasture during the late fall and early winter.

ROOT CROPS

By Byron Hunter, U. S. Dept. of Agriculture, Farmer's Bulletin No. 271

Since the soil requirements and the methods of culture of mangel-wurzels (Beta vulgaris var. macrorhiza), carrots (Daucus carota), and ruta-bagas (Brassica campestris) are very similar, they will be treated collectively. Like rape and thousand-headed kale, they succeed best where the weather is moist and cool. Hence their eminent adaptation to Western Oregon and Washington. In this region the yield of these crops is enormous, the ordinary yield being from 20 to 35 tons per acre, while reports of 45 to 50 tons are not infrequent.

Root crops usually succeed best on deep, moist, friable loam soils. On clay land they grow too slowly, and the soil is also difficult to work. Ordinarily, land for roots is heavily manured in the fall and then plowed considerably deeper than for other crops. If the

soil runs together badly during the winter, it is replowed in the early spring. Instead of the above procedure, the manure is sometimes spread during the winter, the land plowed deep in the early spring, and a fine, firm seed bed formed immediately by disking, harrowing, rolling, planking, etc., as the conditions may require. Between the preparation of the seed bed in the early spring and planting the seed during April or early in May the land is cultivated sufficiently to keep the weeds subdued. Just before planting the seed a thorough cultivation is given, finishing with a planker or clod masher. This destroys the weeds, thoroughly pulverizes the soil, and leaves the surface smooth and in good condition for planting.

Mangel-wurzels and ruta-bagas are usually grown in rows from 22 to 30 inches apart. When planted in continuous rows, enough seed is used to insure a good stand. When sown with a hill-dropping planter, the hills are from 8 to 15 inches apart and 4 to 5 seeds are dropped in each hill. The rows of carrots are usually 18 inches apart and the hills 8 inches.

As soon as the plants can be seen in the rows, the wheel hoe is started. With the guards of the hoe next to the row, the cultivation is done as close to the row as possible without covering or disturbing the plants too much. Considerable hand weeding and hoeing between the hills and along the rows is usually necessary. When the plants are 3 or 4 inches high, they are thinned, leaving the most vigorous plant in each hill. When sown in continuous rows, the thinning is largely done with a hoe, striking across the row. Subsequent cultivation should at least be sufficient to keep the weeds under control. As much of it as possible is usually done with a horse cultivator.

Ruta-bagas are sometimes sown in drills in the early spring and transplanted like cabbage. The plants may be transplanted like kale, as the land is plowed. The roots of the plants are placed where the next furrow will cover them and the tops are left sticking out.

About the 1st of November the roots are topped, pulled, and placed in narrow bins in the barn. Upon the approach of cold weather they are covered with hay or straw. The tops are sometimes cut off with a sharp hoe and the roots then dug with a potato fork. More generally they are dug first, the worker pulling on the top of the root with one hand as he bears down upon the handle of the potato fork with the other. The roots of two or three rows are laid together with the tops one way. The tops are then cut off with a long-handled knife. Some twist the tops off, claiming that the roots do not bleed and wither so much as they do when the tops are cut off. Roots are grown mostly for winter use and are fed up to the 1st of April. They are generally sliced before being fed to dairy cattle. Some dairymen feed them whole, claiming that cows can handle large roots nicely and that, unless the slicing is carefully done, they do not choke so frequently when feeding on whole roots as they do on sliced roots.

The flat or fall turnip (Brassica rapa) is also grown in Western Oregon and Washington. Since it matures quickly, grows mostly above ground, and has a flesh less firm than that of other roots it does not keep well and is adapted only to fall and early winter use. Its soft flesh and habit of growth above ground make it an admirable root to be harvested by stock turned into the field. It is usually sown broadcast on clean land about the 1st of July. It may be sown also in corn. If intended for winter use it should be gathered and put into bins before becoming water-soaked from fall rains.

SUGGESTIONS IN POTATO GROWING

By Prof. J. L. Stahl, Horticulturist, Western Washington Experiment Station

Potatoes like best a deep, rich, garden loam, although a good crop may be grown on quite a variety of soils. Such a soil may contain considerable sand but one containing much heavy clay should be well manured before planting to potatoes. When used on potato land manure is best applied the fall previous to planting, or, if crop rotation is practiced, to the crop grown the previous season. Clover is a good crop to grow just before potatoes.

Good drainage is absolutely necessary for the production of smooth and disease-free tubers.

Plowing should be deep before planting, unless the soil is deficient in humus, and when this is the case the humus content should be increased accordingly. Deep fall plowing followed by shallower spring plowing is a good general practice. After plowing it is necessary to work the soil fine, putting it in the best possible tilth. Pieces of sod or hard lumps have no place in the well-prepared potato seed bed.

According to chemical analysis the soils of Western Washington, in general, are lacking in lime, potash and phosphorus. Reports of potato growers who have carried on tests of commercial fertilizers in a small way by applying sulphate of potash, acid phosphate, bone meal and lime, in various combinations, show that in some cases the application gave increased yields while in others they did not. This indicates that there is considerable need of further experiments along this line.

If possible, potatoes from selected plants and hills should be secured for planting. If such seed is not available the most uniform tubers, with shallow eyes and free from disease, should be chosen from sack or bin.

Before planting, all seed potatoes should be soaked in a good antiseptic solution to kill spores of disease which might be clinging to the surface of the tuber. A common solution for this treatment is one pint of formalin (commercial formaldehyde) in every thirty gallons of water. Place the seed in sacks and soak in the solution two hours, then dry the seed before cutting for planting. Knives used for cutting, and sacks or pails in which the cut seed is placed, should receive the same treatment as the tubers.

The seed can either be cut or whole tubers planted. If planting is done very early in spring and the field is wet, whole seed is less apt to rot than cut seed. Otherwise it is considerably cheaper and just as well to plant cut pieces. A seed-piece weighing two or three ounces makes a convenient size for planting and contains enough food material to support vigorous stalks until the plant has developed its own roots. When cut, all pieces which show signs of disease should be discarded. Only clean and healthy seed should be planted, as rotted or scabby tubers are apt to inoculate the soil with spores of the disease.

Depth of planting will depend upon the character of the soil. In light sandy soils which tend to dry out, the seed-piece should be planted four or five inches deep, while three inches is deep enough if the soil is heavy. Early potatoes should not be planted quite so deep as later varieties.

The distance between rows and hills will also depend on the soil and the variety of potato. Varieties which produce large tubers should be planted closer than those which produce small tubers. Good care will also permit closer planting than if the soil is neglected. The usual planting distance is from twelve to eighteen inches in the row, with rows thirty to forty inches apart. Using a two-ounce seed-piece every fifteen inches in rows thirty-six inches apart will require about fourteen sacks of seed per acre.

Soon after the seed is planted cultivation should begin. Harrow thoroughly every week

or ten days until the plants are well above the ground. After this the surface soil should be cultivated often enough to hold an earth mulch and keep the weeds from starting. Cultivating deep close to the plants after they are half grown is apt to break off many lateral roots and this should be avoided. Sometimes the cultivator teeth may be adjusted to work deep midway between the rows and shallow near the plants. The soil may thus be stirred close to the rows without cutting off lateral and surface roots. Hill or ridge cultivation tends to destroy many of these roots, and unless the soil is wet or the tubers apt to grow out of the soil and sunburn, hilling should not be practiced. The crop is more readily harvested by this method and it is an easy habit to acquire, but in general it is not the best practice.

Late blight is a disease so prevalent in Western Washington that spraying to control it is almost a necessity. Bordeaux mixture should be used in such spray. Usually two applications of Bordeaux will be needed and during a rainy season more may be necessary. Make the first application when the plants are eight to twelve inches in height and watch the plants carefully to see when later applications are needed. As long as the spray shows plainly on the foliage of the plants it will not be necessary to make a second application, but it should be made as soon as the spray washes off. Drench the plants thoroughly on the upper and under sides of the foliage. The expense of spraying will vary with the cost of materials, ease with which they may be mixed and applied, and the strength and amount of the materials used. Copper sulphate, the active agent in Bordeaux mixture, is several times its normal price at present. It now costs from $20 to $25 an acre to make the same sprayings which cost from $7.50 to $10 an acre two or three years ago. During the past season conditions were not favorable for the development of blight in many localities, so that the loss was not generally severe, but in some seasons it is not uncommon to have a forty to sixty per cent loss in fields which are not sprayed.

Bordeaux mixture may be bought on the market in a paste form, but a more efficient mixture may be made by preparing the material just before using. Common formulas for this material are 4-4-50 or 5-5-50 when the trees or plants are in foliage, and 6-6-50 when the trees are dormant. The 4-4-50 formula means four pounds of copper sulphate (bluestone), four pounds of stone lime (quick lime), to every fifty gallons of water. The copper sulphate may be diluted by placing the number of pounds desired in a burlap sack and suspending it in a barrel on the surface of twenty-five gallons of water. In this way no stirring is necessary and the material will dilute over night, but if the crystals are thrown loosely in the bottom of the barrel it may take considerable stirring to dissolve them. Four pounds of quicklime is slacked in a little water and then diluted in enough water to make twenty-five gallons. The diluted copper and lime water are then poured or dipped from their respective barrels into the sprayer, at the same time, to give a good mixture. After the mixture has been made it should be used at once, but the copper sulphate solution or lime water may be kept separately for a long time if covered to prevent evaporation.

It is often convenient to make stock solutions of the copper and lime in quantities for future dilution by using a gallon of water for every pound of the material. When dilutions are needed for Bordeaux mixture a gallon of stock solution may be used for every pound of each material desired in the dilution. The copper sulphate and the Bordeaux mixture should be handled in wooden vessels, but this is not necessary for lime. Barrels or large wooden tanks are convenient vessels for handling the materials. If much Bordeaux is to be used it is more convenient to have the barrels or mixing tanks on an elevated platform so that the solution may be carried through hose or troughs to the mixing tank or sprayer by gravity instead of by hand labor.

To prevent clogging of the spray nozzles the mixture may be passed through a fine strainer on its way to the spray tank. An eighteen or twenty mesh brass wire screen makes a good strainer.

All metal parts of the spray machinery or equipment which comes in contact with Bordeaux mixture should be lined with brass to prevent corroding.

Shortly before digging time go through the field and mark with stakes the most vigorous plants. Dig those hills first and save the most desirable tubers from the best yielding hills. Use such tubers for the selected seed for next year.

If the grower has a large acreage of potatoes he can plant the selected seed in rows near the main field, giving it as good care as he gives the main crop. From these rows he may choose the best hills each year for the selected seed of next year, using the remaining rows for seed of the main field.

Good tubers for seed should be of the variety type and shape, should be free from disease and insects, free from knobs or irregular growths, and should have shallow eyes.

Potatoes for seed are best kept in bins, crates or trays in a cool, dry, well ventilated cellar or storage room where they can be frequently examined during the winter and the tubers removed which develop storage roots. Seed stored in pits or covered piles out-of-doors is not so accessible during the winter.

The market usually calls for about three usable grades, large, medium and small potatoes. The grower may make the grades and receive full value for his product or he may sell his potatoes field run and expect the buyer to discount enough from the market price to pay for grading, sorting, sacking, and shrinkage from small and diseased tubers.

He who makes potato growing a business, produces his own seed, and gives his crop good care, can usually expect a reasonable profit for his labor, but he who waits until just before planting time to buy his seed, pays no attention to the details of planting, and neglects his crop during the summer, cannot expect a profitable crop.

POTATOES IN IRRIGATED DISTRICTS

By A. G. Craig, Horticulturist, Washington Agricultural Experiment Station Bulletin No. 11

Enormous yields of potatoes have been secured under irrigation, but their cultivation is attended with some difficulty. No other crop is so much dependent upon the skillful use of artificial water. The quality of irrigated potatoes may, or may not, be as good as that of those grown without irrigation.

Winter irrigation may be practiced very successfully in potato growing. The fields should be flooded before plowing, and allowed to dry to a tillable condition. This insures perfect condition of the soil for working and for the early growth of the potato plants. The ordinary methods of cultivation may then be followed, without further addition of water, until about the time the plants blossom. At this stage of development the tubers are set, and it is then that an abundance of water is needed to give them good growth. After the water is once applied to the soil, it should not be allowed to become dry again until time for the crop to mature. If the soil is allowed to become dry at any time after the first application of water and a subsequent irrigation is given, the tubers are sure to make a second growth and become knobby. Water should not be applied too late in the season, or the potatoes will not ripen properly. In all applica-

tions of irrigation water, care must be taken to avoid bringing it in direct contact with the growing tubers, as under such conditions the tendency for the potatoes to become scabby is increased.

If winter irrigation is not practiced, the first water should be applied immediately after the seed is planted. Irrigated potatoes should be hilled, and the water applied between the rows. In ordinary soil, water applied in the middle of rows three feet apart satisfies the requirements of the growing potatoes. The cultivator should follow each application of water.

"Sub-irrigated" lands, when not too wet or too strong with alkali, are most satisfactory for raising potatoes. There are some localities where soils receive just enough seepage from irrigation ditches, or other water supplies, to keep it in moist, friable condition throughout the season. These, with shallow cultivation, produce the finest, smoothest tubers, with the least trouble and expense. To produce uniform moisture conditions in the soil is the secret of successful irrigation, and this is the absolutely essential condition for the most profitable potato growing under irrigation.

LATE SOWN FEED CROPS

By Prof. E. B. Stookey, Agronomist, Western Washington Experiment Station

Where an early maturing crop has been harvested, or where the soil cannot be put into shape until late in the summer, it is often desirable to put in some crop that will mature sufficiently for hay, or at least can be fed green or pastured. The crops that can be used will be determined largely by the amount of moisture in the soil, and the time necessary for the crop to develop sufficiently for use. The amount of moisture depends on the kind of soil and its treatment, and the kind of crop, if any, that has been harvested. The light sandy soils will have less moisture naturally than the heavier ones. It is often a question whether to risk putting in a crop or let the ground lay fallow. Each field is a separate problem, and the farmer will have to determine for himself whether there is enough moisture to grow a profitable crop. It must be remembered that during the latter part of July and August there is usually very little rainfall over Western Washington generally, and the moisture to grow the crop must be in the soil at the time it is sown. If the soil would grow a good crop of weeds it will probably produce enough crop to make it worth while planting it, but if the soil is too dry it will be a waste of seed to sow at this time.

Given a reasonable amount of moisture there are a number of crops that can be used with profit. If the crop is to be cured it will be necessary in most places to have it harvested by the last of September. If sown by the middle of July to the first of August that will give sixty to seventy-five days for the crop to grow. For soiling or pasture it would be possible to leave the crop on the ground thirty to forty-five days longer. As the crops sown at this time are used for different purposes they will be discussed separately.

Barley. On fairly fertile soil barley is one of our best crops for late sowing. It is commonly ready to cut for hay within seventy-five days when sown in early spring, and sown later maturity is hastened, but of course it does not make as rank a growth. Beardless barley is more desirable for hay than the bearded as the beards often make the animols' mouths sore. Success Beardless is somewhat earlier than the other varieties tried at this station. One and one-half to two bushels (72 to 96 lbs.) an acre is the usual rate of seeding.

Peas. Sown in the early spring, peas require eighty-five to one hundred days to mature sufficiently for hay, but seeded in the early summer will be ready for hay in seventy to seventy-five days. The White Canadian is the pea generally used, and is perhaps the only variety on the general market. Several varieties on trial at this Station seem to give greater promise than the Canadian. Two to two and one-half bushels (120 to 150 lbs.) an acre is the usual rate of seeding. In some sections late sown peas are badly damaged by aphis (the small green plant lice). The dry, hot weather prevailing at this time is favorable to their development.

Oats. Oats require a little longer growing period than barley, so for the later summer seeding is not quite so desirable. The growth, however, is somewhat greater and the stem is stiffer, so are preferred to barley for growing with peas. When sown the first part of July, oats will probably produce more than barley. On bottom land sown the first of August last year oats made two and a half to three feet of growth, but did not head, while the barley was heading in sixty-five days from date of sowing. This of course was sown too late for hay. The White Triumph and Canadian varieties of oats are somewhat earlier than the varieties usually grown in this section. Two to three bushels (64 to 96 lbs.) an acre is the usual rate of seeding. Mixtures of peas and barley or peas and oats are sometimes more desirable than any one of the crops alone.

Millet. Millet has a lower feeding value and requires as long or longer to mature than the above crops. The yield is less, too, so it does not seem advisable to use it as a summer catch crop.

Rape. Rape is a very quick growing crop, often being ready to pasture within forty to forty-five days from date of sowing, and in fifty-five to sixty-five days is ready to cut for green feed. Dwarf Essex Rape sown on bottom land the first of August of last year was two feet high sixty days from planting. On rich soil with enough moisture, rape can be sown quite late and still give very good results. It may be sown in rows and cultivated or may be sown broadcast. When sown in rows, one to one and a half pounds are required to sow an acre; when sown broadcast four or five pounds an acre are generally used. It is an excellent forage crop and deserves to be generally used.

Turnips. Of the root crops, turnips are the best adapted for late sowing. They make a rapid growth, and will have made good growth in sixty to seventy days after sowing. This will allow of their being sown in July and August provided there is a sufficient amount of moisture. Turnips may be sown broadcast or in cultivated rows, requiring about the same amount of seed an acre as rape. One advantage of sowing turnips late is that very little damage is caused by the root maggot.

It is very important that crops sown late in the season be given the most favorable conditions. The soil should be put in the best tilth possible and special attention should be given to retention of moisture. In order that there shall be enough moisture the soil must be cultivated immediately after the previous crop is harvested so that little moisture will be lost. After the crop is sown it may be advisable to compact the soil around the seed with a roller so that germination will be hastened. Peas may be harrowed just as they are coming up, and barley and oats may be harrowed after they are well up, if the harrow teeth are slanted back.

HAYMAKING

By Byron Hunter, U. S. Dept. of Agriculture, Farmer's Bulletin No. 271

To make hay of prime quality west of the Cascade Mountains is often a difficult matter. Most of the hay crops, if allowed to mature naturally, are ready to cut during the month of June, while the late spring rains are usually not over until the 1st of July. Thus, haymaking would naturally occur at a time when good weather can not always be relied upon.

Even when the weather is fair the nights are cool and dews are frequent and heavy. This difficulty is often partially overcome by pasturing the meadows in the spring until about the 1st of May to retard the development of the crop, so that haymaking will occur after the late spring rains are over.

There are several factors to be considered in determining the proper stage at which a crop should be cut for hay. Chemists tell us that hay made from young growing plants is more digestible and contains more protein per pound than hay made from mature plants. If hay is cut early the percentage of protein is greater; if cut later, the percentage of protein is less, but the yield of dry matter in pounds is materially increased. As an illustration of this, see the table governing the amount of dry matter in corn at different stages of development, page 55. The protein content of hay made from the true grasses, such as timothy or orchard grass, is always low, and the gain in protein per pound from cutting such hay early is always more than counterbalanced by the loss in dry matter. On the other hand, hay made from some of the leguminous plants is said to be too rich for certain classes of animals. Men who have had considarble experience in feeding vetch and alfalfa hay generally agree in saying that either is too strong to feed for horses, especially if cut very green. For this reason hay made from leguminous crops is frequently cut much riper if for horses than when intended for other animals.

Laxative feeding stuffs are undesirable for horses, but not for cows. Green hay is laxative in character, while hay cut in a more mature condition has an opposite tendency. The stage at which hay should be cut, therefore, will depend upon the class of animals for which it is intended.

The number of times a meadow is to be cut during a season is another factor in the time for cutting hay that must not be overlooked. If there is to be but one cutting, the greatest yield will be secured by allowing the crop to become quite well matured before it is cut. When two cuttings are to be made, farmers who have tried the experiment find that the greatest yield is secured by cutting the first crop while it is still green and growing and before the dry season has begun. The ordinary hay plants are not inclined to continue their growth after the first cutting if allowed to stand until their seed is pretty well formed. A delay of only a few days in cutting the first crop of the season often seriously affects the growth of the second.

A statement of the time for cutting will be found under the special discussion of each crop.

The best hay is made without rain and with the least possible amount of sunshine. If it were possible to cure hay in the shade, the quality would be much better. The curing of hay is a process of drying and of fermentation. Hot sun tends to stop fermentations which produce hay of good quality.

From what is said above it is evident that hay should remain in the swath only until dry enough to be raked evenly into windrows; that most of the curing should take place in the cock rather than in the swath or windrow; and that, just as quickly as it is safe to do so, it should be placed in the stack or mow. With fair weather and hot sun, light crops may be raked soon after mowing, often in two or three hours. Heavier crops, especially when green, require more time. When the growth is heavy the swath is often packed so closely to the ground from its own weight and the pressure of the wheels of the mower that the use of the tedder is necessary to dry it out evenly.

West of the Cascade Mountains hay is generally put up in permanent cocks, where it remains for a week or ten days. If it is to remain in the field but a short time some farmers cure it quickly by first putting it into small, flat cocks. In about twenty-four hours these are turned over, allowed to air, and three or four of them are then made into one permanent cock. At what stage hay should be stacked is a question upon which there are many opinions. A common rule with many farmers is to stack when juice can not be twisted out of a wisp of hay taken from the middle of the cock.

As stated, the common practice in this region is to let hay remain in the field for about a week; in fact, a very large majority of farmers think good hay can be made in no other way under the climatic conditions west of the Cascade Mountains. There are some successful men, however, who put up hay by what has been termed the "rapid process." With good haying weather the method is about as follows: The grass is cut in the afternoon. Being unwilted, the first night's dew does not injure it. If the crop is heavy the tedder is started the next morning as soon as the dew has dried off, and the hay is gone over as many times as possible during the day. Just before evening it is raked and cocked. The hay then stands in the field for two nights and a day and until the dew is off the second day. The cocks are then scattered and aired, especially the bottom portions of them, and the hay is hauled to the mow during the day. It thus requires three days from cutting to hauling. The hay is scattered evenly in the mow so that it may all settle alike and exclude as much air as possible, and is salted at the rate of 10 pounds per ton. At night the barn is tightly closed to keep out damp air.

When the price of hay is high, it is quite probable that hay caps can be used profitably in making hay west of the Cascade Mountains. The use of caps would prevent the outside of the cocks from becoming too dry, and would thus add to the total weight of cured hay. The quality of the hay would be greatly improved, for it would be practically uniform throughout. The use of caps would also greatly increase the certainty of saving the crop. A farmer in Georgia has used hay caps for ten years. He thinks they materially increase both the quality and the quantity of his hay. Unfortunately there are at present no hay caps on the market. However, they may be made of light canvas or any strong cotton cloth in sizes to suit. Caps 4½ to 5 feet square, with pegs or weights attached to hold them in place when in use, ought to give satisfactory service. A coat of oil should be applied to one side of the cloth. The caps should always be dried after being used, for they will mold if piled up wet.

SAVING HAY CROPS

By Prof. H. L. Blanchard, Assistant Superintendent, Western Washington Experiment Station

Frequently the unnecessary losses and waste on the farm amount in the aggregate to a few hundred dollars each year. One of the greatest sources of such losses will generally be found to be connected in some way with the meadow or hay crop. It has become quite generally known that after a grass crop has arrived at a certain stage of development and maturity its feeding value becomes less each day until harvested. Often weather conditions are such that unless the farmer has managed rightly he must suffer quite a loss before he has secured such crops. There are two ways under which such may be managed, thereby reducing the loss to the minimum, viz., pasturing the meadow during early spring and by the use of the silo. In cases where there is no silo on the farm, or for any reason the pasture plan is to be adopted, care must be exercised or there will be danger of the loss resulting therefrom being greater than the benefit received. The practice of permitting the stock to graze the meadows all winter and until late spring, about May 15th, has many objections,

chiefly among which are tramping and close grazing, both of which are very destructive to the roots of many of the tame grasses and thereby more or less destroy the stand for hay and permit inferior wild grasses to gain possession of the meadow. When pasturing of the meadow is rightly done it becomes both a safe and economic practice. The animals ought not to be permitted on the meadow at all during the winter months and in the spring not until the grasses have attained a growth of five or six inches at least, when grazing ought under no conditions be permitted closer than about four inches. The period for pasturing the hay meadow usually dates from April 15th to May 15th. Such a practice may be recommended for wet seasons only. The experience of the Western Washington farmers for the year 1914 demonstrates conclusively the mistake of pasturing the meadows at all during a dry year. However, in a normal season pasturing the meadow along the lines advised may be considered to be a safe practice.

The normal dates for the maturing of the tame grasses, such as orchard grass, rye grasses, and the clovers, in different localities, is from June 5th to 20th, and of the late grasses such as timothy, red top and the like, July 5th to 20th. The grasses and legumes that mature in June are especially adapted to the dairy farm's needs. Favorable weather conditions for hay making do not often prevail before the dates when the late grasses are ready for the harvest. Thus the June harvest must often be deferred for about a month, waiting for suitable weather conditions. In the meantime the crop has lost a considerable percentage of its feeding value, and also has prevented the growing of the second crop.

There is almost every season a considerable shortage of succulent feed for the dairy herds during the months of August and September, causing a decreasing milk supply accompanied with an increasing market price. The business farmer would like to take advantage of this condition which is an annual occurrence. His greatest and most practical hope is in the use of the silo to secure the June crops. This system admits of the utilization of these crops for feeding the dairy herd and thus converting them into cash within ninety days after harvesting same, which system will be admitted is better business than allowing the depreciation that necessarily follows a month's delay in harvesting the crop as hay and then securing a questionable quality of hay to be utilized for the herd five to eight months later with uncertain results. Then there is the value of the second and third crops of hay to be considered, which becomes impossible when the June crops are not harvested until July.

Usually the weather is sufficiently settled during the latter half of July and August to permit of curing hay in a satisfactory manner, though a high per cent of it is always inferior, largely due to poor management.

Three things are to be considered when passing upon the quality of hay, viz., color, aroma, and freedom from dust. Dusty hay is usually the result of permitting the crop to become too ripe before cutting, or heating in the mow; while hay that has lost its color and is without the desired aroma is less digestible and less palatable. The color and aroma then are important factors, not for the intrinsic values, but because they evidence proper curing. The loss of aroma is due to the cut grass becoming wet from either dew or rain, since during the drying process that principle of the grass that gives its characteristic odor and taste is carried off in the vapor. A secret in making sweet-smelling and palatable hay is the protection of the cut grass from all external moisture, while promoting the escape of the excess of internal moisture from the stems and leaves without undue exposure to the sun and wind.

There is no hard and fast rule for making good hay under all conditions of soil and weather, nor for every season. Here is where the farmer needs to rely upon his judgment and experience for his knowledge. With a knowledge of the objectionable factors that enter into hay curing, one soon learns by observation to do the right thing at the proper time.

For a guide to the hay maker we offer the following plan which will bring satisfactory results in Western Washington. The writer has followed this plan with great success for many years. Do the mowing between 9 A. M. and 12 M. or after 3 P. M. When the grass is heavy let the tedder follow the mower. Do not expose the crop while lying in the swath to the sunshine to exceed one hour. At 4 P. M. begin raking into windrows all that was cut before 12 M. The evening cutting may remain in the swath over night and as soon as the dew is off the next morning tedder same. The dew will do little harm while the grass remains fresh cut and green. In the afternoon bunch the previous day's cutting, either by hand with forks or with the horse rake. In the afternoon of the following day cock by putting from two to three bunches in a cock, depending upon the size of the bunches. In the absence of any external moisture the hay may be stacked or hauled to the barn, or it may be allowed to stand in the cock for a few days when weather conditions are favorable. In such cases the cocks ought to be toppled over and spread in forkful bunches an hour before hauling. When there is moisture in the soil on low land a better practice is to tip over the original bunches and allow them to remain bottom up for an hour before cocking. On dry and gravelly locations this will not be necessary.

As the hay is stored apply either salt or air-slacked lime, or a mixture of two parts of salt to one part of lime by measure. Use from two to three quarts per ton. The lime takes up the moisture and the salt appears to make the hay more palatable for the animals.

This method applies to all hays but more particularly to the clovers and other legumes as well as the combinations, grain and vetch. Hay secured in this way will receive the minimum percentage of dampness and loss and will be first-class in every particular, retaining its palatability and maximum feeding value.

The question that will naturally arise at this point will be what to do under adverse weather conditions. It frequently occurs that when the clover and early grasses are ready to be cut the weather is very uncertain and that hay weather cannot be relied upon for more than one or two days at a time, to be followed by a few rainy days. Under these conditions the farmer is fortunate who has a silo. In such a case the crop can be cut at the proper time and removed and the land at once given a slight top dressing of barnyard manure, preparatory to a good second crop. A manure spreader is the best tool for this purpose. In the absence of a spreader a heavy brush or light harrow may be used to evenly spread the manure.

However, where the silo is not available for this purpose, and there is a promise of two or three fairly bright days without rain, by a little extra effort the cut clover can become sufficiently wilted to admit of being cocked with safety. The cocks ought at once and continuously to be protected from the weather by the use of hay caps. These caps should not be less than forty inches square and may be made at a cost of about 12 cents each. With proper care they will be serviceable for several years. A weight like a rock the size of a hen's egg may be fastened to each corner of the cap that it may not be removed by the wind. Under these conditions the clover will go through a week's rainy weather with the minimum amount of damage. The secret of success in this matter is not to allow any external moisture on the clover from the time it is cut until it has been cocked and capped as stated.

THE SILO

By Byron Hunter, U. S. Dept. of Agriculture, Farmer's Bulletin No. 271

That the silo should have a very general use in Western Oregon and Western Washington, not only for the preservation of corn but for many other crops as well, ought to be apparent from an understanding of the climatic conditions of the region. As previously stated, most of the hay crops are ready to cut during the month of June, while spring rains frequently continue until about the 1st of July. (See table giving the distribution of rainfall on page 8.) It will thus be seen that haymaking ordinarily occurs at a time when good weather cannot always be relied upon. If meadows are pastured during the spring to retard the development of the crop, so that haymaking will occur after the late spring rains are over, the yield of the second crop is usually much lighter, since its growth is confined entirely to the dry season. By the use of the silo, on the other hand, the first crop may be cut for ensilage early in June, even though the weather be unfavorable for haymaking. If cut at this time, while the plants are still growing vigorously, a good second crop will usually mature for hay early in August—the best haying season of the year. A light third crop can be used for pasture or cut for ensilage late in the fall. It is evident, therefore, that the use of the silo will practically insure the saving of the first crop, increase the total yield per acre, and cause the second crop to mature at a time when good haying weather can usually be relied upon.

That all kinds of ensilage should be finely cut may be desirable, but we must not get the idea that it is essential. For years ensilage of the finest quality has been made in Western Oregon and Western Washington out of whole clover and grass (timothy, English rye-grass, etc.). In making ensilage of this kind, however, there are two essentials—an air-tight silo and great care in filling it.

Farmers who use the silo as indicated above agree that the first crop of grass and clover should be cut for ensilage from the 1st to the 15th of June, for the earlier the first crop is cut the greater will be the yield of the second. Difficulty is usually experienced in raking up freshly cut green grass with an ordinary hay-rake. Some farmers avoid this difficulty by cutting with a self-raking reaper or a mower with a buncher attachment. These bunches are then thrown on a wagon by hand. Others cut with an ordinary mower and load from the swath with a hay loader. The heavy green grass often bends the teeth on the elevator bars of the loader. The teeth may be reinforced by nailing blocks of wood on the elevator bars just back of the teeth.

In filling the silo the material must be evenly spread and thoroughly tamped, so that all of the air possible will be excluded. If this is not done much of the ensilage will spoil. Two principal methods were found in use by farmers in filling silos. In the first the freshly cut grass is dropped directly into the silo with a hayfork. Two men in the silo spread the material and tramp it thoroughly, especially around the edges. The center of the silo where the loads from the fork fall requires but little tramping. The second method is to drop the material upon a platform at the top of the silo by means of hay slings or a hayfork. A man upon the platform throws the material into the silo, placing it as best he can. Another man spreads it evenly in the silo and tramps it thoroughly. This is perhaps the safest method, for there is less chance to slight the work. For a few days after the silo has been filled, the settling of the material will allow the addition of two or three loads each day, each load being thoroughly tramped when added. When the filling is completed the top is covered about 1 foot deep with marsh grass or other waste material that will pack closely and exclude the air. This is wetted thoroughly and tramped daily for several days, using about 2 barrels of water at each wetting. The writer has seen ensilage of excellent quality made from whole grass in this way. He has also seen ensilage made by dropping the material into the silo without spreading and tramping that was practically a total loss.

SOILING (GREEN FEEDING) CROPS

By Byron Hunter, U. S. Dept. of Agriculture, Farmer's Bulletin No. 271

The mild weather climate and abundant rainfall of Western Oregon and Washington make it almost an ideal region for the production of soiling crops. By the judicious selection and planting of crops green succulent food may be provided for the dairy cow during practically the entire year. That a much greater amount of feed can be obtained from the same area of land by this system as compared with pasturing is a fact well recognized by the progressive dairymen. Much of the tillable land of this region is now very valuable. As values advance beyond the limit where farm land may profitably be used for pasture and it becomes necessary for the small farmer to keep the maximum number of stock upon his few acres of tillable land, the growing of soiling crops becomes of vital importance.

Below is given a list of crops that are used for this purpose. The dates of planting and the approximate dates upon which these crops may be used are also given. It must be understood, however, that the variation in seasons prevents one from saying definitely when a crop will be ready to use.

Dates for Planting and Using Soiling Crops in Western Oregon and Western Washington.

CROPS.	WHEN PLANTED.	WHEN USED.
Rye and vetch	September 1 to 15	April 1 to May 15.
Winter oats and vetch	September and October	May 15 to July 1.
Winter wheat and vetch	Do	Do.
Red clover		Do.
Alfalfa		During June.
Oats and peas	February	Do.
Oats and vetch	Do	June 15 to July 15.
Oats and peas	April	During July.
Rape	May 1	Do.
Oats and peas	May	During August.
Rape	June	Do.
Corn	May 10 to 20	During August, September and October.
Turnips	July 1	Late fall and early winter.
Thousand-headed kale	March 15 and transplanted June 1	October 15 to April 1.
Mangel-wurzels, carrots and rutabagas	April	October 15 to April 1 (fed from bins, pits or root houses).

LEGUMINOUS PLANTS

By Byron Hunter, U. S. Dept. of Agriculture, Farmer's Bulletin No. 271

Plants that produce their seed in two-valved pods, such as peas, beans, vetch and alfalfa, are called legumes. The value of this family of plants as soil renovators has long been recognized, but in just what way they are capable of restoring fertility to the soil has not been understood until recent years. If the roots of a leguminous plant be carefully removed from the soil little lumps, called nodules or tubercules, will usually be found upon them. These nodules vary in size with different legumes and may be found alone or in clusters. On the roots of red clover they are about twice as large as the seed of that plant. The nodules are caused by bacteria that are parasitic in the roots.

By the aid of the bacteria living in the nodules, leguminous plants are enabled to assimilate atmospheric nitrogen. Since nitrogen constitutes approximately four-fifths of the atmosphere this family of plants has an inexhaustible supply of this important plant-food element. Other plants cannot assimilate the nitrogen of the atmosphere; they can obtain it only from decaying organic matter and from commercial fertilizers containing nitrogen. Chemical analyses show the tissues of leguminous plants to be very rich in nitrogen; hence the value of these plants when plowed under as green manure. The roots of a clover crop ordinarily contain more nitrogen than the whole crop removes from the soil. As these roots decay, the plant food in them becomes available for other plants. Nitrogen is usually the first element of plant food that needs renewing; hence the great value of leguminous plants as soil renovators.

Generally speaking, the nodules of each kind of legume are caused by certain kinds of bacteria. Thus there is one kind for alfalfa, another for red clover, another for common vetch, and so on. At any rate the nodule-forming bacteria of red clover, for example, have become so accustomed to that plant that they are of little or no value in forming nodules on the roots of most other legumes. If nodule-forming bacteria are not in the soil no nodules will be formed; the failure of leguminous crops is often due to this cause. These bacteria may be artificially supplied in two ways, namely, by means of pure cultures of the bacteria and by transferring soil from one field to another. For further information regarding these two methods, see Farmers' Bulletin No. 240, U. S. Department of Agriculture.

LOOSE SMUT IN OATS

Washington Agricultural Experiment Station Bulletin No. 129

An examination of oat fields in Whitman and Spokane counties during the latter part of July, 1915, showed the presence of large quantities of loose smut. It was not uncommon to find fields containing five and ten per cent of smut and in some cases twenty-five per cent of the crop was smutted.

The smut appears in oats soon after the crop begins to head and all of the heads of plants that contain smut are usually destroyed by the fungus. The smut masses break open soon after they appear and the smut spores are distributed by the wind. A portion of the spores come in contact with normal heads while the grain is standing in the field. Practically no smut will be observed in the field at harvest time and the loss to the crop is commonly underestimated.

No further harm is done to the maturing crop but the smut spores which cling to the grain are a source of infection for the next year's crop if the seed containing them is planted.

It is believed that the smut of oats can be practically eliminated by proper treatment of seed. Dr. F. D. Heald of the Division of Plant Pathology recommends the following treatment, using formalin or a forty per cent solution of formaldehyde, one pound to forty gallons of water.

1. Put a sufficient amount of the solution (35 to 40 gallons) into a barrel to completely immerse a sack of seed or use a larger quantity in a tank.
2. Put the seed to be treated into sacks (one and one-half bushels) and dip each sack into the solution, allowing it to remain ten minutes.
3. Remove the sack and drain, allowing the excess of the liquid to run back into the barrel or tank. Replenish the solution as often as necessary from a stock solution so as to always have the sack completely immersed.
4. Allow the treated seed to remain over night in the wet sacks and use the next day. If the seed is not used within forty-eight hours after treatment, it should be spread out to dry to prevent sprouting in the sacks.

COVER CROPS FOR ORCHARDS

The Fruit Grower

A cover crop system is not only highly essential to the present success of the orchard, but to its future success—the lack of it may explain failure. We have carefully observed cover crops throughout our own state—and too often the lack of them in the Pacific Coast country and the Northwest.

It is a common saying among orchardists that we do not get bumper crops as in the old days when this was a virgin country. To repeat such crops, one absolute necessity is to put the soil in as near the fertile condition it was following the removal of the forests. The mineral elements of the soil remain, but the humus has been "burned out." After this humus is gone it is harder for the plants to use the minerals.

There are two ways to restore vanishing fertility. One method is by applying fertilizers. The so-called complete commercial fertilizer contains three elements, nitrogen, potassium and phosphorus, which are most commonly lacking in land that has ceased to produce. Commercial fertilizers rightly used are profitable, but are expensive. Barnyard manure is a cheaper fertilizer but more bulky. It contains a fair percentage of the three elements. Both commercial fertilizers and barnyard manure are all right in their place, but the supply is limited. Many growers are gradually reducing the ability of their orchards to bear. It is a question of vital importance to the fruit grower. Cover crops solve the problem. They are economical and consistent with the best methods of farm management. Clover, cowpeas and other legumes indirectly take nitrogen from the air by action of bacteria living in the root nodules, and change it to a form that can be used by plants.

The elements of the soil can be classed under two heads: First, Mineral Elements—which are the residue of decomposed rock; pure clay is a good example; it may not have occurred to you in just this light, but practically all earthy soil came either directly or indirectly from the original stone. The soil usually contains the same materials as the underlying rocks, except a large part of the more soluble material has been washed out. Second, Humus—which is partially decayed organic matter—leaf mold, grass, weeds, etc., that have lost their original form, but in which the process of decay is incomplete. Peat and muck are good examples of soils which are practically

all humus. Between the two extremes of pure clay and muck, there are almost an infinite number of loamy and sandy soils. The earthy portion of the soil contains practically all minerals necessary for plant growth. In some cases potash and phosphate may be lacking, but these are infrequent. On the other hand they are often in an unavailable form; that is, the soil may contain a large amount of each, but it is insoluble and the plants cannot make use of it. Clay lands are usually rich in potash, while limestone lands nearly always contain sufficient phosphate.

Humus supplies nitrogen to the soil. Most of the nitrogen is locked up in the humus which breaks down gradually, thus supplying the plants with food and preventing excessive waste. The soil has been called "Nature's work-shop and chemical laboratory." It is a laboratory and the simplest processes that go on there are far more complex than the most intricate experiments of our scientific investigators. Nitrogen in plants is converted during the complex process of decay into nitrates which are then ready to be used by plants. Organic matter, when decaying, forms carbonic acid in the soil, and although it is a very weak acid, it is able to dissolve much of the potash and phosphate which were formerly insoluble. Thus the three elements commonly sold in commercial fertilizer are furnished for orchard growth by humus. It liberates the potash and phosphate already in the soil and supplies nitrogen.

Humus is beneficial to the soil in many ways. It makes land more porous, enabling it to hold water like a sponge. It makes stiff clay soil of lighter tilth by separating and loosening the soil particles, thus making cultivation easier and more effective.

Cultivation is something more than an efficient method of destroying weeds. It helps to get rid of surplus water—yet if properly done retains all beneficial moisture. It aerates the soil, letting in the air and warmth, thus aiding the many chemical processes in the soil to greater activity. There is this difference between cultivation and cover crops: Cultivation liberates plant food already in the soil. Cover crops also do this and add more to the organic store, at the same time preventing loss of available plant material which would otherwise have leached away. Both are invaluable in their places.

Humus is partially decomposed vegetable matter—not completely decayed. When vegetable matter forms humus, or humus breaks down to form simpler compounds, heat is liberated. Whether a pile of leaves is burned or allowed to rot, the same amount of heat is eventually given off. Thus decaying organic matter in the soil makes it warmer and dryer in the spring, and growth will start more readily and be faster throughout the season. Humus makes the soil darker, and by test it has been shown that dark soil is warmer than the same soil under like conditions but lighter in color. Dark soil also holds the heat longer.

When a country is in a wild state humus is supplied by dead leaves, grass and other vegetation, most of which falls and rots where it grew, but with modern methods of plowing and clean cultivation, we "burn out" the humus and at the same time do away with the source of supply. We may supply this deficiency by applying barnyard manure and commercial fertilizer, and by using cover crops. (We might add that millions of dollars' worth of fertilizer is lost by the American people through careless handling of manure. It should never be exposed to sun and weather.) Cover crops are especially adapted to the best cultural methods in orchards. The ideal cultivation, we believe, is intensive, clean culture from early spring to June or July, depending on the season; then seed to the cover crop which seems best adapted to your particular orchard.

Cover crops may be divided into two classes, those taking free nitrogen from the air (clover, cowpeas, etc.), and those using only the nitrogen already in the soil. Rye and oats are good examples of the latter, which are used as catch crops where no more nitrogen is desired. They should be used in pear orchards which are inclined to make too rapid growth.

"Catch crops" are necessary because bacteria working in the soil, especially in warm weather, are continually liberating food in the form of nitrates and minerals such as potash and phosphate are continually changing to soluble form. The nitrates, unless used immediately, are liable to be lost by leaching. Some of the more or less soluble minerals may be lost by washing away in the drainage water; their loss, however, is not so great as that of nitrogen. The growing orchard utilizes these minerals during the first of the season, when growth is most rapid, but later, when growth slackens, a cover crop of some sort is necessary to use this food and get it in a form that can be carried over until the next season without loss. Such crops as clover, cowpeas and vetch are especially good. They not only store up all available nitrogen in the soil, but add more from the air, and in the spring they decay readily. They thus increase the value of crops and extend the life and productive age of the orchard.

Hairy vetch is probably one of the best crops suited to these methods. Intensive, clean culture can be given until mid-summer; vetch can then be sown and turned under the following spring.

FERTILIZER NEEDS OF WASHINGTON SOILS

By Prof. R. W. Thatcher

Most soils in the state of Washington are as yet fairly new. Their native or virgin fertility is not yet exhausted. There are, however, many different types of soils in the state, some of which do not naturally contain very large supplies of the different elements of plant food needed by crops.

Such soils are likely soon to "run out," and need application of fertilizers carrying the particular elements in which they are deficient. Other soils which carry fairly good supplies of the different elements of plant food have been improperly handled or wastefully cropped until badly out of condition. These can best be restored or built up in fertility by the use of fertilizers to stimulate increased growth until the soils can be properly brought back into good condition.

Fertilizers may, therefore, be used for two separate purposes; namely, the application of some one or more single elements of fertility to correct deficiencies in those particular elements, or the application of a complete mixed fertilizer to stimulate crop growth.

The only possible means of determining whether fertilizers for either of these purposes can be profitably used is by field experiments. A chemical analysis of the soil indicates the total amounts of plant food which are present but does not show how much of this is available for use of different crops, nor does it prove whether the use of any given fertilizer would yield enough increase in crop growth to pay for the cost of the fertilizer. Field trials with fertilizers are, therefore, the only conclusive evidence of their value.

But chemical analysis do indicate which elements are likely to be deficient because of an insufficient total supply. The Washington State Experiment Station has completed a soil survey in the course of which samples of every type of soil found in the state have been analyzed. The following brief statement of the conclusions to be drawn from these analyses will serve as a basis for field experiments with fertilizers on the different types of soil as mentioned.

Reclaimed tide flats are usually well supplied with all the essential elements of fertility but are likely to be "sour" because of excess of organic acids resulting from the decay of large amounts of organic matter. They, therefore, generally need lime as a fertilizer to correct this acidity.

The red-fir uplands or second bench lands usually contain fairly good supplies of mineral plant foods but limited amounts of humus, and need the plowing under of some clover crop or the addition of a complete fertilizer.

Alder bottom lands are rich in decaying vegetable matter but usually low in phosphorus and lime.

The potash content of all soils west of the Cascade Mountains is usually low, and for those crops like fruit and vegetables, which need large proportions of potash, fertilizers carrying potash are generally very beneficial.

Phosphorus is usually present in sufficient quantities in upland soils, but likely to be deficient in the lower lands.

Nitrogen is present in abundance in the bottom land soils, but often deficient in upper gravelly or clayey soils, particularly if they have grown large forests of fir and pine.

Special types of soil such as shot clay, beaver dam, gravel prairie, etc., require special treatment.

Marshy bottom lands, whatever the type, are almost invariably sour, because of the excess of decaying organic matter and lack of lime.

Shot clays are usually strong soils, ordinarily carrying a good supply of phosphorus and nitrogen, but are apt to be somewhat deficient in potash. The percentage of lime is rarely very high, but seems in most cases to be sufficient for plant needs. The plowing under of vetches or clovers gives specially good results on this type of soil.

The sage brush soils of the irrigated valleys east of the Cascade Mountains are very rich in lime, carry fair supplies of potash and phosphorus and are very low in nitrogen and humus. The addition of nitrogen carrying fertilizers or plowing under of leguminous crops is the first necessity, while for special fruit crops potash fertilizers are generally profitable.

Most of the upland soils of eastern Washington are very rich in all the mineral elements of fertility. The supply of humus and nitrogen is only moderate, and in regions of low rainfall is quite low. The proper attention to the humus supply will probably be all that will be necessary for long continued fertility, particularly for extensive cropping. For intensive cropping, such as market gardening, fruit growing, etc., the addition of humus forming fertilizers will give profitable results.

AVAILABLE FERTILITY

By Prof. R. W. Thatcher

Soil fertility means essentially favorable conditions for crop growth. This naturally depends upon many different things. For example, a soil might be abundantly supplied with all the necessary elements of plant food in proper form, yet if the soil were to remain dry throughout the season, no crops would grow in it. Again, a soil might contain abundant available fertility and plenty of moisture but remain frozen through an entire season, in which case no crop would grow. In a broad sense, therefore, fertility requires favorable conditions of moisture supply, temperature, state of tillage, sufficient supply of plant food of proper kind, etc. As commonly used, however, the term fertility means a sufficient supply of plant food in available form.

What is available plant food? A little thought will show that it is plant food in such form that it will dissolve in soil, water or plant root juices. Plants have no power or ability to absorb food in solid form. Plant food is taken from the soil through the roots and circulates in the sap. It must, therefore, be in liquid form, and available plant food is that form of plant food which can be dissolved from the soil and so be taken up in liquid form. The availability of plant food is, therefore, measured by its solubility in plant juices.

All the chemical elements in the soil (of which there are about fifteen) may be taken up by the plants, but not all of them are of equal use or value. Some are not necessary at all to plant growth. Others which are necessary for plant growth are always present in the soil in abundance. A few which are absolutely necessary for all plant growth are commonly present in the soil in comparatively small proportions. These are the so-called "critical elements" of fertility; namely, nitrogen, phosphorus, potash and lime.

The element nitrogen is used by plants in building up the green growing foliage. Phosphorus is essential for the production of seeds. Potash aids in the building up of starches or sugars, which are essential parts of all plants. Lime is in some obscure way connected with the building of woody fiber.

Obviously then, all these elements are necessary for every kind of farm crop, although different amounts are needed by different crops.

Lime, in addition to its value as a direct plant food, has much to do with the physical condition of the soil and the availability of plant food. Fertility, from the standpoint of plant food, therefore, requires a sufficient supply of each of these four critical elements in proper or available form.

Lime, potash and phosphorus are all found in rocks. They are the mineral elements of fertility.

Nitrogen is not a mineral element, and is not found in rocks. Nitrogen comes originally from the air, but must be converted into liquid or available form by the decay of plant tissue containing it. It can be taken from the air only by the bacteria which grow on the roots of leguminous clover plants, including alfalfa, clovers, vetches, peas, beans, etc. These bacteria take nitrogen from the air, and when they die and decay make the nitrogen which they contain available for other plants.

Most soils contain considerable supplies of all the essential elements of fertility, generally enough to last for a hundred years or more. The problem of fertility is that of getting this plant food into available form.

The chief agencies for dissolving mineral plant food materials are the bacteria and acids which are developed in decaying vegetable and animal matter. Rotting vegetation, or humus, is therefore the best agency for maintaining or increasing the availability of plant food.

This accounts for the well known beneficial effect of manure. The actual benefit of manure when applied to soils is at least double the value of the plant food which the manure supplies, because of the fact that the manure in rotting dissolves and makes available plant food which was already present in the soil in unavailable form.

One of the best means of increasing fertility of soils is, therefore, the plowing under of some humus forming material. For this purpose barnyard manure is best. Next in value are so-called "green manures" or green crops plowed under. Of these the legumes are by far the best because they are the nitrogen gathering crops.

A red clover crop when plowed under adds to the soil about $20.00 worth of nitrogen which the bacteria associated with it have taken from the air.

Other green crops, like rye, buckwheat, etc., when plowed under, produce humus, and, therefore, help to make available the plant food already present in the soil, but they do not add

to the soil any of the critical elements of fertility which were not already present in the soil.

In the absence of a sufficient supply of barnyard manure, commercial fertilizers may profitably be used; particularly if the price of land, or market conditions make it undesirable to lose the use of the land while green leguminous crops are being grown to be plowed under.

Again, the addition of available fertility in the form of commercial fertilizers often profitably supplements the supply of available fertility which is naturally present in the soil or is developed by proper handling of the land.

The chief determining factor in the use of commercial fertilizer is, of course, the profit which may be obtained from their use.

LIME FOR CORRECTING ACIDITY IN THE SOIL

By Prof. E. B. Stookey

Based on chemical analyses, it may safely be said that most soils in western Washington are in need of lime. The analyses in the U. S. Reconnaissance soil surveys of western Washington show a deficiency of from 0 to 30,000 pounds of limestone per acre, with the large number of samples showing a need of less than 2,000 pounds per acre.

This means that this much limestone is required to neutralize the acid in the soil. It is generally conceded that the greatest need of lime in the soil is to counteract acidity. Lime, however, is essential to plant growth, has a beneficial effect on the physical conditions of soils, and aids in liberating plant food.

Where lime is needed the character of the plant growth is usually such as to indicate it. Sorrel and horse-tail rush are generally present, and replaces red clover. Red clover shows the need of lime in the soil as quickly as any other plant. The litmus paper test is fairly satisfactory. Blue litmus paper, pressed against moist soil, will turn red or pink if the soil is in need of lime. The length of time it requires to change color indicates in a general way the amount of lime required. If the action is slow, probably one thousand pounds of lime, or one ton of ground lime rock, per acre, would be sufficient. A light soil will require less lime than a heavy one.

The kind of lime to apply will depend on the soil condition and the result to be accomplished. This will be better understood if we know what the different forms of lime are, and the effect of each.

Lime, or calcium oxide, is known as quicklime, burned lime, stone lime, lump lime, unslacked lime, etc. Calcium oxide is composed of forty parts calcium and sixteen parts oxygen by weight. In all lime fertilizer compounds, calcium is the element that should be considered.

We may consider the weight of calcium oxide as 56. When quick-lime is slacked it combines with water and forms hydrated lime, known chemically as calcium hydroxide. If we slake 56 pounds of pure lime there is produced 74 pounds of hydrated lime. The weight is increased almost half, and the bulk is more than doubled by this chemical addition of water. If just a sufficient amount of water is used, the lime will fall apart into a fine white powder.

If this 74 pounds of slaked or hydrated lime is exposed to the air a few days it will completely air slake, the water taken up chemically will be replaced by carbonic acid gas from the air, and there is produced 100 pounds of air slaked lime, known chemically as calcium carbonate.

Ground limestone rock is made from calcium carbonate rock, and is chemically the same as air slaked lime. Air slaked lime is usually in a finer state of division than ground limestone, and will contain some quick-lime and some hydrated lime.

If 100 pounds of pure limestone rock is kiln burned it will form 56 pounds of quick-lime. We see then that 56 pounds of quick-lime equals 76 pounds of hydrated lime or 100 pounds of air slaked lime or ground lime rock.

Some recent experiments carried on by the Pennsylvania State College show that ground lime rock is as effective for the correction of soil acidity as an equivalent amount of quicklime.

Quick-lime is caustic in its effect; that is, it burns substances that it comes in contact with if moisture is present. If water is applied to lime it generates heat, and expands. Barreled lime often breaks the barrels, because of the absorption of moisture and exposure to air. If quick-lime is put on the soil it does not remain long in lump form. As soon as water falls on lime it slakes and forms hydrated lime, and the hydrated form soon changes to the air slaked or carbonate form.

Theoretically the humus in the soil is burned by the lime undergoing these changes, and practically we find that the humus content of the soil organisms diminishes under such treatment. This decrease is probably due in part to the increased activity of the soil organisms working on the humus.

Ground lime rock or fully air slaked lime applied to the soil does not have a caustic action, and is not so chemically active, so the action of soil organisms is not so greatly accelerated. It does, however, correct soil acidity. Ground limestone and fully air slaked lime are therefore the safest forms of lime to apply.

On soils that are rich in humus, such as the peat and muck soils, the loss of humus will not be serious, and on such soils quick-lime or hydrated lime may be used. Many soils in western Washington, in fact most upland soils, are deficient in humus, so that it would seem unwise to put anything on them that would burn out the small supply.

Lime will not take the place of manure or commercial fertilizers, nor will manure or commercial fertilizers take the place of lime.

If quick-lime is to be used it may be applied in several different ways. The lump lime may be placed in small piles over the field, and slaked with a pail of water, or the lime piles may simply be covered with earth. In this way the lime will slake by drawing moisture. After the lime is slaked the piles of lime are scattered evenly over the ground. When applied in this way the application is usually made in the fall or during the winter. Lime in this form is caustic, so must be applied a considerable length of time before a crop is to be put on the land. After the lime is spread, it should be well incorporated with the soil by discing or harrowing.

The quick-lime is sometimes slaked and then applied. Considerable care is necessary to use just enough water so the lime crumbles into a fine state of division. It should not be allowed to burn, nor should too much water be used, as that makes it hard to handle. In this form it should be applied during the winter or very early spring. This form is caustic, and would injure a crop planted too soon after the lime is applied.

Finely divided quick-lime is sometimes spread directly on the land. Applications of this kind should be made in the fall or winter. It should be borne in mind that all forms of quick-lime are caustic. It is doubtful if this form should be used on a light soil. On a heavy clay soil, or a soil rich in humus, it may be profitably used, or if a soil is very strongly acid and it is desired to correct the acidity immediately this form of lime is desirable. After the acidity is once corrected it is perhaps advisable to use a safer form of lime, and in a smaller amount.

Hydrated lime can be secured commercially, and is in a finely divided state. Quick-lime that is no longer fresh enough for building purposes is sometimes sold for hydrated lime. If air slaked lime is used, there will probably be some quick-lime in it. The quick-lime should be slaked before using.

Quick-lime is easily converted into hydrated lime by slaking with water. It will sometimes be cheaper to buy quick-lime and slake at home, than to buy lime in any other form. Any form of hydrated lime is caustic, therefore it should be applied in the late fall to early spring, as a crop would be injured by it. It should be disced or harrowed to thoroughly incorporate it with the soil.

Ground lime rock, fully air slaked lime, ground shells, and such carbonaceous materials, can be obtained commercially, and at a reasonable figure. These forms of lime can safely be applied at any time, as they are not caustic and will not injure a growing crop or sprouting seeds.

Any of these forms, to give the best results, should be in a very fine state of division. Although it requires more of these than of the other forms of lime to be as effective, yet they can be used without danger of burning a crop or the humus in the soil. It may well be said that they embody the good qualities of the other forms of lime, but will not injure the soil or a crop. If more than necessary is used, there need be no fear of injury.

Experiments at the Illinois Experiment Station seem to indicate that two tons per acre of ground limestone usually give the highest returns. Subsequent applications of a ton per acre should be used whenever the soil begins to show signs of acidity. It is considered good practice to apply one or two tons of carbonate of lime per acre every five or six years.

Any of the caustic forms of lime should not be applied with manure. The carbonate forms of lime, however, could safely be applied with manure, but it is seldom done. Manure should be plowed under, but any form of lime should be applied to the surface and thoroughly incorporated with the soil by discing or harrowing.

Lime can be applied broadcast, but is more easily applied with a fertilizer attachment or a fertilizer drill.

It should be remembered that the highest returns cannot be secured unless the fertility and humus supply of the soil is maintained.

Different crops are affected differently by liming. While some crops are benefited, some do not give any reaction one way or the other, and same are injured if there is too much lime present. The last are known as acid loving. The following classification of plants is taken from the report of work done by the Rhode Island Experiment Station, and bulletin No. 6 of the U. S. Dept. of Agriculture.

Plants usually benefited by lime applications are alfalfa, asparagus, beans, beets, barley, blue grass, cantaloupe, cherry, cabbage, clovers, cucumbers, cowpea, dandelion, egg plant gooseberry, lettuce, onions, oats, parsnip, pepper, pea, peanut, plum, pumpkin, red raspberry, rhubarb, spinach, squash, tobacco, timothy and wheat.

Plants indifferent to lime are apple, corn, cotton, carrot, millet, peach, pear, red top, Rhode Island bent grass and rye.

Plants impaired by large amounts of lime in the soil are blue grass, blackberry, black raspberry, potato, radish, seradella and watermelon.

Plants adapted to acid conditions are blueberry, buckwheat, carrot, corn, cranberry, hairy vetch, millet, oats, potato, raspberry, red top, rye, strawberry and turnip. While these plants are adapted to acid conditions, some of them will be benefited by liming. It will be noticed that some of the plants in the last list are included in one of the other classifications.

Brief Points on Liming

1. The different forms of lime contain different amounts of calcium.

2. To improve a poor, acid soil, plow under manure, apply lime and disc in, and grow legume crops in the rotation as much as possible.

3. Lime corrects acidity, but rarely acts as a true fertilizer.

4. Use burnt lime with caution.

5. Ground limestone and thoroughly air slaked lime are not injurious to soils or crops.

6. Lime is not a "cure all" for every soil ailment.

NITRATE OF SODA FOR GARDEN CROPS
U. S. Department of Agriculture Bulletin No. 162

The result of experiments by the New Jersey stations to test the value of several common forms of nitrogenous fertilizers for certain market garden crops have been summarized in an earlier number of this series. In a recent bulletin of the stations Prof. E. B. Voorhees gives the results of further experiments along the same line. The purpose of the later experiments was to study the value of different amounts of nitrate of soda for several prominent market garden crops, and also the effect of applying the nitrate in two and three equal dressings, the first when the crops were planted, the others when the character of the season and the growth of the crops indicated.

The question of the proper use of nitrate of soda is of special importance because (1) it is an expensive fertilizer, (2) it furnishes only one element of plant food, namely, nitrogen, and (3) it furnishes nitrogen in a form which is highly soluble, and consequently is not only quickly absorbed by the plant roots but is also readily washed out of the soil and lost. In order, therefore, that this fertilizer may be most economically and profitably employed it is necessary not only to use it in proper amounts but to apply it in such a way that the nitrogen is used by the plant to the fullest possible extent.

If the quantity found to be necessary for a definite increase of crop, under average conditions, were applied at once, say in the early spring, a greater opportunity would be offered for losses from leaching than would be the case if the material were given in successive dressings, so that the losses due to the escape of the nitrogen would be minimized; on the other hand, if no losses occurred, the plant might take up more than could be utilized in a normal development, thus defeating the purpose, because resulting in a product of less commercial value. This would apply, of course, only in the case of those crops that are injured by abnormal development in certain directions, as, for example, too large a proportion of straw in cereal grains, too large root in sugar beets, etc. All these may be obviated by a fractional application, or, in other words, by supplying the nitrogen at the time and in the quantity best adapted for the plant and for the purpose in view in its growth. The results from the use of nitrogen may also be unsatisfactory if nitrogen only of the essential elements is used. The best results from the use of nitrate can come only when there exists in the soil, or are applied with it, sufficient amounts of the mineral elements to enable the plant to obtain a food suited to its needs.

The experiments of the New Jersey stations were planned to determine not only the best amounts of nitrate to use in case of various garden crops, but also the best method of application. The land used in the experiments was very fertile, but in order to insure an

abundance of phosphoric acid and potash in the soil it was further enriched in every instance by applications of 350 pounds per acre of a fertilizer containing 3.69 per cent of nitrogen, 7.85 per cent of available phosphoric acid, and 6.39 per cent of potash. The results obtained with the different crops were briefly as follows:

Cabbage—With this crop there was a yield of but 910 prime heads per acre when no nitrate of soda was used. When 300 pounds of the nitrate was applied per acre in two equal dressings the number of prime heads obtained was 3,260. When the same amount was applied in three equal dressings the yield of prime heads per acre was 5,390. On the plat which had received 400 pounds of nitrate of soda per acre in two equal dressings the yield was 4,160 prime heads per acre, and when this same amount was applied in three equal dressings 7,580 prime heads were obtained per acre. From these figures it will be seen that the use of the nitrate of soda greatly increased the yield of prime heads in every instance. It will further be noticed that when the nitrate was applied in three equal dressings the largest yields were obtained. Applying the nitrate in three dressings proved more effective in increasing the yield than increasing the amount 100 pounds. For example, 300 pounds in three equal dressings was more effective than 400 pounds in two equal dressings, and the best yield of all was obtained by applying 400 pounds of nitrate in three equal dressings. Not only was the yield much greater than on any other plat but the quality of the cabbage was much improved, the heads selling for 50 per cent more than those from any other plat.

Celery—As with the cabbage crop noted above, 300 and 400 pounds per acre of nitrate of soda were used on different plats in two and three equal dressings. The average increased yields of all the plats, due to the use of nitrate, was 17,810 pounds or 132 per cent. This was on good land previously well fertilized with 450 pounds of high-grade fertilizers. No marketable celery whatever was obtained when the nitrate was not used, and the use of the ground, expense of growing, etc., was a total loss. Where the nitrate was used the crop was worth on the average $378.10 per acre. The cost of the nitrate was but $7. This is equivalent to a gain of $54.01 for every $1 invested in the nitrate of soda. As to the influence of the amount applied the average increased gain due to the use of 400 pounds of nitrate was 255 marketable roots, worth $25.19. When the nitrate was applied in three equal dressings there was an increased gain on the average of 495 plants, worth $31.19 over the yield obtained when the application was made in two equal dressings. The gain from the third application was considerably larger when the 400 pounds of nitrate was applied than when 300 pounds was used, the value of the increased gain in the former case being $16 and in the latter $56.38. These results indicate the value of a liberal quantity of nitrate of soda for celery as well as judicious distribution throughout the season.

Tomatoes—With tomatoes the heaviest yields were obtained when 200 pounds of nitrate of soda was used per acre in three equal dressings. The increase in the yield in this case was 5,880 pounds. When the same amount of nitrate was used in two equal dressings the gain was but 3,220 pounds. When 300 pounds of nitrate of soda was used in two equal dressings the increased yield was 4,610 pounds. When the same amount was applied in three equal dressings the increased yield was but 3,540 pounds. The third application in this case caused a larger growth of vine and later maturing fruit, thus considerably reducing the yields.

Turnips—This crop is often grown for early market. In the station experiments different plats were fertilized with nitrate of soda at the rate of 200 and 300 pounds per acre, respectively, in two and three equal dressings. Where no nitrate was used the yield was 8,230 pounds per acre; when 200 pounds was applied in two equal dressings the yield was increased to 12,740 pounds; and when in three equal dressings the yield was but 11,220 pounds. When 300 pounds was applied in two equal dressings the yield was 16,520 pounds, and when in three equal dressings the yield was but 13,360 pounds. These figures show that while there was a greatly increased yield in every instance due to the use of the nitrate of soda, the best yields were obtained when the nitrate was applied in two equal dressings rather than three. The late dressings seemed to induce growth of tops rather than of roots. The greatest increase in yield and the most profitable crop was obtained from the use of 300 pounds of nitrate of soda in two equal dressings.

HOW AND WHEN TO APPLY COMMERCIAL FERTILIZERS

The best method and time for applying commercial fertilizers depends upon conditions and the kind of fertilizers used. They should be gotten into the ground in time to become dissolved and available when the young plants are ready to use the plant food.

Some of the slow acting fertilizers are best applied a considerable time before the seed is sown, and on heavy soils not liable to be washed by winter rains those fertilizers may be applied during the winter or fall prior to sowing the seed.

On light sandy or gravelly soils, from which some of the fertilizers might be washed by rains, it is best to apply them at the time of seeding, or a few days before.

The complete mixed fertilizers are usually best applied at the time of seeding or a short time before, but will often give excellent results if used as a top dressing after the plants are up. These fertilizers are composed of a variety of fertilizing ingredients, some of which are almost immediately available and others are slower acting and release the plant food only as fast as it is required by the plants.

Most of the nitrogen fertilizers are readily soluble, and should not be applied until the seed is sown, or used as a top dressing later. Nitrate of soda and nitrate of lime have produced best results when applied in several light applications at intervals of two or three weeks during the early growing season.

Commercial fertilizers may be sown broadcast evenly all over the field, and harrowed in before the seed is sown; they may be drilled in with a special fertilizer drill, either at the time the seed is sown or later; they may be scattered in the hills or drills where the seed is to be sown provided they are scattered evenly and thoroughly mixed with the soil; or they may be used as a top dressing after the seed is sown or after the plants are up, in which case rain and cultivation will work them into the soil. Any method that will distribute them evenly in the soil where the roots of the plants will reach them will be effective. In small operations they are sometimes applied by dissolving in water.

In any case they should be applied evenly and thoroughly mixed with the soil, so that no considerable quantity will come into direct contact with the seeds or roots.

When used for fruit trees, berry bushes, etc., they must, of course, be used as a top dressing, and may be sown broadcast or a small quantity may be distributed around each plant or tree, and cultivated into the soil.

An excellent way to use the potash fertilizers in conjunction with stable manure is to scatter a small quantity over the manure each day, either in the stable or on the manure pile. In addition to adding potash to the manure, making it a correctly balanced fertilizer; they help to retain the ammonia in the manure, greatly increasing the value.

PLANTING TABLE FOR VEGETABLE GARDEN

SEED	Quantity Required	Depth	Dist. Apart Rows	Dist. Apart In row	When to Sow	Ready for Use
Artichoke, Globe, Seed	1 oz. for 500 plants	1 in.	1 ft.	3 in.	Spring	Second summer
Artichoke, Globe, Plants			3 ft.	2 ft.	Spring	Summer
Artichoke, Jerusalem	600 lbs. per acre	3 in.	3 ft.	2 ft.	Early spring	Late summer
Asparagus, Seed	1 oz for 500 plants	1 in.	1 ft.	3 in.	Early spring	Third spring
Asparagus, Plants			4 ft.	14 in.	Spring	Second spring
Beans, Dwarf	1 lb. to 100 feet	2 in.	2 ft.	4 in.	Late spring	45 to 65 days
Beans, Pole	1 lb. to 150 hills	2 in.	4 ft.	3 ft.	Late spring	75 days
Beets, Table	1 oz. for 50 feet	1 in.	1 ft.	3 in.	Early spring	65 days
Broccoli	1 oz. for 2000 plts.	½ in.	2 ft.	12 in.	Spring	Winter
Brussels Sprouts	1 oz. for 2000 plts.	½ in.	2 ft.	18 in.	Early spring	Fall and winter
Cabbage	1 oz. for 2000 plts.	½ in.	2 ft.	18 in.	Early spring	90 to 150 days
Carrot	1 oz. for 125 feet	½ in.	1 ft.	2 in.	Early spring	Early summer
Cauliflower	1 oz. for 3000 plts.	¼ in.	2 ft.	18 in.	Early spring	110 days
Celeriac	1 oz. for 5000 plts.	⅛ in.	2 ft.	5 in.	Early spring	Fall and winter
Celery	1 oz. for 5000 plts.	⅛ in.	3 ft.	6 in.	Spring	6 months
Chervil	1 oz. for 100 feet	¾ in.	1 ft.	4 in.	Early spring	Summer
Chicory	1 oz. for 100 feet	½ in.	1 ft.	3 in.	Early spring	4 months
Collards	1 oz. for 2000 plts.	½ in.	18 in.	14 in.	Spring	Fall
Corn, Sweet	1 lb. for 200 hills	2 in.	3 ft.	3 ft.	Late spring	80 to 100 days
Corn Salad	1 oz. for 50 feet	½ in.	1 ft.	3 in.	Early spring	100 days
Cress, Peppergrass	1 oz. for 150 feet	½ in.	1 ft.	3 in.	Spring	Summer
Cucumber	1 oz. for 100 hills	1 in.	6 ft.	4 ft.	Late spring	3 to 4 months
Egg Plant	1 oz. for 2000 plts.	¼ in.	2 ft.	18 in.	In hot bed	160 days
Endive	1 oz. for 400 feet	½ in.	18 in.	8 in.	Spring	Summer
Horseradish, Roots		¼ in.	2 ft.	12 in.	Spring	Fall
Kale	1 oz. for 200 feet	½ in.	18 in.	12 in.	Spring or fall	45 days
Kohl-Rabi	1 oz. for 150 feet	½ in.	18 in.	6 in.	Spring or fall	4 months
Leek	1 oz. for 300 feet	½ in.	14 in.	4 in.	Early spring	Late summer
Lettuce	1 oz. for 400 feet	½ in.	18 in.	8 in.	Early spring	65 days
Melon, Musk	1 oz for 60 hills	1 in.	6 ft.	4 ft.	Late spring	4 months
Melon, Water	1 oz. for 30 hills	1 in.	8 ft.	6 ft.	Late spring	4 months
Okra, or Gumbo	1 oz. for 100 feet	1 in.	4 ft.	2 ft.	Late spring	3 months
Onion, Seed	1 oz. for 300 feet	½ in.	1 ft.	3 in.	Early spring	4 to 5 months
Onion, Sets	1 lb. for 40 feet	1 in.	1 ft.	1½ in.	Early spring	Spring
Parsley	1 oz. for 300 feet	½ in.	1 ft.	4 in.	Early spring	Summer
Parsnip	1 oz. for 400 feet	½ in.	18 in.	3 in.	Early spring	4 months
Peas	1 lb. for 50 feet	3 in.	3 ft.	2 in.	Early spring	8 to 12 weeks
Pepper	1 oz. for 1500 plts.	¼ in.	2½ ft.	18 in.	In hot-bed	5 months
Potato	5 lbs. for 100 feet	4 in.	2½ ft.	18 in.	Spring	July to Sept.
Pumpkin	1 oz. for 30 hills	2 in.	8 ft.	8 ft.	Late spring	4 to 5 months
Radish	1 oz. for 100 feet	½ in.	1 ft.	2 in.	Early spring	30 to 45 days
Rhubarb, Seed	1 oz. for 50 feet	½ in.	1 ft.	4 in.	Spring	2 years
Rhubarb, Plants		6 in.	4 ft.	3 ft.	Spring	1 year
Ruta Baga	1 oz. for 150 feet	½ in.	15 in.	6 in.	Spring & sum'r.	3 months
Salsify	1 oz. for 50 feet	½ in.	1 ft.	2 in.	Early spring	5 months
Spinach	1 oz. for 200 feet	½ in.	1 ft.	3 in.	Spring & fall	45 days
Squash, Bush	1 oz. for 25 hills	2 in.	4 ft.	4 ft.	Late spring	65 days
Squash, Winter	1 oz. for 12 hills	2 in.	12 ft.	12 ft.	Late spring	125 days
Tomato, Seed	1 oz. for 2000 plts.	¼ in.			In hot-bed	150 days
Tomato, Plants			4 ft.	4 ft.	Late spring	
Turnip	1 oz. for 150 feet	½ in	1 ft.	3 in.	Spring & sum'r.	60 to 75 days

QUANTITY OF FARM SEEDS USUALLY SOWN

	Lbs. Per Acre
Alfalfa	10 to 20
Alsike	6 to 10
Artichokes, Jerusalem	400 to 600
Barley	100
Beet, Mangel or Sugar	5 to 6
Broom Corn	8 to 12
Buckwheat	40 to 60
Carrot, Stock	3 to 4
Clover, Alsike	6 to 10
Clover, Sweet	20 to 30
Clover, Red	8 to 15
Clover, Mammoth Red	8 to 15
Clover, Crimson	10 to 15
Clover, White, for pasture	8 to 10
Corn, Field	12 to 20
Corn, Fodder, in drills	50 to 75
Corn, Pop	5 to 10
Emmer, or Speltz	100
Feterita	10
Flax, for seed	30
Flax, for fiber	50
Grass, Kentucky Blue, for pasture	20 to 30
Grass, Canadian Blue, for pasture	20 to 30
Grass, Timothy	10 to 20
Grass, Red Top, Unhulled	30 to 40
Grass, Red Top, Hulled	10 to 15
Grass, English or Perennial Rye	30 to 50
Grass, Italian Rye	30 to 50
Grass Orchard	40 to 60

	Lbs. Per Acre
Grass, Meadow Fescue	25 to 30
Grass, Brome Grass	30 to 40
Grass, Crested Dog's Tail	20 to 30
Grass, Tall Meadow Oat	20 to 25
Grass, Velvet, or Mesquite	40 to 50
Grass, Sheep's Fescue	35 to 40
Grass, Fine Leaved Fescue	30
Grass, Hard Fescue	30
Grass, Red or Creeping Fescue	30
Grass, Pasture Mixtures	30
Grass, Hay Mixtures	30
Grass, Sudan	16 to 24
Hemp	40 to 50
Kale, Thousand Headed	1 to 2
Kaffir Corn	6 to 10
Mangel Wurzel	5 to 6
Millet	20 to 50
Oats	75 to 100
Peas, Field	90 to 120
Potatoes	400 to 600
Rape, Dwarf Essex	3 to 5
Ruta Baga	2 to 3
Rye	90 to 120
Soja Beans	30
Sorghum, in drills	10
Turnip	2
Vetch, Common or Spring	60 to 100
Vetch, Hairy or Winter	30 to 60
Wheat	90 to 120

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LILLY'S