LILLY'S CROP BOOK

PUBLICATIONS

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Farmers and gardeners in this section are just beginning to realize that the fertilizer question is a very important one to them, and this little book is intended to assist them in deciding what is needed to produce greater profits in their business. It is not simply a catalog of commercial fertilizers; it is worth asking for.

LILLY'S CROP BOOK.

Unlike the other publications issued by us, this book is not given away free, neither is it for sale at any price. We give it with any order for LILLY'S Seeds, or any other goods listed in any of our catalogs, regardless of amount, provided it is asked for with the order. It is compiled from Government Bulletins and other reliable sources of information and also contains many articles written especially for us by men who are experts on the subjects handled, including cultural directions for all the common vegetables, flowers and farm crops.

THE CHAS. H. LILLY CO.

Portland Seattle

LILLY'S CROP BOOK

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LILLY'S CROP BOOK

The Vegetable Garden

Almost any one 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 really almost human, and it is sometimes surprising that they thrive as well as they do under adverse conditions. Neglected plants in uncongenial soil, without sunshine and proper nourishment and care are very similar to children raised in the tenement houses of large cities, and will seldom mature into anything very useful or ornamental.

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 side 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 not to 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 sub-soil near the surface, it should be sub-soiled, and the ground broken up to a considerable depth without turning it over. It is best to plow stiff clay soil in the fall, leaving it rough, to be broken up by the action of the weather during the winter into a fine grained mass. If found to be packed hard in the spring it should be plowed again, and then repeatedly harrowed and rolled until it is thoroughly pulverized, and there are no lumps larger than a pea. The thorough preparation of the soil is very important; do not slight it, expecting to remedy it by cultivation after the seed is planted; neither should you make the surface smooth, leaving 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 prepare the soil is when it will crumble into fine particles when pressed between the hands. Do not 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 unavilable 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 the soil. 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 mature and produce seed properly, phosphoric acid is lacking. The soil is only strong in proportion to its weakest ingredient. It may contain an abundance of two of these elements, but if lacking in the third it will not produce a satisfactory crop. 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 or 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, which although not really fertilizers are of value in improving the mechanical condition of the soil.

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

Potash is esential to the formation and transference of starch in plants. Starch is formed in the leaves and gradually passes into the fruit. Potash is necessary for the development of the woody part of stems and the fleshy portions of 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 decayed vegetable or animal matter in the soil, 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 either in the form of stable manure or commercial fertilizers. If stable manure is used it should be well rotted, and applied as long as possible before seeds are planted. Commercial fertilizer may be applied any time before seeds are planted, but it is best to apply early enough to give it time to assimilate with the soil before being required by the plants. Any fertilizer, whether stable manure or commercial fertilizer, should be thoroughly mixed with the soil.

Too much fertilizer at one time is not profitable. Feed the soil abundantly, but not excessively. Study it, decide what it needs, and feed accordingly. It is better to apply fertilizers frequently than all at one time. Much valuable plant food is lost by improper feeding. It is not possible to judge just how much of each form of plant food is required, but by experimenting you can form a pretty good idea. The science of fertilizing is in its infancy. Our posterity may know all there is to be known about it, and have hard and fast rules to work by, but we can only experiment and do the

best we can with the limited amount of light that has been given us on the subject. Plants cannot speak, but appearances sometimes speak plainer than words, and with a little study and experience you will be able to judge from their appearance what they need.

For the benefit of the one crop only it is economy to apply fertilizer in the hill or drill where the seed is to be planted, but it must be thoroughly mixed with the soil so that the seed does not come into direct contact with any considerable quantity of it. As a general thing we would prefer to apply the fertilizer broadcast and harrow it in. It is a common practice to sow commercial fertilizer in the row with seeds at the time seed is planted, but we do not consider it advisable.

During the winter, while there is little else to do, 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. Then make a diagram of the garden, showing where the various seeds are to be planted. Arrange it so that the taller plants will be on the north side, and will not shade the smaller plants. Quick growing plants, such as radishes, lettuce and onion sets for green onions, should be planted between rows of such plants as will occupy the ground during the entire season, and the quick growing plants will be out of the way before the larger plants need the ground. Radish seed may be mixed with such seed as onion, lettuce, carrot, parsnip or beet, and the radishes will be removed before the other plants are large enough to shade them. Large plants such as tomatoes and cabbage may be set in the rows of quick maturing plants, at proper distance apart.

By all means have the ground thoroughly pulverized, granulated, and mellow, and the surface smooth. Make the rows straight with a line or board. If the ground is very 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 dealer who tests all the seed sold. Never buy cheap seeds, the little thatyou save is insignificant compared with a crop failure.

Do not plant too early. A few vegetables such as radish, onions and peas, may be planted as soon as the ground is in proper condition to work, but most other seed should not be planted until the weather is thoroughly settled and the ground warm, so that the plants will start to grow immediately, 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 mature in. It may seem heartless to pull out so many good plants, but it is much better to have one good plant than several weak, spindling ones. Do not plant too deeply. A good rule is to plant to a depth of three to five times the diameter of the seed. The earth should be packed firmly over the seed, especially when the soil is light and porous.

Commence cultivating as soon as the plants are large enongh so that you can follow the rows. If you have a garden of any size at all, even a small kitchen garden, it will pay you to have a garden cultivator, as you can do better work, and with a very small percentage of the labor required with a hoe. Do not cultivate to kill weeds. Cultivate to conserve the moisture by forming a thin dust mulch on the surface, and do it so frequently and thoroughly that the weeds will not have a chance to start. Always cultivate as soon as the ground is in condition to work after each rain or each time you have irrigated. Do not cultivate more than one-half 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.

If irrigation is to be practiced, it is better to give the ground a thorough soaking once a week 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 surmount. In nearly every case of failure the failure is attributed to poor seed, but in ninety-nine cases in every hundred it is on account of carelessness in planting or unfavorable conditions of soil or weather. Of course some poor seed is sold, but if you purchase seed from a seedman who cares for his reputation, and tests all seeds sold by him, you will never have a failure on that account. A frequent cause of failure is planting too early, too late, or too deep.

Often the seed will germinate quickly, but the plants will make a feeble growth. This is usually on account of 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 can be seen almost immediately. 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 one hundred pounds per acre should be applied at one time, and the solution should not be made stronger than one pound of nitrate of soda to five gallons of water.

Garden and Small Fruit Crop Preparation

By C. W. Tonneson, Editor Northwest Horticulturist.

In the preparation of the soil for any garden or small fruit crop, the essential is to pulverize deeply before planting time and the more thorough that is done, other conditions being equal, the greater the profit and pleasure to be realized. Figure on getting it done as cheaply as possible, but not at the sacrifice of thoroughness. Plow, and when going deeper than eight inches, use a sub-soil plow, for the soil bacteria is contained in the first six or eight inches, and that part should be kept near the surface. After the plowing use a disk, then harrow and disk again. Apply manure before the plowing, if available, but when not obtainable the extra harrowing and disking will in a measure make up for the manure in creating conditions for retaining moisture when temperature for growing conditions is right. Disk and harrow each twice and more if you can. Then after planting follow up with one of the improved cultivators, where the plants are set in rows.

The disks, cutaway harrows and the improved seed planters, wheel hoes, horse cultivators are labor-saving implements. Endeavoring to produce a crop at as low cost as possible is the aim of the successful progressive farmer, and with that purpose in view he selects the particular implements and tools which will best suit his need and uses them effectively.

Starting the Plants

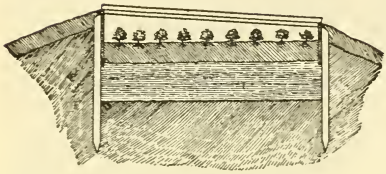
By S. W. Fletcher.

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.

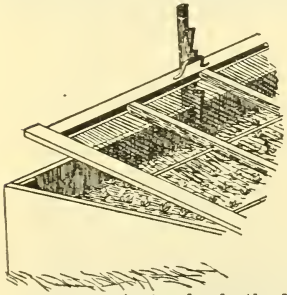
Our short season makes it necessary to start tomatoes and cabbages under glass or in the house. Watermelons and muskmelons also are often benefited by being started on pieces of sod or in strawberry boxes; but the difficulty of hardening them off so they will stand transplanting to the field usually 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, prefereably 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.

How to Make a Hotbed



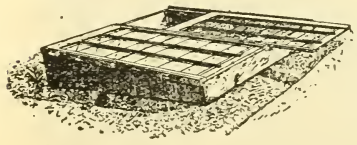
Select an open, sunny position, with a slope to the south, with a building, tight board fence, or other wind-break on the north side. About three feet from this wind-break drive a row of stakes about three feet apart, making the row the proper length to be covered by the number of sash which you wish to use, and driving them at least two feet into the ground. Board up the south side of these stakes, preferably with two-inch planks, but one-inch will do, to a height of fifteen inches. About six feet south of this wall, drive another row of stakes, and board up on the north side of these stakes to height of nine inches. Board up the ends, sloping them from top of back wall to top of front wall, making a slope of six inches toward the south. The width of this enclosure should be such as will be covered by a sash six feet long, and the length to be covered by one, two, or more, sash three feet wide, allowing space for a strip of wood one inch thick between each two sash. For four sash the outside dimensions of the frame should be five feet ten inches wide by twelve feet three inches long, not including the stakes. The standard size of hotbed sash is three by six feet. At the place where the sash meet, place a strip of one or two inches thick and three inches wide, from top of back wall to top of front wall, for sides of sash to rest on, setting them into the walls so that tops will be flush with tops of wall. On the upper side of these strips nail strips one inch thick and as wide as the sash are thick, to act as jambs between the sash.



Excavate inside this enclosure to a depth of twenty-eight inches from top of south wall, and thirty-four inches from top of north wall, using the dirt to bank against outside of frame to within three inches of the top; later this embankment should be covered with three inches of manure.

To provide heat for the hotbed decomposing horse manure is generally used. While a large amount of straw is not desirable, the presence of urine-soaked bedding to the extent of one-third is not objectionable. 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 the pile should be spread evenly in the hotbed, taking care that all corners are well filled, packing it firmly with the fork, and filling it to the proper depth so that when finally tramped it will be eighteen inches deep. 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, but when the temperature has fallen to below ninety degrees the seed may be planted.



During severe weather the sash should be covered at night with mats or burlap, 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 (Fig. 2) or sliding them down (Fig. 3). By the middle of the afternoon the sash should be replaced.

A space of at least three feet should be left on all sides of the hotbed, so that you will have room to work.

A cold frame is made in the same manner, except that there is no excavation under it, and no manure to furnish heat.

This picture shows the instruments used by The Chas. H. Lilly Co. for making seed analysis for purity. The Mixing Machine thoroughly mixes samples from different parts of each bag of each lot of seed, thus insuring a fair sample. The Scale is a very delicate instrument, will show the weight of the tiniest seed, and must be enclosed in a glass case. The operator must be an expert, and be able to name every seed in the sample.

GOOD SEED

The following is copied from Garden and Farm Almanac:

Good seed is worth good money. The quality of the seeds used is such a factor in farming success or failure that it may be broadly stated, as a general rule, that the unsuccessful farmers are the farmers who buy cheap seed. It seems difficult for them to realize that seed at fifteen dollars a hundred pounds can be much cheaper than seed at five dollars a hundred pounds. The up-to-date modern farmer never hesitates to pay the top price for what he wants. Price, indeed, is a small consideration to him; he wants the best quality. This is more especially true of high-grade vegetable seeds.

As the ordinary buyer of seeds cannot tell by looking at them whether they are good or not, he must take the word of the seedsman from whom he is purchasing, and many times the seedsman himself does not know the exact quality or he does not know their history. So buy from a dealer in high-grade seeds who has a reputation to maintain. Cheap seed is expensive! And this cannot be better illustrated than by the following analysis of two lots of red clover seed which were actually bought in the open market, one lot costing five dollars and twenty cents a hundred pounds, and the other fifteen dollars a hundred pounds:

	Sample 1	Sample 2
Percentage of weed seeds	25.78	.09
Percentage of dirt, sticks and stones	26.16	1.08
Percentage of red clover seed	48.08	98.83
Percentage of red clover seed that germinated	18.25	95.86
Number of weed seeds per pound	139,727	150
Actual cost per hundred pounds of red clover seed that germinated	$28.48	$15.65

Obviously the farmer who bought the cheap seed made an expensive investment. Had he bought one-third the quantity, buying good seed, he would have had twice as big a crop. The temptation to mix good and poor seed or otherwise to adulterate what they

sell is apparently a temptation too big to be resisted by some dealers, as the profits are so large and the risk of detection seemingly small.

But whether the seed is adulterated intentionally, or whether it is just naturally poor, makes little difference to the farmer. The result is the same to him in either case —wasted money and a poor crop. He gets it at both ends—spends money for nothing in buying poor seed and spoils a crop by using it, which costs him more money.

The United States Department of Agriculture is trying to suppress seed adulteration by publishing, by authority of laws recently enacted, the names and addresses of firms known to sell adulterated seeds or who misbrand the goods they sell.

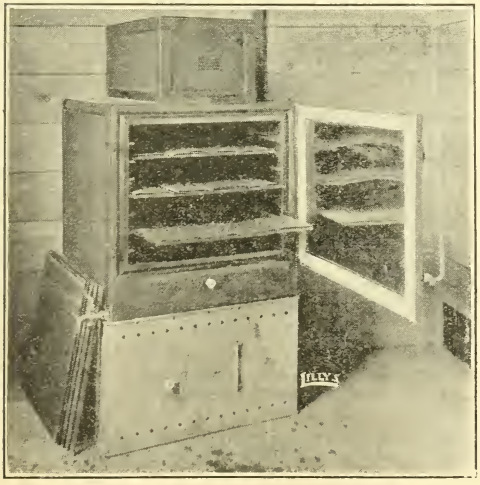
If you buy your seeds from a reputable house you can be assured that you are getting seeds which are practically pure. Yet it is always a good plan to test them before sowing in order that you may know their power of germination. This is especially true of high-bred varieties. Take the cauliflower, for instance; it is a fact that the seeds of the best varieties, which cost fifty or sixty dollars a pound, do not possess as high a germinating power as the seeds of varieties costing only six to ten dollars a pound. Having the percentage of germination, one can sow his seed accordingly.

To make an accurate test, a fair sample of seed must be taken. If a small quantity of not more than five bushels is to be sampled, spread it out thin upon some flat surface —floor or table—and thoroughly mix it by hand, after which small quantities are taken from ten or twelve different parts of the mass and mixed together to form the sample.

It is really much more important to know the germinating power of the seed—how much will actually grow—for practically the only adulteration that high grade seeds contain are "dead seeds" and it is impossible to buy seeds which do not contain at least a small per cent. of these. The seed with the greatest percentage of germinative power is the best seed to use. And the way to test it is as follows:

Take a piece of clean flannel cloth which has been washed and fold it once. Moisten it until it is thoroughly damp but not dripping wet, and lay it upon a dinner plate. Count out carefully enough seed for a fair sample—a hundred is a convenient number if the seeds are not too large—and lay them carefully separated upon the inner fold of cloth, covering with the out fold. Then invert a second plate upon the whole and set in a warm place. The temperature in winter should never be less than 50 degrees at night and 65 degrees or 70 degrees in the daytime. The cloth should not be allowed to dry out, a little moisture being added when necessary, but if the plates fit well together it will stay moist for a long time.

Every day the little germinating chamber must be examined and the sprouted seeds removed, and a careful record kept of the number. When the test is completed, the number of seeds which sprouted is to be compared with the original number and the percentage of good seed thus determined. It is wise to make duplicate tests at the same time, and strike the average between them; but if they vary more than 10 per cent., make a new set of duplicate tests. Tests range in time from a few days to a month; a seed will sprout in a germinating chamber in from one-half to one-fifth the time necessary for it to sprout in the ground.



The free seeds distributed by the government are as a rule very unsatisfactory and in the end very expensive. The experienced gardener always buys good seed of a reliable dealer.

This picture shows a Germinator used by The Chas. H. Lilly Co. for testing seeds for germination. It is heated by electricity, and mosture is supplied automatically. It is the same as those used by the United States Department of Agriculture.

THE VEGETABLE GARDEN.

ASPARAGUS.

Three or four years are required from the time of planting asparagus seed before the tips should be cut for use, but by purchasing one year old roots a little may be used the second year and it will be produced in markable quantities the third year.

One ounce of seed will produce about four hundred plants. About one 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 three inches apart in the rows. As the seed germinates very slowly it is advisable to mix radish seed with it. The young radishes will come up quickly, mark the rows so that cultivation may begin much sooner, and will be used before the asparagus attains any size. 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. The bed 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. A loose, porous, well drained soil is necessary. The flavor of the young shoots depends greatly upon the character of the soil. It is also necessary that the ground should previously have been planted to some hoed crop, and be in a high state of cultivation. A very heavy application of well rotted manure should be plowed under deeply. In addition to this about one thousand pounds per acre of kanit should be applied, and the ground then harrowed repeatedly until it is thoroughly pulverized and the fertilizer thoroughly mixed with it. If there is a hard sub-soil near the surface it should be sub-soiled, that is, it should be broken up to a considerable depth without turning it on top of the surface soil.

It is best to transplant in the spring, any time before June first. Some claim that it must not be done at any other time, but on the Pacific Coast, where the winters are mild, it could usually be done in the fall if for any reason it was more convenient.

There is a great difference of opinion in regard to the proper distance between the plants, some advising that the rows should be ten feet apart, but that distance seems unnecessary, and although the roots spread wonderfully in good soil, we believe that for field culture four feet each way is sufficient, and for the home garden three by three or even three by two feet will be far enough apart.

Plow furrows eight inches deep at the proper distance apart, and mark at right angles so that the rows will be perfectly straight in both directions.

Any sprouts that have started on the plants should be broken off, and about one-third of the length of roots should be cut off, making them even. Set them in 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 with the cultivator as the plants grow, so that by the middle of the summer the ground will be perfectly level.

Cultivation during the summer should be frequent. The tops should be allowed to grow until they are 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 work in the spring it should be thoroughly and deeply cultivated. This may be done with a harrow, or even with a plow provided that it does not cut more than three inches deep, and no attention need be paid to the rows at this time of the year, for the roots being six inches deep will not be harmed. It will be found profitable to apply a half ton of kanit per acre each spring. Asparagus requires a great deal of salt, and the large amount of salt in kanit makes it the best fertilizer for asparagus; it also contains some potash which is beneficial. It should be applied broadcast and cultivated or harrowed into the soil. Do not use it after the spring rains have stopped and the ground has become dry. Some of the young shoots may be used this, 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 fall, then cut close to the ground and burned. The following season will be a repetition of this, except that nearly a full crop 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 not to injure other sprouts.

These instructions are for producing the green tips. If the white asparagus is preferred the soil should be ridged around the hills to blanch the sprouts, and they should be cut four or five inches below the surface.

ARTICHOKES—GLOBE.

There are two distinct varieties of artichokes. The kind commonly called "Globe" is the one used for the table. Sow in hotbeds in the late winter or early spring, and transplant so as to give plenty of room until danger of frost is over. Then set in very rich, well drained soil about four feet apart and two feet apart in the row. The edible portion is the undeveloped flower head, which is produced about the first of September until frost. Late in the fall cut off the tops and thoroughly protect the crowns with leaves or straw, to prevent freezing. The second year thin the starting shoots to three of the best, which will commence to form about July 1. The plants may also be blanched, which is accomplished by cutting back the stems close to the ground in July. The rapidly forming shoots which then start may be tied and blanched. As artichokes do not yield satisfactorily after three or four years it would be well to set out a new bed every three years. Use 500 to 800 pounds per acre of a fertilizer containing Nitrogen 4 per cent, Potash 9 per cent, and Phosphoric Acid 8 per cent.

ARTICHOKES—JERUSALEM.

The Jerusalem artichokes are good hog feed and are raised from roots or tubers. The cultivation is the same as for potatoes.

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. There is an old rule that beans should not be cultivated while wet with dew or rain, but we do not know why, and have never seen any harm come from it.

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 hot-bed and transplanted to the garden. They require a great deal of potash, and a complete fertilizer analyzing nitrogen 3%, phosphoric acid 6%, and potash 11% will improve quality and increase quantity.

BEETS—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.

A very satisfactory garden vegetable that does well wherever cabbages will grow. It produces numerous small heads about one inch in diameter that are cooked like cabbage or cauliflower. They are of a very delicate flavor, and from plants set out in June, about the first week, a crop may be gathered from August until Christmas time in those sections where frost is not too heavy. In the fall the leaves should be broken down to give the little heads more room to grow. Use 1000 to 2000 pounds per acre of a fertilizer containing Nitrogen 3 per cent, Potash 5 per cent, and Phosphoric Acid 11 per cent.

CABBAGE.

It is necessary that cabbage seed for early varieties should be planted under glass. Seeds should be planted in rows about three-fourths of an inch apart, four or five seeds per inch, and covered a quarter of an inch deep. These should be transferred in the field in rows 30 inches apart and plants 24 inches in the row. For a succession about three different varieties should be grown. First one of the early pointed sorts, then a midseason cabbage, and later one of the hard-headed kinds, such as Ball Head. In the Sound country the hard-headed varieties may be left standing in the ground all winter or until such time as they are to be used. East of the mountains they may be pulled and placed heads down in a pit and covered with straw and dirt enough to keep them from freezing. For good results cabbage must be planted in very rich soil and should be

heavily fertilized with well rotted manure or commercial fertilizer containing a large proportion of potash and nitrogen. The cabbage worm must be watched for and destroyed with one of the many good preparations on the market, such as Slug Shot. Use 1000 to 2000 pounds per acre of a fertilizer containing Nitrogen 3 per cent, Potash 5 per cent, and Phosphoric Acid 11 per cent.

CARROTS.

Sow carrot seed as early in the spring as ground can be worked in rows twelve inches apart for hand cultivation and 24 inches apart if cultivated with a horse. Plant at the rate of two pounds of seed per acre and about one inch deep. When planting in the garden radish seed may be sown in the rows and the radish can be pulled before the carrots need the ground. Carrots do well in all sections of the Northwest and make a valuable food for horses and dairy cows, as well as for the table. Use 1000 to 2000 pounds per acre of a fertilizer containing Nitrogen 3 per cent, Potash 11 per cent, and Phosphoric Acid 6 per cent.

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 hot-bed, 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. Use 1000 to 2000 pounds per acre of a fertilizer containing Nitrogen 3 per cent, Potash 5 per cent, and Phosphoric Acid 11 per cent.

CELERIAC.

This is a form of celery in which the root is the edible portion. It requires the same cultivation and conditions as common celery.

CELERY.

This vegetable needs very rich and very moist soil. It cannot be grown in Eastern Washington without irrigation, and even west of the Cascade Mountains the best results are had with a well drained soil that can be irrigated. In the warm, broad valleys in the eastern part, such as the Snake River, celery does well where properly irrigated. Thoroughly reclaimed swampy lands give the heaviest yield and the best flavored celery. These plants, like asparagus, should be fertilized heavily with Kanit. There is probably no other crop of the garden that will produce as much money per acre in the Puget Sound country as celery. The seed should be sown in hot-beds about March 1st. Celery plants should be transplanted once before planted into the garden, and when transplanting it is a good idea to cut off a portion of the tops. On the market there are now many varieties of celery that are called self-blanching, but the best results in blanching are to be had by putting a 12-inch board on each side of the row. This blanches the celery thoroughly and makes a more compact bunch. Set the plants in rows about four feet apart and six to eight inches in the row. Fresh stable manure is liable to make celery coarse, stringy and inferior in flavor, and cause rust. Use only Kanit at the rate of about 1000 pounds per acre.

CHARD.

Swiss chard is a variety of beet grown for the tops only, which are used for greens. Cut the tops off as they are wanted for use, and they will sprout up again. A few short rows in the garden will supply a family all summer. Requires the same soil and cultivation as beets.

CHIVES, or SCHNITTLAUCH.

A plant resembling a clump of bunch grass, but the leaves have the flavor of onions. The leaves are used in soups and salads, giving a mild onion flavor. Plant either seed or clumps of roots in a corner of the garden where they can remain permanently. They need very little attention. Cut the tops off as they are needed for use. Fertilize with stable manure, or a complete fertilizer containing Nitrogen 3 per cent, Potash 5 per cent, and Phosphoric Acid 11 per cent.

CHERVIL.

A hardy annual, largely used for flavoring and garnishing. Sow early in spring in rich, well prepared soil, and when plants are well established transplant to about one foot apart. Use 1000 to 2000 pounds per acre of a fertilizer containing Nitrogen 3 per cent, Potash 5 per cent, and Phosphoric Acid 11 per cent.

CHICORY.

The dried and prepared roots are used quite extensively as a substitute or an adulterant of coffee. Seed should be sown as early in the spring as the ground can be worked, in a rather light, moderately rich soil, in drills 15 inches apart for garden, and two to two and one-half feet for field culture. When the plants are large enough thin to four or six inches in the row. The young leaves make an excellent salad. Fertilize liberally, with stable manure and Sulphate of Potash.

COLLARDS.

A kind of cabbage growing two or three feet high, but does not make hard heads. Extensively used in the South, but not desirable for the Northwest.

CORN SALAD.

Also known as Lamb's lettuce. The plants form rosettes of tender edible leaves, which are used as a substitute for lettuce. May be sown in the spring at the same time and in the same manner as lettuce, or may be planted in the fall like spinach. Use stable manure and Potash or a complete fertilizer consisting of Nitrogen 3 per cent, Potash 5 per cent, and Phosphoric Acid 11 per cent, at the rate of about 1000 pounds per acre.

CORN—SWEET.

This is being grown to a greater extent each year in the Northwest, and varieties that do well here produce corn of most excellent flavor. It requires a rich, warm loam soil that is well cultivated and fertilized, and, although easily killed by frost, it will pay to plant early and take some chances. If there is an early summer the result will be a good crop of corn on the market early, and should a killing frost come it is neither very much trouble nor expense to replant. An earlier crop would be secured if some sort of quick-acting nitrogenous fertilizer is used. It has been demonstrated repeatedly that it pays well to use an abundance of all forms of fertilizers for sweet corn. Hills should be about three feet apart each way, using about six kernels to the hill, and then thinned down to three or four stalks. It requires about 16 pounds of seed to plant an acre. Fertilize liberally with stable manure, potash and super phosphate, or apply 800 to 1000 pounds, per acre, of a complete fertilizer containing Nitrogen 3 per cent, Potash 5 per cent, and Phosphoric Acid 11 per cent.

CRESS, OR PEPPER GRASS.

The variety generally grown is the Water Cress. It will do well in any ditch, shallow stream or moist earth. It is a perennial and easily started by scattering seeds where plants are wanted. Garden cress or pepper grass should be sown thickly in drills every few days for a succession. It should have a rich soil.

CUCUMBERS.

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 air-slacked lime or Slug Shot.

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.

A common weed in many places, but the improved varieties make delicious greens. Seed should be sown in rows early in the spring.

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 nor in the Palouse section. 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. Use at least 2000 pounds per acre of a fertilizer containing Nitrogen 4 per cent, Potash 9 per cent, and Phosphoric Acid 8 per cent.

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.

GINSENG.

Has been grown only in very rare instances in the Northwest, but those who have tried it report that it makes a splendid growth. Seed should be planted one-half inch deep in rows one foot apart and six to eight inches distant in the row. Ginseng prefers rich soil and must have shade. The dried roots of ginseng bring from $5 to $8 a pound.

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 the 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, or BORECOLE.

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.

This is one of the onion family, being somewhat similar to a young onion, but the flavor is milder, and by a great many people is preferred to onion. Seed should be planted as early as danger of frost is over. The cultivation and soil should be the same as for onions, but leek should have a little more room to develop fully.

LENTIL.

An annual plant of the bean family, grown for its round, flat seeds, which are boiled for soup or cooked like beans. It requires a warm, sandy soil, and should be planted about the time soup beans are. Sow in drills 18 to 24 inches apart and harvest when the stems begin to yellow. The seed may be beaten out with a flail when the pods are dry.

LETTUCE.

Where grown for family use the most satisfactory way to get a crop of early lettuce is to make a bed of straw stable manure six inches deep, sowing the lettuce seed mixed with radish on this bed. It is surprising how quickly both the lettuce and radishes are produced by this method. For early use some of the early curled varieties of lettuce are best, but for summer the heading varieties should be planted. These may be sown in a bed and transplanted, or may be sown in rows 18 inches apart and thinned out. Those growing lettuce for the market will find it very much to their advantage to use nitrate of soda very heavily. It produces larger heads of lettuce, which are more tender and of better color.

MELONS—MUSK.

The musk melon requires a quick, warm, sandy loam, and will not make a satisfactory crop unless these conditions are supplied. It is a long season crop, and there are only favored sections of the Northwest, such as Wenatchee and the Yakima Valley, where it may be grown with any degree of good success. Early melons may be obtained by planting the seed under cover on thick sods. These sods should be cut to about four inches square, placed close together, grassy side down, in the hot-bed, hollowed out in the center and a little dirt filled in, and six or eight seeds planted on each sod. Plants should be gradually hardened off and set in the field, sod and all, the three strongest plants being allowed to stand in each hill. A cloudy day or late in the afternoon is the best time for transplanting. Much better results are to be had with melons if some form of nitrogen is used. Nitrate of soda, 200 pounds per acre, or dried blood, 700 pounds per acre, may be used by working it into the soil before the seed is planted. Good results may also be had by dissolving the nitrate of soda in the irrigating water.

MELONS—WATER.

These should receive the same soil, cultivation and other attention as musk melons. If manure is used for fertilizing see that it is very thoroughly rotted, otherwise it will heat and burn out the tender vines before they have attained much growth.

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 they 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.

This is an annual from the West Indies, cultivated for its young seed pods which are used in soups or stewed and served like asparagus. Plant in hills about four feet apart, putting six to eight seeds in a hill, and after the plants are well started cut out all but two. Gather the pods when quite green and about an inch and a half long. Use 600 to 800 pounds per acre of a fertilizer containing nitrogen 3%, potash 5%, and phosphoric acid 11%.

ONIONS.

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 of course 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 top dressing of well-rotted barnyard manure should be used, at the rate of 20 wagon loads per acre, and well worked into the soil. After this a complete commercial fertilizer containing 4 per cent of nitrogen, 8 per cent phosphoric acid and 9 per cent 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, cannot be too rich. The most successful growers use, in addition to the above, from 250 to 500 pounds per acre of nitrate of soda, applied broadcast in three or four different applications during the season. 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, as it is very hardy. 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.

This plant is a low growing perennial and is harvested by cutting the leaves. It wants a rich, mellow soil, such as is found in the well manured and well cultivated garden. The seed are very slow to germinate. It should be sown early in the season in rows 10 to 12 inches apart and the plants should be three or four to the foot. Plants will live outdoors all winter, but in sections where there is a heavy frost they should be protected with a little straw or a board.

PARSNIP.

For this vegetable the same conditions and cultural directions will suffice as for the carrot. Great care must be used in seeing that the seed is fresh, and from reliable sources, as this is one of the most short-lived of all seeds. The crop may stand in the ground over winter, and is improved by freezing.

PEAS.

Peas are very hardy, 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. The extra-early round, smooth varieties are the most hardy, but are inferior in flavor, and since there are now some improved wrinkled varieties which are sufficiently hardy and are very nearly or quite as early, we do not recommend planting the smooth varieties. Many prefer the dwarf varieties, growing twelve to fourteen inches tall, as they do not require any support, but the taller varieties are more satisfactory, being more easily picked, yield more abundantly, and the peas and pods are larger. It is a very easy matter to make supports by driving stakes in the rows about six feet apart and three to five feet high, according to variety grown, and stretching between them twine, wire

or poultry netting. For garden culture they are usually planted about three to four inches deep in drills thirty inches apart, dropping the seeds about one inch apart. They may be planted very early in spring, and for succession, every two weeks until the middle of June. On the Pacific Coast, where the winters are mild, they may be planted on rather light, porous soil in November, as instructed elsewhere for sweet peas, and will be ready for use about the first of June. Considerable well-rotted manure should be mixed with the soil. The seed should be planted six inches deep when planted in the fall. It was formerly supposed that only the extra early, smooth sorts could be planted in the fall, but we have had splendid success with Thomas Laxton and Gradus when planted in November. Early peas may be planted between rows of cucumbers, squashes, melons or pumpkins, and will be out of the way before the ground is required by the vines. If the soil is inclined to be sour or heavy an application of air-slacked lime will be very beneficial. Although a good crop may be grown on ordinary soil, increased yield and better quality will amply repay an application of stable manure and commercial fertilizer in which potash and phosphoric acid predominates. One pound of seed is required for fifty feet of drill; two hundred pounds for one acre.

PEPPERS.

These may be grown in all sections of the Northwest, but in the Sound region it is necessary to start the seed under glass. They require a warm spot in the garden, and should be protected from cold rain or wind. East of the mountains, if planted out early, it will be necessary to protect them on nights when there is danger of frost. Use 1,000 to 2,000 pounds per acre of a complete fertilizer containing nitrogen 4%, potash 9%, and phosphoric acid 8%.

PUMPKINS.

This vegetable thrives best in a warm, sandy loam, but should not be planted until all danger of frost is over, and on the west coast until the land is thoroughly warm. In growing table pumpkins, if there is danger of their not maturing, they may be benefited by pruning. Confine the vines to about three runners, and when the fruit is set cut off the tops of the vines. This throws all the energy of the plant into producing fruit, and at the same time allows the sunlight to penetrate through the vines. Fertilize same as melons.

RADISH.

This is a hardy, quick-maturing early season garden crop. It does best in rather cool weather. For the earliest radishes sow with lettuce seed as described under lettuce. Some of the newer varieties are good throughout the summer, and may be sown in drills about 12 inches apart, covered one half inch deep. As a rule, however, radish may be sown with some other slow growing crop, as they are large enough for the table within four to six weeks from the time of planting. One ounce of seed is sufficient for 100 feet of row. Winter radishes are grown like turnips, and should be planted in the latter part of July or during August. A good dressing of nitrate of soda will stimulate the growth and insure tender, brittle roots. To keep up a supply for the table, make successive sowings from a week to ten days apart.

RHUBARB, OR PIE PLANT.

This should be in every garden, as it comes in very early in the season and takes the place of fruit. It is sometimes propagated by division of the roots, but the best results are to be had by setting out small plants grown from seed. Plant on mellow soil in rows five feet apart and about three feet apart in the rows, with crown about four inches below the surface of the soil. The soil for rhubarb should be extremely rich, and a good surface dressing should be applied every season. Rhubarb may be easily forced in the cellar or cheap sheds constructed especially for the purpose. There is good money to be made in this industry, and there have lately been introduced some very superior varieties of forcing rhubarb. For forcing it is necessary to have plants two years old and transplant them in the fall with large clumps. These should be placed in a bed of manure and buried three or four inches deep in moist sand. Better rhubarb will be had by keeping it very dark about these beds. Rhubarb will also come earlier if light is excluded.

RUTABAGA.

This is a variety of the turnip family, and should be given the same soil and cultivation as the latter.

SALSIFY, OR VEGETABLE OYSTER.

Grown under the same conditions as parsnip. In many sections of the Northwest, if permitted, salsify will grow wild. It is easily grown everywhere.

SPINACH.

An annual plant used for greens. It is very hardy, and does best if sown early in the spring or late in the fall. Sow in rows about 12 inches apart, and begin thinning out the plants when the leaves are an inch in width. It should have very rich ground —the richer the better. In the early spring one of the thick leaved varieties should be planted and in the fall sow some of the winter varieties.

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. Where frosts occur 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. Fertilize same as melons and pumpkins.

TOBACCO.

This is an annual plant and will do well in the warmer sections of the North. The seed should be sown as eariy as possible after danger of frost is over. A good plan is to burn a quantity of brush and rubbish in the spring on the ground where the tobacco is to be raised, then dig and thoroughly pulverize the earth and mix with the ashes. After which the seed may be sown and covered very lightly. When the plants are about six inches high transplant into rows four or five feet apart each way and keep up a thorough cultivation. Do not use stable manure, but it should follow a crop which has been heavily fertilized with stable manure. In addition apply sulphate of potash liberally, or a complete fertilizer containing nitrogen 4%, potash in the form of sulphate 9%, and phosphoric acid 8%. Do not use muriate of potash, kanit or other fertilizer containing chlorine.

TOMATOES.

Should be sown under glass and then transplanted into boxes, or they may be replanted into berry boxes containing one plant each. These should be gradually hardened off, so that by the time they are of sufficient size to set in the garden they will be able to stand the outdoor weather without suffering a setback. They require a rich, warm, sandy loam. In the Sound country tomatoes may be successfully grown by staking. One stake should be used to each vine and a couple of wires run lengthwise of the rows, the first one 12 inches from the ground and the next one about 30 inches. This will form a sort of trellis for the vines, which should be then pruned to about three stems. This pruning increases the size of the individual fruits, also allows the sunlight to reach the blossoms and fruit, thus promoting a much earlier crop. This may look to the reader like considerable trouble, but two vines thus cared for will produce more fruit and at a much earlier season than will a dozen vines allowed to grow in their own way. Use 1,000 to 2,000 pounds per acre of a complete fertilizer containing nitrogen 4 %, potash 9%, and phosphoric acid 8%.

ASPARAGUS AND TOMATOES UNDER IRRIGATED CONDITIONS.

ASPARAGUS.

From The Northwest Horticulturist.

A very successful asparagus grower in the vicinity of Kennewick, Wash., starts it on sandy soil as follows: Furrows are laid off in the early spring about 15 to 20 inches apart. After scattering partly decayed stable manure in the furrows water is turned on to thoroughly soak up the soil and manure. Nitrate of soda is then applied and the soil cultivated while it is still moist. Seed that has been soaked in warm water for at least twenty-four hours is planted in drills laid out over the furrows in which the manure and nitrate of soda were applied. The seed is sown in the drills about 1½ to 2 inches apart, and when the plants are started well they are thinned to 3 or 4 inches. After sowing the seed the land is irrigated frequently and the soil cultivated while damp. Cultivating while the soil is moist keeps it from drifting so easily.

When the plants are one year old they are transplanted in rows 4 or 5 feet apart. Ditches 8 inches deep are laid off, into which the manure is scattered and soaked as when planting the seed. The yearling plants are set 18 inches apart in the rows. The crowns should be 6 to 8 inches below the surface of the ground. Irrigation is frequent and manure is liberally used. One year from the date of transplanting, cutting the shoots for market begins. By purchasing the yearling plants for transplanting one year may be saved.

Tomatoes.

When they do not suffer too heavily from blight, tomatoes are a profitable crop. Gardeners in the vicinity of Sunnyside, Wash., have adopted the practice of growing tomatoes in drills. The seed is sown in the open field from April 1 to 15, at the rate of 1 to 3 pounds per acre. The drill rows are usually about 4 feet apart. The percentage of plants that blight are about the same whether grown in hills or drills. By sowing plenty of seed in drills there are enough plants which escape the blight to make the crop. Some even claim that a much smaller percentage of the plants blight when grown close together in the rows.

TURNIPS.

Seed should be sown in July and August, in drills for table use and broadcast for a stock feeding crop. Plants are not injured by frost, and make the best growth in cool weather. For the table they should be sown in rows about 18 to 24 inches apart. An acre requires from two to three pounds of seed. The ground should be rich and freshly plowed. Turnips may be sown on a piece of land that has been used earlier in the season for peas or some other garden crop. Sheep or cow manure is better than horse manure, or use a complete fertilizer at the rate of 500 to 800 pounds per acre, consisting of nitrogen 3%, potash 5%, and phosphoric acid 11%.

SOME INSECTS
Most Destructive in the Vegetable Garden.

CABBAGE WORM.

A common white butterfly, with black spots on the wings, measuring about one and one-half inches with wings extended, deposits the eggs on the leaves of cabbage, cauliflower, kale and brussels sprouts. The worms are green, round, velvety, and are about one and one-quarter inches long when they become full grown, which is about two weeks after they are hatched. They are very destructive, and will completely destroy the plants if not attended to.

Spray, as soon as the plants are set out, with Electro Powdered Arsenate of Lead, at the rate of 1 pound to 50 gallons of water, and repeat if necessary. Careful experiments have proven that there is no danger in eating cabbages which have been sprayed with Arsenate of Lead.

CUTWORMS.

There are several varieties of cutworms, all of which are the larvae of night-flying moths, are rather thick, naked worms, three-quarters to one and one-quater inches long, and are similar in habits. The eggs are deposited on the branches of trees and shrubs, the larvae descending to the ground in search of food as soon as hatched. Most of them feed upon grass or clover when young, becoming about half grown by winter, when they burrow into the ground. In spring they attack a variety of young plants, cutting off the stems just below the surface of the ground. They are very destructive, and difficult to exterminate. There are three methods which have proved more or less effective. Mix four parts of bran or middlings with one part Electro Powdered Arsenate of Lead, and sweeten with molasses. Sprinkle this poisoned bait on the ground near the plants. Be careful to keep poultry and animals away from the poison. Small pieces of boards may be laid on the ground, and the worms will come to the surface under the boards, where they may be destroyed early in the morning. When plants are found cut off, the worms may be dug out with the fingers and destroyed, to prevent further depredations.

ROOT MAGGOT.

One of the most troublesome pests in the garden. A small two-winged fly resembling the common housefly, appears in spring and deposits eggs about the stems of plants at surface of the ground. From these eggs are hatched little whitish maggots which attack the roots of garden plants such as radishes, turnips, cabbage, etc. They are very difficult to destroy, and no thoroughly effective method has yet been devised. The Washington State Agricultural Experiment Station recommends spraying the ground around the plants with Carbolated Lime, which is prepared as follows: Slake 10 pounds of lime in a little water, add 1 pint or more of crude carbolic acid and enough water to make 50 gallons. The spraying should be repeated at frequent intervals, and the soil should be frequently and thoroughly cultivated.

THE FLOWER GARDEN.

Following are lists of some of the most popular and pleasing annual and perennial plants which may be easily grown from seed, arranged to assist in selecting plants most suitable for various purposes:

Annual Plants for Beds or Tall Borders, growing one to two feet high.

Adonis, Ageratum (Tall), Amaranthus, Asters, Balsam, Calliopsis, Candytuft, Centaurea, Chrysenthemums, Clarkia, Dahlia (Annual), Dianthus, Eschscholtzia, Four O'Clock, Gaillardia, Godetia, Gypsophila, Larkspur (Dwarf), Linum, Lupins, Marigold, Mignonette, Nasturtiums (Dwarf), Nigella, Petunia, Poppy, Scabiosa (Dwarf), Schizanthus, Stocks, Zinnia.

Perennial Plants for Beds or Tall Borders, growing one to two feet high.

Antirrhinum, Aquilegia, Carnation, Cineraria, Columbine, Gypsophila Paniculata, Pentstemon, Pyrethrum Hybridum, Sweet William, Wallflower.

Annual, Tall Growing Plants for Grouping, growing two feet or more in height.

Amaranthus, Arctotis Grandis, Calliopsis, Cosmos, Helianthus. Hollyhock (Annual), Larkspur, Nicotiana, Ricinus, Salpiglosis, Scabiosa (Tall).

Perennial, Tall Growing Plants for Grouping, growing two feet or more in height.

Canna, Campanulla, Chrysanthemum (Marguerite), Foxglove, Hollyhock, Lychnis, Salvia, Snapdragon, Wallflower.

Annual Edging Plants, six to twelve inches high.

Ageratum (Dwarf), Alyssum, Calendula, Candytuft, Centaurea, Cockscomb, Dianthus, Lobelia, Marigold, Mignonette, Nasturtium (Dwarf), Nemophila, Pansy.

Perennial Edging Plants, six to twelve inches high.

Daisy, Forget-me-not, Pansy, Iceland Poppy, Primula, Pyrethrum, Violet.

Plants for Rockeries, Hanging Baskets or Window Boxes.

Lobelia (Trailing), Mimulus, Portulaca, Thunbergia, Verbena.

Annual Climbing Vines, growing six feet or more in height.

Calempelis, Canary Bird Flower, Cobea Scandens, Echinocystis, Gourds, Japanese Hop, Mina Lobata, Moon Flower Vine, Morning Glory, Nasturtium (Tall), Sweet Peas.

Perennial Climbing Vines, growing six feet or more in height.

Adlumia Cirrhosa, Kudzu Vine, Smilax.

ARRANGEMENT OF FLOWERING ANNUALS.

By Eben E. Rexford, in The Farm World.

Personally, I am not much of an admirer of carpet or ribbon bedding or the "designs" which the enthusiastic amateur gardener frequently attempts, but is pretty sure to abandon later in the season, because he discovers that designs work out unsatisfactorily in annuals.

The fact is, carpet-bedding plans are only effective when such foliage plants as the Coleus, Achyranthes, Centaurea, Pyrethrum and Alternanthera are used, because they can be kept within their proper limits by shearing and pruning, while the annuals have too much "sprawl" to be tractable, and very few kinds give a sufficient mass of bloom to produce the desired color effect.

We are likely to think that because a plant has yellow, red or blue flowers, that it will prove effective wherever these colors are desired, but we lose sight of the fact that the flowers will be so few in number and so far apart that there is seldom any solid color effect such as is necessary in properly working out patterns.

This being the case, only the simpler designs should be attempted with annuals, and only such effects aimed at as can be produced by contrast in which harmony plays an important part.

Ribbon beds are easiest of all to make. Very pleasing ones can be made with pink, pale yellow and white Phlox Drummondi, planted in rows. If darker colors are preferred the scarlet and crimson can be used, always combining them with white to give the necessary contrast and relief.

Do not use the soft delicate colors with the stronger tones, as there is a lack of harmony between them.

Asters can be planted in rows of white and lavender, with very pleasing results, provided the same kind is used in each row.

If we were to use the tall, branching variety in one row and dwarfs in another, the effect would be unsatisfactory, though the tall-growing sorts could be used in three rows—one each of the colors named—with the dwarfs as an edging or border, with very good results.

Ribbon beds would become monotonously tiresome if we were to confine ourselves to them, therefore it is advisable to have something else for a change.

Next to them the circular bed is easiest to make. I would not advise too many colors. Have the center of one color, say lavender; if asters are used, then a row of pale pink, with white in the outside row. This arrangement of colors can be varied to suit individual taste. If sweet alyssum or white candytuft is used as an edging the effect is heightened, as these plants bring a mass of foliage down to the ground, and hide the tall stalks of the asters.

A very brilliant combination is made by filling the center of a circular bed with calliopsis, rich yellow and maroon, and surrounding it with white and pale-yellow phlox. The contrast between the dark, rich yellow of the calliopsis and the softer shade of the same color in the phlox is charming. If another color seems advisable, use pink phlox. This harmonizes beautifully with the stronger tones of the calliopsis.

The center of a circular bed can be filled with scarlet salvia, with nasturtiums as a border. The contrast between the fiery scarlet and the rich tones of yellow and orange and sulphur found in the latter plant is exceedingly lovely, while the pea-green foliage of the nasturtium affords just the right amount of that color to bring into strong relief the blossoms of both plants. Such a bed anyone can make with very little trouble.

A charming hedge is made by planting scarlet salvia in a row as a background, then a row of white nicotiana, with blue ageratum as a border. Here we have the patriotic colors of our flag effectively combined. The blue of the ageratum and the scarlet of the salvia would prove a rather violent contrast if planted next each other, but separated by the white of the nicotiana, their aggressiveness is toned down in such a manner as to produce a pleasing effect.

A beautiful hedge is made by using zinnias in the back row, then calliopsis, with white phlox as a border.

Fine effects are secured by the liberal use of ricinus. This plant will grow to a height of seven or eight feet in rich soil, with leaves often a yard across, of a rich bronze-green, overlaid with a coppery lustre. It is advisable to have three or four plants in a group, as the more stalks there are the more solid the effect. One plant seldom proves satisfactory, because of a lack of branches. Used in the center of circular beds I consider it far superior to canna or caladium, because of its stronger, statlier habit of growth and its rich, tropical foliage. If used as a screen, plant thickly and mass

some such plant as zinnia, calliopsis or nasturtium in front of it. Being quite tender, seed should not be put in the ground until danger of frost is over.

Ribbon beds can we worked out with good effect by using different colors of the verbena in rows. Such beds are most pleasing when near the house or close to the path, where they can be looked down upon. But in order to carry out such plans with this flower, it will be necessary to purchase plants of each color from the florist, who grows them from cuttings. Seedlings are quite sure to bring plants of all colors common to the family, therefore are not to be depended upon where it is absolutely necessary to have each color in its proper place.

Those who have old plants of geranium, which have been kept over the winter in the house, can utilize them in the summer by planting them out. Of course the effect will be most pleasing if the pinks and scarlets and crimsons are kept by themselves. Try combining them with such annuals as white phlox, yellow calliopsis, white nicotiana, or, in case of pink sorts, lavender ageratum. If you have old plants of Madam Salleroi geranium, break them apart and use the cuttings so secured, for border purposes. Each cutting will be almost sure to take root. Put them in the ground where they are to grow, about eight inches apart, pinching the soil firmly about the base of each. In six weeks' time they will have made a fair showing, and by mid-summer they will have grown together in a most attractive row of green and white. This is one of our best edging plants.

AGERATUM.

The best anual 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 bushlike 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.

Grows about nine inches high and bears a profusion of large spikes of small white flowers, and is splendid for borders, edgings, baskets, pots, rockwork, and for cutting. For borders the seed should be sown thickly, to form masses. For winter bloom, sow in August and thin to four inches apart. For spring bloom and for borders sow in the open early in spring, or late in the fall in mild climates.

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.

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.

CALANDULA or 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.

CALIFORNIA POPPY (Eschscholtzia).

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.

CALLIOPSIS.

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.

CANDYTUFT (Iberis).

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-shaped 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.

CASTOR BEAN (Ricinus).

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, calad-

iums, 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.

CHRYSANTHEMUMS.

The large-flowered types of chrysanthemums, which produce such gorgeous shows in the florists' stores, are not hardy, and must be grown in the green-house. 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.

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.

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.

COCKSCOMB (Celosia).

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.

COLUMBINE (Aquilegia).

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 to a profusion of [illegible] 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.

CORN-FLOWER or BACHELOR'S BUTTON (Centaurea).

A hardy annual, growing about two feet high, and producing a profusion of bright blue flowers. Seed should be sown in the open ground in April or May and the plants thinned to four inches apart. There are also perennal varieties.

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.

FORGET-ME-NOT (Myosotis).

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.

FOUR-O'CLOCK or MARVEL OF PERU (Mirabilis jalapa).

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.

FOXGLOVE (Digitalis).

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.

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 hot-bed 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 (Evening Primrose).

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.

HOLLYHOCK (Althaea rosea).

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.

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 shrubbery 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.

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.

MARIGOLD (Tagetes).

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 (Reseda).

No garden is complete without a plentiful 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.

MOON FLOWER VINE (Impomoea bona-nox).

A very rapid-growing climbing annual, invaluable for trellis or arbor, quickly attaining a height of twelve to fifteen feet. Seed should be sown in bot-bed or in boxes or pots in the house earil in March, and the plants transplanted to the open ground after all danger of frost is past. The seeds have a very hard shell which should be filed thin on one side or soaked in warm water two or three days to soften it. Set the plants about one foot apart.

MORNING GLORY or CONVOLVULUS (Impomoae purpurea).

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.

NASTURTIUMS.

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.

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.

PANSY (Viola tricolor).

The pansy, sometimes called heartease, 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. The writer has several plants which are two years old, and are loaded with blooms from early in spring until late in the fall. 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 hot-bed, 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 (Phlox drummondii).

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 hot-bed 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, thor-

oughly 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 hot-bed 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 hot-bed.

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 (Papaver).

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.

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 rock-work, 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.

SALVIA (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 bot-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.

SNAPDRAGON (Antirrhinum).

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.

STOCKS (Matthiola).

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 above 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 complete fertilizer containing nitrogen 4%, potash 9% and phosphoric acid 8%, 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.

The Cupid, or Dwarf, varieties do fairly well east of the Cascades, but are of no value on the coast. The new Double Sweet Peas are useful mostly as a novelty; they are no more beautiful than the single varieties, and little more than half the flowers are double.

Sweet Peas are exceptionally free from diseases and enemies. They are seldom troubled by anything except cut-worms, which cut off the young shoot just after it is up. There is no sure cure for cut-worms except digging around the plants and removing the worms. Working slacked lime or potash into the soil will sometimes help; a handful of grass dipped in a solution of paris green and placed on the row may kill them; or if shingles or short pieces of boards are placed on the ground the worms will come to the surface under them and may be destroyed.

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 bot-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.

ZINNA (Youth-and-old-age).

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.

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 the best varieties you will soon have an abundance.

Peonies

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 ofAugust as the bulds 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.

Roses

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 waste 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 no 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 varieties 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 which are desired to cover buildings or trellises may be pruned only sufficiently to remove old or dead wood and to make them conform to the space to be covered; but better flowers may be had by pruning them the same as blackberries; that is, removing all old wood, and leaving only four or five canes of the previous season's growth.

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 arenate of lead diluted at the rate of one pound to forty gallons of water. Green Aphis is the most common pest. To destroy the eggs, spray with lime and sulphur solution, diluted one part solution to eleven parts water, 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 temperature or stagnant air or soil conditions. Some varieties are more susceptible to it than others. Dust the foliage in the evening with sulphur or Grape Dust; 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 inclined 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 analyzing about 5% nitrogen, 8% phosphoric acid, and 5% potash 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 rejuvinate it almost immediately. Comemrcial 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.

HORTICULTURE

THE PRUNING OF 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 so 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 heavy 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 produce 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 part 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 secures 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 experiments 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 Wagener should be headed a little higher. It is frequently difficult to secure sufficient well placed branches upon a large one-year-old transplanted Wagener 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, removing almost as much wood each year as it produced the preceding 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.

The following bulletin contains the results of experiments and observations in connection with the investigation of the possibility of utilizing small and bush fruits as an inter-crop in commercial orchards and for the home vegetable garden, as described in Popular Bulletin No. 25.

The currant is one of the few plants that if planted at all in the home garden is permitted to grow at will, usually more or less choked with grass and weeds and rarely or ever given any pruning or cultivation. While it will exist under such conditions, it rarely gives satisfactory returns and so for this reason is not generally considered a profitable commercial crop. On good rich soil and under thorough cultivation the currant may be made a profitable crop in many parts of the state.

Propagation. The currant, like all other cultivated fruits, does not "come true" from seed, so, for this reason, it is necessary to propagate it by means of cuttings, layers or division.

The wood from cuttings should be of the current year's growth and may be taken any time between the falling of the leaves in the summer and the beginning growth in the spring. The strongest plants and most satisfactory results are usually secured from cuttings made early in the fall and planted immediately. The cuttings are usually made from seven to eight inches long. The lower end should be cut just below a bud while the upper end may be from one to two inches from a bud, depending upon the length of the wood. If the cuttings are made late in the fall or during the winter it is usually best to pit them in a callousing pit or pack them in damp moss or soil in a cool cellar until early spring. They should then be planted in deep, rich, moist soil in nursery rows three or four feet apart and the cuttings six or eight inches apart in the row. Plant down to the top bud making the soil very firm around the base of the cuttings in order to prevent drying out during the summer months. After from one to two year's growth the plants will be in excellent shape to set in the permanent plantation.

Soil. Almost any good rich soil of sufficient depth and fertility to produce a good crop of grain will produce good 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 conditions. 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 transplanting 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 6x6 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 currant 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 currant 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 fruiting 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 cur-

rant 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 three 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.

Harvesting and Marketing. Since the currant is largely used for jellies and spice purposes, a rather tart fruit is more desirable than a thoroughly ripened fruit. For this reason as well as the better shipping habits of slightly green fruit, currants should be picked just before they are ripe rather than after they have become fully ripe. Fruit picked while it is cool ships much better than fruit picked during the heat of the day. Under no consideration must fruit be picked while it is wet with rain or dew as it soon spoils if handled while wet. The bunch should be removed whole from the plant and kept whole, never shelling or stripping the bunches, as it is sure to lower the grade, if not ruin the fruit entirely.

Up to the present time there is no established method here in the west, for marketing currants. The common 24 quart crate is extensively used and is undoubtedly the best and most adaptive western package. A few growers use a ten or twenty pound shallow box for near markets, but find it unsatisfactory for long shipments. The Pony Refrigerator can be advantageously used for the fancy grades but should not be used for anything but the best.

GOOSEBERRIES

By W. S. Thornber, Horticulturist.

Washington State Agricultural Experiment Station Popular Bulletin No. 25.

The very rapid development of commercial orcharding in this State, resulting in the setting out of thousands of acres to fruit trees which will require from three to five years growth before coming into bearing, makes the need for information concerning crops which can safely and profitably be grown between the trees in these young orchards, as well as in the home fruit garden, very apparent. This Station has, therefore, established a small fruit plantation in which investigations for this purpose are in progress. The gooseberry plantation has now been studied for four years, and this report of the notes taken from this plantation, or gathered from commercial orchards is presented as a popular summary of the work up to date.

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 ever 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.

Propagation. While the cuttage method of multiplying the named varieties can be used the same as for many other plants it is not so successful or satisfactory as the layerage method for the gooseberry.

Layering is accomplished by two common methods. One consists of bending the lateral shoots down to the ground and covering their tips with moist earth; the other, of mounding the entire plant with earth. The latter is the more simple and most rapid plan for a nurseryman to follow, while the former is probably best adapted for the amateur, who desires to secure a few for home use. The work of layering is done any time while the plants are in active growth but gives better results when done in early spring than early summer. The rooted tips and layers are usually dug in the fall and either stored in a plant room or immediately planted in nursery rows for another year's growth. When planted in the fall they should be mulched to prevent heaving or winter injury.

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.

Harvesting and Marketing. A large part of the booseberry crop is picked while the berries are hard and green long before they have reached full size, which makes it possible to ship to distant markets in common carriers.

The picking of many American sorts is a tedious, slow, rather unsought task, but the large English sorts, on account of their size and few thorns, are comparatively easy to pick. Like currants, gooseberries should never be picked while wet or hot, since it

very materially shortens their lives as a fresh fruit when handled in this manner. While the green fruit will ship long distances, the ripe will not and must be handled very carefully to avoid heavy loss in marketing.

The common method of marketing gooseberries here in the West is in the 24-quart crate, and while it is a little more expensive than the basket or flat box, yet it places the fruit on the market in first-class shape and nearly always gives better prices than any other method.

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 Mammoth 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 rainfal 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 or 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.

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-glass, 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 tiled 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.

Innoculation.

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 plan 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 thorcughly 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 near-by fields or shipped long distances, the evidence should be clear that the soil is free from the objections mentioned 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.

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. Other people 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.

Method of Sowing.

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 horrow. 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 furnishes 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.

The Seed Crop.

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 WHITE (Trifolium repens).

This is also called White Dutch Clover and is the same as the Irish Shamrock. 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.

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 duriuscula).

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.

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 ryegrass, 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.

MEADOW FESCUE (Festuca pratensis).

This is a valuable grass for use in pastures in a mixture with other grasses. It grows three to four feet high, yields a large amount of hay of excellent quality and is productive on soils which are thin and dry, although it does much better on good soil. It will stand a great deal of abuse and being of long duration is especially valuable for permanent pastures.

It should be sown at the rate of about 20 lbs. to the acre if alone, or in the same proportion if sown with other grasses. The seed of meadow Fescue is very similar in appearance to that of English Rye Grass. In fact it is almost impossible to tell the difference except with a glass.

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).

This is one of our most useful grasses, especially in pastures. In fact no pasture mixture is complete without Orchard Grass, as it comes very early in the year and gives an abundance of succulent feed before any other grass. It will grow in many shady places where other grass will not make satisfactory growth. Orchard Grass is also used oftentimes for hay. It makes a good hay if cut at the right period, but the greatest objection to it, especially in the Williamette Valley and the Puget Sound country, is that it matures too early in the year before there is sufficient bright weather for hay. It also is objectionable in a hay mixture because it matures before the other grasses do, but for a pasture grass and to sow on burns it cannot be excelled. It is not advisable to sow it alone as it grows in clumps or tufts and if sown without other grasses these tufts pull out easily when the stock is grazing and much of the pasture is thus destroyed, but by mixing some of the other deep-rooted grasses with it, it forms a solid turf which will stand much abuse and the Orchard Grass will come in early while, for instance, Italian Rye Grass would come in during the middle of the summer and Red Top would make a late Fall pasture.

There is a great deal of Orchard Grass on the market that is mixed with Rye Grass and Mesquite or Velvet Grass. It is very hard to tell a mixture of 50% unless careful examination is made, therefore it does not pay to buy cheap Orchard Grass, as it usually is a great deal more expensive than to buy the best.

ORCHARD GRASS.

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 lbs. 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 certan 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 entirely 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 river-sides, 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 passed 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 lbs. to the acre.

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 red clover. It is sometimes sown in the fall 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 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 wool-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.

FARM CROPS.

BARLEY.

Barley is to be sown about seventy-five to a hundred pounds to the acre. It produces a good hay, especially the beardless and hulless barley. The hay makes excellent feed for work horses and is considered the strongest feed of any hay grown. The bearded barley makes a good quality of hay but it is not used so much on account of the troublesome beards which get in the horses' teeth and mouths and oftentimes cause considerable trouble. In the section west of the Cascade Mountains, barley can be sown either in fall or spring and in California it is best to sow altogether in the fall as the ground dries out too quickly in the spring and the crop does not have time to mature.

CHEAT (Bromus secalinus).

An annual grass, valuable for low lands. Can be planted in either Fall or Spring. When cut for hay it should be harvested before it gets too ripe. Sow about 100 lbs. to the acre.

CORN, FIELD.

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

The climatic conditions of Western Oregon and Western Washington are not well adapted to the growing of corn (Zea mays). 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.

The following table gives the quantity of water and dry matter in corn at different stages of growth, as determined by the New York (Geneva) Agricultural Experiment Station:

Water and Dry Matter In Corn at Different Periods After Tasseling.

Date of cutting.	Stage of growth.	Corn per acre. Tons.	Water per acre. Tons.	Dry matter per acre. Tons.
July 30	Fully tasseled	9.0	8.2	0.8
Aug. 9	Fully silked	12.9	11.3	1.5
Aug. 21	Kernels watery to full milk	16.3	14.0	2.3
Sept. 7	Kernels glazing	16.1	12.5	3.6
Sept. 23	Ripe	14.2	10.2	4.0

This table is very interesting. The last column shows the dry matter of corn at different stages of growth. 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 as much as corn in the milk; hence, the importance of growing corn for ensilage that will mature. The table also shows the great waste in feeding corn green instead of letting it mature properly and making it into ensilage.

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 1st to the 15th of August. As previously stated early varieties should be planted, and seed grown west of the Cascade Mountains succeeds better than eastern seed.

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 as *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 fom 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 itermediate crop when the soil has become exhausted by the growth of other more 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, how-

ever, 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.

KAFFIR CORN (Andropogon sorghum var.).

United States Department of Agriculture, Bureau of Plant Industry.

Kaffir corn is one of the nonsaccharine sorghums, classing with brown dhoura, the milos, and Jerusalem corn. It will grow on a variety of soils, but does best on one that is fairly rich. It stands drought much better than corn and over much of the drier portion of the country will give a higher yield of grain per acre, while the grain is nearly equal to corn in feeding value. There are two standard varieties now widely grown—the Red and the White, or, as it is sometimes called, the Black-hulled White. This latter name is used to distinguish the white variety now grown from the inferior white sort first introduced and now almost entirely replaced by the Black-hulled White. Probably more than three-fourths of the Kaffir corn grown in this country is of this latter variety. At present this crop is grown most largely in Kansas, Oklahoma, Indian Territory, Northwest Texas, and Southern California. It is also grown to some extent in Arizona and New Mexico and in Southern Nebraska. When grown for grain the yield varies from 15 to 50 bushels per acre. When cut for hay or fodder it yields from 2 to 6 tons per acre. The grain and fodder may be used in the same ways and for the same purposes as corn. Seed may be obtained from farmers and dealers in the sections where the crop is largely grown and from most other seedsmen throughout the country.

Planting.—Any soil rich enough to grow corn or cotton will grow Kaffir corn. The land should be thoroughly prepared by plowing and harrowing. Plowing should be done, if possible, when the soil is moist enough to break up mellow. If cloddy, the field should be disked and harrowed until the clods are well broken and the surface fine and level. When grown for fodder the seed may be planted in rows and the crop cultivated, or it may be sown broadcast or with a grain drill. When broadcasted or drilled the surface should be fine and mellow for best results. When planted in rows it is customary to use a lister, though level planting is sometimes practiced, especially along the eastern edge of the Kaffir belt. For level planting in rows a grain drill with all but two or three holes stopped or a corn planter with special sorghum plates may be used. When planted for grain a lister or corn planter is usually used, and the crop is cultivated the same as corn. This crop is frequently grown on freshly broken sod and usually does well under such conditions with little or no cultivation. Planting should be done rather later than for corn, as the young plants are tender and make but little growth before warm weather sets in. May and June are the usual planting months. When sown with a grain drill or broadcasted 1 peck to 1 bushel of seed to the acre is used, the smaller quantity being used in the driest portion of the Kaffir belt. When planted for grain 3 to 5 pounds per acre are sufficient. The seed should be covered to a depth of 1 or 2 inches. Kaffir corn weighs about 56 pounds per bushel.

Cultivation.—As many of the roots of Kaffir corn are near the surface, shallow cultivation is desirable for best results. Where planted in lister furrows the harrow is usually used at the first one or two cultivations. Then the sled cultivator follows, finishing with some of the common forms of shovel cultivators. When planted on the level the cultivation is the same except that the sled cultivator is eliminated. The field should be cultivated after each heavy rain in order to maintain a dust mulch and prevent loss of moisture. If the crop is broadcasted, no cultivation can be given, but if the crop is cut early for hay a good harrowing will help to retain moisture and push the second crop into rapid growth.

Harvesting.—The methods of harvesting Kaffir corn both for hay and for grain are numerous, varying with the methods of planting, the implements at hand, and the uses to be made of the crop. When planted in rows the stalks may be cut with a corn binder, sled cutter, or by hand and shocked like corn, or the heads may be removed in any one of several ways and the stalks then cut or pastured. The leaves of Kaffir corn remain green much longer than do those of corn, and hence the fodder may be cut after the grain becomes more mature. The best fodder is secured by cutting when the seed is in the hard dough. When grown principally for grain the heads may be removed from the standing crop when well matured, cutting by hand or with a special Kaffir header attached to the wagon box. The grain may be removed from the shocked fodder by laying the heads on a block and cutting them off with a corn knife or broadax, or the heads may be inserted in a thrasher, the grain thrashed out, and the stalks withdrawn. The most improved separators have a circular saw attached, which cuts the heads from the stalks and drops them on the feeding table. The cut heads may be thrashed in an ordinary separator with part of the concaves removed to prevent cracking the grain. When sown in drills the crop may be cut with a grain binder, like wheat or oats, left to cure a few days, and then shocked, or

it may be cut with a mower, raked, cocked, and stacked like sorghum or other coarse hays. In stacking, a sweep rake is commonly used to save handling. Where sown rather thinly the heads are occasionally removed with an ordinary grain header and the stalks then cut for hay.

Feeding.—Kaffir grain is usually considered rather less valuable for feeding than corn, 5 bushels of Kaffir corn being equal to about 4 bushels of corn, although some tests have shown Kaffir corn fully equal to the latter grain. Best results will be secured by grinding the grain before feeding to cattle and hogs, as the hard kernel is not easily broken by animals. If fed whole, much of it passes through undigested. The heads may be fed whole to cattle quite advantageously, as the presence of the stems and hulls causes a more complete mastication of the grain. Kaffir corn is considered an excellent feed for horses and mules, being less heating than corn. The whole plant may be fed like corn fodder and is then nearly equal in value to that roughage. Kaffir hay is reather less succulent than sorghum hay and is usually fed later in the season after sorghum hay has soured from alternate freezing and thawing. Like corn, Kaffir corn is high in carbonaceous or fat-forming material and low in protein or muscle-building substances. For best results some nitrogenous food like alfalfa hay should be fed with it. Kaffir corn is also rather constipating, and this effect is counteracted by the opposite tendency of the alfalfa hay.

KALE, THOUSAND HEADED.

Belongs to the cabbage family, and should be planted and cultivated in a similar manner. It is valuable as a green feed for cattle, hogs and poultry through the winter, from October to April, as it will endure the winters on the coast, and yields thirty to forty tons of nutritious green feed per acre. A deep rich loam is best for this crop, but it will produce good crops on almost any fertile soil if well drained and thoroughly tilled.

Seed should be sown in drills as early in spring as ground can be worked, and transplanted when six to twelve inches high to rows three feet apart each way. It grows about four feet high with a wide spread of leaves. Single plants often weigh thirty pounds. Should have frequent shallow cultivation, to conserve the moisture, until the leaves spread out so far as to prevent further cultivation.

For summer feeding it may be sown in the fall and transplanted early in the spring. Under favorable conditions it will be ready for cutting during July, August and September, but the yield will not be as heavy as that planted for winter use.

Two pounds of seed will produce sufficient plants for an acre.

It is a heavy feeder, and should be heavily fertilized with stable manure applied the previous season, and potash, or a complete fertilizer containing nitrogen 3%, potash 5%, and phosphoric acid 11%, at the rate of 500 to 700 lbs. per acre.

KALE. THOUSAND-HEADED
(Brassica oleracea)

By Dr. Jas. Withycombe, Director Oregon Experiment Station.

This is a forage plant that is worthy of the widest possible range of production. Without question this is the most valuable of all forms of winter succulent feed. It is a large yielder, easily grown and not only ideal for the dairy cow but excellent for fattening sheep and a good winter maintenance ration for swine. There is certainly big money in kale.

From a protein standpoint twenty-five tons of kale equal four tons of bran, worth at present $100. Thus a good crop of kale is worth $100 per acre.

Excellent beef and mutton can be produced from good hay and kale, and the stock hogs can be carried through the winter on this forage plant. Kale is also an excellent poultry food. If the money invested by farmers in condimental stock and poultry foods could be expended in the growing of kale their financial condition would be better, and they would experience much less trouble from sick stock.

THOUSAND HEADED KALE.

By H. B. Scudder, Agronomist, Corvallis, 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 cut-worms 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 transplating, 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 trans planting 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.

How to Feed.

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 Fall Use.

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 irrigated, 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.

OATS.

Oats when sown alone are generally sown about one hundred pounds to the acre, or, when sown with peas or vetches, about sixty pounds of oats to the acre. In the Puget Sound country oats are generally sown in the spring during March, but gray oats and black oats and even white oats are sown in the fall with vetches and peas and they withstand the winter without any trouble.

PEAS, FIELD.

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

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 of hay 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 soon 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 the 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.

POTATOES.

The climate and soil of the Northwest is especially adapted to growing potatoes, we are not troubled with the potato bug, there is always a demand for them at high prices, and many farmers could grow them more extensively to good advantage. Much land that is summer-fallowed could be planted to potatoes, and if properly cultivated, the condition of the soil would be improved for fall planting.

A deep, mellow loam, rich in humus, is best for potatoes, but heavier soils will produce good crops if they contain an abundance of humus. They will not succeed on heavy soil which is inclined to pack, but such soils may be made in splendid condition for potatoes by turning under clover or alfalfa sod, vetch, or other green manure, which will supply humus. Potatoes are also one of the best crops for new land. If stable manure is used, it must be well rotted and thoroughly mixed with the soil; otherwise it is almost sure to make the potatoes scabby. It is better that the manure should have been applied to the previous crop. If commercial fertilizer is used, it should contain a large proportion of potash. A sack of Sulphate of Potash to each acre, in addition to stable manure, would pay big interest on the investment, as stable manure contains very little potash, and most of the soil west of the Cascades is deficient in potash. Muriate of Potash should not be used on potatoes, as the chlorine which it contains is harmful to that crop, although it may be used on most other crops equally as well as sulphate. Potatoes should not be planted on the same ground two seasons in succession, especially if the first crop has been infected with scab.

It is best to plow the land in the fall, especially if the soil is heavy, and leave it rough, to be broken up by the action of the weather during the winter. If impossible to plow in the fall, it should be plowed as early as the soil is in proper condition in the spring, immediately harrowed, and repeatedly harrowed and disced until ready to plant. If at all cloddy, a clod-crusher should be used. Early potatoes should be planted as early in spring as soil and weather conditions will permit. Late potatoes may be planted as late as the middle of June, provided sufficient moisture can be depended upon; otherwise they should be planted early. The farmer who plants five or six acres will find it economy to have a horse potato-planter. If to be planted by hand, furrows should be made with a shovel-plow, the proper depth, after the ground has been thoroughly prepared and pulverized, and after the seed is dropped, cover with the plow, and harrow thoroughly. Late potatoes in porous soil should be planted about six inches deep, but early potatoes, or late potatoes in heavy or wet soil, should not be planted more than three or four inches deep. The rows should be two and one half to three feet apart, and the hills twelve to eighteen inches apart in the rows, according to varieties and soil. Rich soil will stand closer planting than poorer soil. Varieties which produce very large tubers should be planted closer than smaller varieties.

Not enough care is taken by most farmers in selecting seed. With potatoes, as with everything else, like will breed like, and continual breeding from poor stock will produce inferior potatoes. Not only should the most perfect potatoes be selected for seed, smooth, medium size and free from scab, but they should also be selected from the best hills. Potatoes selected at planting time, although perfect in every way, would as likely as not come from a vine which produced only the one potato, so that they should be selected at the time they are dug. They should also have special care during the winter, as very low temperature will injure the germination, and they should be stored in a cool, dark, dry place, so that they will not sprout. It is best to cut to about two eyes, although it is more important that the size of the pieces should be unform than that they each contain the same number of eyes. They should not be cut more than two days before planting, and should not be placed in large piles, on account of danger of heating.

Immediately after the seed is planted the ground should be thoroughly harrowed, and this may be repeated at intervals of a week or ten days, or after each rain, until the plants are up. This will not only keep the weeds down and make cultivating easier, but above all will improve the condition of the soil and hold moisture. After this cultivation should be frequent, especially after each rain or irrigation, should continue until plants begin to ripen, and should be shallow, to form a dust mulch.

If potatoes are grown at all extensively. It will pay to have a potato-digger. If to be dug by hand, a long-handled, long-tined potato hook is the best implement. They should be handled as little and as carefully as possible, to avoid bruising, and great care should be taken in grading. Buyers prefer potatoes of medium size, smooth and uniform.

POTATOES IN IRRIGATED DISTRICTS.

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

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 applications 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.

RAPE, DWARF ESSEX.

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

"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 plenty 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 harrow 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."

Fertilize liberally with stable manure, potash and super phosphate, or a complete fertilizer containing nitrogen 3 per cent, potash 5 per cent, and phosphoric acid 11 per cent.

RAPE (Brassica Napus).

By Dr. Jas. Whitycombe, Director Oregon Experiment Station.

Dwarf Essex rape is one of the most valuable summer forage plants for sheep and hogs. It is easily grown and has a wide range of adaptability. Nothing equals rape for the production of wool and mutton.

There are two general systems for growing this forage crop. For early summer feed it should be sown early in the spring in rows about three feet apart, putting on about one pound of seed per acre. When the plants are about four inches high start the cultivator and cultivate all summer similar to corn. Another good plan is to sow broadcast about the first of June, covering the seed with a heavy discing. Plow the land a good depth in the fall, then again in the spring when the soil is in condition; work down fine and allow the field to remain idle until about the first of June, then sow from one to pounds of seed per acre broadcast, disc in and work down fine. In about six weeks the rape should be a foot high and furnish an abundance of highly palatable and nutritious feed.

Another good method of utilizing rape, especially valuable on rich moist soil, is when seeding such ground to oats or barley in the spring, sow about two pounds of rape seed per acre. The rape will come up with the grain, but will have a struggle for existence during the summer; after the grain is harvested the rape, with the first rains in the fall, will spring into new life and quickly develop an excellent fall pasture.

A popular system in clover-growing districts is to sow about one pound of rape seed per acre with the spring seeding of clover and pasture during the late summer with sheep.

Rape is worthy of a place upon every farm and with proper cultural methods will yield good returns.

ROOT CROPS.

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

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.

RYE.

Spring rye is mostly sown for hay, while the winter rye is usually planted for grain. To secure a good stand and to avoid having hay too coarse, it is necessary to sow at least one hundred twenty-five pounds to the acre when sown alone. Rye is very often sown with vetches either in the fall or spring and in this case it is only necessary to sow about sixty pounds to the acre of the rye and an equal amount of the vetch. Rye will grow on poor land but when sown alone it is hard on the land. Where it is sown together with vetch, the vetch supplies the plant food that the land is robbed of by the rye and thus makes a very satisfactory crop to grow. With the exception of Speltz, rye will produce a crop of either hay or grain in less time than any other cereal. It is therefore useful on land that is wet and hard to get on early in the spring.

SORGHUM (Andropogon sorghum var.).

United States Department of Agriculture, Bureau of Plant Industry.

Varieties.—The best of the sweet sorghums to plant for soiling in the South are Amber, Orange, and Red Top. Amber reaches maturity first, and is quite extensively grown, but makes a slender cane rather sparsely leaved. It is preferred, however, in some sections, as the smaller cane is more readily eaten by stock than that of Orange or Red Top. Both Orange and Red Top make a heavier, stockier growth than Amber, and the leaves are large and close together on the stems. Orange is the better known of the two varieties, but Red Top is rapidly coming into favor in many sections. There is little choice between these two varieties.

Sowing.—The land should be prepared by plowing and harrowing as for corn and cotton. Careful preparation of the seed bed will be well repaid by the increased yield. Plow 5 to 7 inches deep, but never plow more than 2 inches deeper than the land has formerly been plowed, and never plow when the soil is very wet or very dry. Plowing should be done when the soil breaks readily and turns up mellow. The plow should be followed every half day with the smoothing harrow. The seed bed should be prepared by disking and harrowing until the clods are well broken up and the surface is fine and mellow. Planting may be done a week or two after corn planting. The seed should be sown in drills 3 to 4 feet apart, the best method being to use a grain drill with all but two or three of the holes stopped. A corn planter with special plates for planting sorghum and Kaffir corn may be used. The seed should be covered to the depth of 1 to 2 inches. Twenty pounds of seed per acre are required. For hay it may be sown broadcast at the rate of one to one and a half bushels per acre.

Cultivation.—Frequent shallow cultivation should be given to keep down weeds and hold soil moisture. Immediately after planting, and again a week later, the field should be gone over with a light harrow, with the teeth slanting slightly backward. This tool, if frequently used, is a very effective one until the crop is several inches high. Sorghum, like corn, has many large roots near the surface and is injured by deep cultivation. Cultivation should be continued at intervals of a week to ten days, using the sweep or some other shallow running tool and cultivating not over 3 inches deep. The field should be cultivated after each heavy rain, even though cultivated the day before, breaking the surface crust and preventing baking and evaporation. The soil should never be worked while it is wet enough to be sticky. Each cutting should be followed by frequent cultivations to induce prompt and rapid growth.

Cutting.—If needed for green feed, the first cutting may be begun when the crop begins to shoot; that is, just before the heads appear. Subsequent cuttings should be made at about the same stage. The crop should be ready for cutting in from sixty to seventy-five days from planting the seed; later cuttings may be made at intervals of about six weeks. Shallow cultivation after each cutting will hasten the growth and increase the yield. If the crop is desired for dry fodder, the seed should be allowed to mature before the crop is cut. In very damp climates, as near the Gulf, it is difficult to cure sorghum fodder. The best way to cure it is to leave it in small shocks for a few weeks and then to stand it on end under cover. For hay, cut at about the time the heads appear, and cure in swath, windrows, or shocks, as other hay, giving a somewhat longer time for the curing than for hay from the less succulent grasses.

TURNIPS.

By Dr. Jas. Whithycombe, Director Oregon Experiment Station.

The common turnip is especially well adapted to Western Oregon and Washington. It is rather remarkable that more of these are not grown. They are easily produced and furnish valuable winter succulent feed.

Prepare the ground in the same manner as recommended for broadcasting rape, sowing only, however, but one pound of seed per acre. No after work is required and the turnips will yield a large amount of healthful feed.

The Yellow Aberdeen or turnips of that type seem to give better results than the common white varieties.

VETCH. COMMON OR SPRING.

By Byron Hunter, U. S. Dept. of Agriculture, in Farmers' 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 efficieucy with which the seed is saved. A bushel of clean seed weighs a little more than 60 pounds.

Method of Sowing.

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 preferred 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.

Soiling.

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.

The Hay 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 matured. 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 heavy 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 oint forward and away from the direction driven at an angle of about 45°. 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 (Vicia sative).

By Dr. Jas. Withycombe, Director Oregon Experiment Station.

This forage plant finds an exceptionally congenial home West of the Cascades. It is valuable either for hay, silage, pasture or for soiling. All classes of stock are exceedingly fond of vetch. It is about equal to alfalfa in food value but consumed with less waste. Sown early in the fall at the rate of about sixty pounds per acre with one bushel of winter oats or wheat it should yield from three to four tons of hay per acre. For cattle a mixture of oats and vetch is desirable; for horses, wheat and vetch are better.

Vetch is a legume, hence a soil builder. It is hardy and easily grown. Vetch drilled in on a thoroughly disced spring sown stubble will produce a good crop. There is nothing better for a winter cover crop than vetch.

Vetch should be cut for hay when the first pods are formed and the seed begins to develop, for cattle. This same stage of ripeness is about right also for silage; for horses, it should be cut later or about the time the first seeds are about half developed.

Vetch is one of the best hays grown for the dairy herd and should receive attention from dairymen. If grown on old grain land fifty pounds of land plaster per acre, sown about April 1st, will often double the crop.

VETCH, HAIRY OR WINTER (Vicia villosa).

What has been said in regard to Common Vetch also applies to Hairy Vetch, except that as it withstands considerable cold and drought, it is best adapted to the country east of the Cascades, where it may be sown in spring, but is best sown in fall. It makes splendid hay, forage or silage, and is the best cover crop for orchards.

Being a legume, it will furnish nitrogen, of which the orchard lands in eastern Washington and eastern Oregon are deficient. It also furnishes humus, the importance of which is explained elsewhere in this book, and protects the ground during the winter. For these purposes it is usually sown in the fall, early enough to get a good start before winter, and is plowed under the following spring.

It requires less seed than Common Vetch, thirty to sixty pounds per acre, and should be sown with barley, rye or wheat to support the vines, which otherwise become a hopeless tangle. Hairy Vetch does not do well where there is an excess of water, and is seldom sown west of the Cascades.

HAYMAKING.

HAYMAKING.

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

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.

Conditions Governing Stage at Which Hay Should be Cut.

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 considerable 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 suffs 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.

Curing Hay.

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.

Hay Caps.

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.

THE SILO.

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

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 can not 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 hayrake. 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.

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

The mild winter 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 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	Sept. 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 ruta-bagas.	April	October 15 to April 1. (fed from bins, pits, or root houses).

LEGUMINOUS PLANTS.

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

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 tubercles, 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 can not 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 bac-

teria 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.

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. Red clover and English rye-grass are each short-lived and should form but a small portion of the mixture, if sown at all. Timber burns that have been seeded down in this way should be pastured pretty closely to keep down the young trees and brush. Goats will help to do this better than any other kind of animal. The success of seeding burnt areas in this way has been thoroughly demonstrated in many parts of the region. It is only a question of sowing the proper seed at the proper time.

THE FORMALIN TREATMENT FOR WHEAT AND OAT SMUT.

From Washington State Agricultural College Bulletin 54, by R. Kent Beattie.

What the Smut is. The disease we commonly call smut is produced by a small plant which lives upon the wheat plant and steals its food from it. The fine black powder called smut is made up of a multitude of small grains, each of which may grow into a smut plant if placed under the proper conditions. The smut plant is a weed. It is a worse weed for the wheat farmer than is wild oats, for wild oats grow only in the soil and there steal the food of the wheat plant, while the smut plant grows in the wheat itself and steals the food after the wheat has extracted it from the air and soil.

When a grain of wheat is planted with a live smut grain on it, both of them soon germinate The grain of wheat produces a wheat plant; the grain of smut produces a smut plant. The smut plant produces smaller colorless grains which at once grow into other smut plants. Thus from one original black smut grain several smut plants may soon come. One of these plants bores its way through the skin of the wheat and gets into the tissues of the stalk. Here it lives for the rest of its life, growing up with the stalk and stealing food from it. But only when the wheat's skin is soft and young can the smut penetrate. About the time that the first green leaf unrolls, the skin gets hard and from then on can not be penetrated by the smut. If the wheat has not been attacked by this time it is safe. If, however, the smut plant has succeeded in entering the wheat stalk the injury is done and the wheat will suffer. While growing up with the stalk during the winter and spring it checks the growth of the wheat straw and makes the smutted plants noticeably shorter than the sound ones. When the wheat head forms, the smut plant sends its branches into it and takes up the plant food as fast as it is deposited in the kernels. There it places its own grain and thus provides for its next year's growth.

Methods of Treating for Smut. It is evident that the way to cure the smut disease is to attack it while its grains are resting upon the seed wheat. There are two general methods of attack: (1) The treating of the seed wheat with something that will retard the growth of the smut and thus allow the wheat an opportunity to get ahead of it; (2) the treating of the seed wheat with something that will kill the smut and thus remove all possibility of contamination. The latter is without doubt the more effective method.

The Retarding Treatment with Vitriol. The almost universal remedy for smut is "vitriol." This is the common name for Blue Vitriol or Copper-Sulphate. The wheat is usually put in sacks which are about half filled. These are dipped one at a time in a barrel of vitriol solution and kept there for from one to five minutes. Some farmers time the process; others merely guess at the time. The vitriol solution is usually made by hanging a bag containing one pound of vitriol in the barrel usually half full of water. After five bushels have been treated many farmers again fill up the barrel with water and add a second pound of vitriol. This process is continued till at the end of the day the solution is of an uncertain but very great strength. After being treated the sacks are removed, drained for a few minutes on a draining board and piled away to dry. This method is sometimes modified by the use of a trough instead of a barrel, and the putting in of the wheat loose. In some ways this is a better method than the other, but it is open to the same objections as to strength of vitriol and length of time of soaking.

Why Vitriol Fails. The chief object of this process seems to be to coat the seed wheat with a visible layer of blue vitriol. The farmers are usually satisfied if after the wheat dries it is blue with vitriol. The fatal error in the process lies in the fact that but few of the smut grains are killed and that those that lie in the crack or groove on one side of the wheat grain are not touched at all. It takes more than one minute or twenty minutes to drive the air bubbles out of this groove and to wet the smut lying hidden therein. The work of one very careful farmer near Pullman has been followed this year and his results show the uncertainty of this process. He used the greatest care in dissolving his vitriol, at the rate of one pound of vitriol to four gallons of water. After carefully timing every sack of wheat for a full five minutes, he was docked two cents per bushel on 1,000 bushels of his wheat and from fifteen to twenty per cent of his crop remained in the field as smut.

The Killing Method with Vitriol. It is possible to kill the smut with vitriol. To do this it is necessary to use a very weak solution (one pound of vitriol to twenty-four gallons of water) and then to soak for twelve hours. If a stronger solution is used the wheat will be seriously injured. After soaking, the wheat must be sprinkled with lime to stop the action of the vitriol. The serious objection to this process lies in the fact that the wheat is slightly injured by the soaking, that after such prolonged soaking it is difficult to dry the seed, and that the time involved makes the process prohibitive to the man who must treat hundreds of bushels of wheat for immediate planting.

The Formalin Treatment for Smut. The formalin treatment is much superior to either of the vitriol processes. It kills the smut instead of retarding its growth. It does not injure the seed if properly used. It costs but little if any more than the usual vitriol treatment. One farmer in Whitman County during the season of 1901 had one of the smuttiest pieces of oats ever seen in this region. This year he treated with formaline, and as a result it was hard to find a smutted head in the whole 70 acres. At the same time he sowed a small row of the seed untreated, and this was badly smutted. Another planted fifty acres of oats untreated and 110 acres treated with formalin. The untreated fifty acres were smutted. The treated 110 acres were not smutted. He harvested ten bushels more to each acre on the treated 110 acres than he did not the untreated 50 acres.

What Formalin Is. Formalin is a forty per cent solution of a volatile liquid in water. As obtained at the drug store, it has the appearance of water, but has a characteristic odor. It is called by some manufacturers formaldehyde, or formalose. Formaldehyde, formalin, and formalose are all the same thing, and any one may be used. It is poisonous in the strong solution in which it is bought and sold, but it is not poisonous in the weak solution in which it is used to destroy smut. About one pound of formalin is necessary for each forty-five or fifty bushels of seed to be treated. One should be able to purchase it at the drug store, or of other dealers, in pound lots or larger at about forty-five to fifty cents per pound.

Treatment by Soaking. Make a large, tight watering trough. The size will depend upon the amount of grain to be treated at one time. The larger the trough, the more quickly and economically the grain can be treated. A trough 12 feet long, two feet wide, and two feet deep, will treat more than twenty bushels of wheat at one

time. This trough should be used the year round as a watering trough, and will then be in good condition for treating seed when needed. If you have two troughs and a great deal of wheat to treat use them both. Make up the formalin solution at the rate of one pound of formalin to sixty gallons of water. Do not make it stronger than one pound of formalin to forty-five gallons of water, or you may kill your wheat. Partly fill the trough with this solution.

How to Treat Wheat. Pour or shovel the wheat slowly from the sacks into the trough, so that the wild oat grains and the smut balls separate out and float. Let a helper skim these off at once while you are putting in the wheat. Getting rid of the wild oats is usually worth a cent or two a bushel to the farmer. Add more solution and more wheat till the trough is nearly full. Let the wheat remain in the trough with enough of the solution to keep it covered for at least one and a half and better two hours. Shovel it out and dry it. Fill in more solution to make up for that which is carried off with the wheat and repeat the process. The solution can be used over and over again if it is not allowed to stand too long. Perhaps 24 hours is the limit of safety.

How to Treat Oats. Oats cannot be treated loose, for they will float. Put the oats in the trough in half-filled sacks, churning each sack up and down to be sure that every grain is thoroughly wetted. Let them remain covered by the solution for one and a half, or, better, two hours. Lift them out and spread the oats out to dry.

How to Dry Seed. Spread it out on a clean floor. If the floor to be used has ever been contaminated with smut, scald it clean with boiling water. If a floor is not convenient, the grain may be dried by spreading it on a clean canvas stretched between four posts, or laid on the ground. If the weather is very favorable, it may be possible to dry it in the sacks. Care must be taken to see that the grain dries, or the experience of one Eastern Washington farmer may be repeated. For some reason his grain was not dried out, and in a few days it had heated and molded and its vitality was considerably affected. The grain may, however, lie in sacks a few hours in any kind of weather without injury.

Treatment for Wheat and Oats by Sprinkling. Make up the formalin solution a little stronger, using one pound of formalin for each forty-five gallons of water. Spread the grain out on a clean floor (cleaning it by scalding if necessary). Put down six to ten bushels. Sprinkle it with the solution from a watering can or with a broom while the grain is being vigorously shoveled. See that every grain is thoroughly wetted. As soon as this lot is wetted throw it aside into a pile and throw down another lot. Continue till all is treated. When all is finished cover it with wet sacks and leave it in the pile two hours. Then spread it out to dry as described above.

The soaking method is perhaps safer than the sprinkling for there is less danger of any grains escaping unwetted with live smut upon them. The sprinkling method is, however, effective if carefully carried out.

Care of Seed After Treatment. One of the most important points in the whole matter is the care of the seed after treatment. If this grain which is now clean is put in dirty sacks, or into anything which is covered with live smut, it will again be infected and the treatment will be useless. After treatment use new sacks or see that the old ones are cleaned by boiling. Wash out your seeder thoroughly with boiling water and see that it is kept clean from smut.

Follow Directions Closely and Carefully. Any inquiries concerning smut in any of the grains raised in the state may be addressed to the Washington Agricultural Experiment Station, Pullman, Washington.

POTATO SCAB.

Washington Agricultural Experiment Station Bulletin No. 83.

By W. H. Lawrence.

Potato scab is a very abundant and widely distributed disease. The disease first appears as brown spots on the surface of the tuber, usually in small roughened areas called lenticles. These spots increase in size at a fairly rapid rate. The color becomes darker and the tissues somewhat swollen. The areas are more or less irregular in shape and are scab-like in appearance, so much so that the common name has been taken from it. These areas, in the older stages, frequently become dry and crack open. The fissures may become of considerable depth in some cases.

The injury done depends upon the number of scabby areas and the depth to which the fungus has penetrated that causes them. If infection takes place while the tubers

are yet young, the disease becomes much deeper seated than if infection takes place at a later date. From the time infection takes place the spots increase in size at a fairly rapid rate. Then continue to increase in size even after the potatoes are ripe, especially if they are allowed to remain in the soil. Since this is true, scabby potatoes should be gathered as soon as mature to prevent this later development.

Since potato scab frequently does considerable damage, and the cost of combating the disease is so slight that the fungicide can be applied at a very low cost, no one should plant seed that is even slightly infected unless properly treated. The best method of getting rid of the disease is to plant clean seed on clean soil. Select smooth tubers and soak them in a solution of formalin (1 lb. to 30 gallons of water) for two hours. Remove them from the solution and let them drain, and then cut them for planting. This will kill the spores of the fungus that may have lodged on the tuber. Be sure before handling the tubers that the knives, pails, sacks, etc., have been further sterilized with boiling water or formalin solution if they have come in contact with diseased potatoes, or the spores will lodge on the sections and the results of the treatment unsatisfactory. As stated above, planting should be done on clean soil. After the fungus has become established in the soil it will live through the winter season, and if the same land is planted to potatoes the following season some of the new tubers will be scabby. It has been found that the soil may become infested by the application of manure from stock that has been fed with diseased tubers. It is evident that the mycelium or the spores of the fungus are not killed in passing through the digestive tract of animals. If the potatoes are to be fed to stock they should first be boiled to kill the fungus.

COVER CROPS FOR ORCHARDS.

From The Fruit Grower, St. Joseph, Mo.

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 exces-

sive 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.

STABLE MANURES.

New York Agricultural Experiment Station Bulletin No. 94.

The average farm-produced manure is a one-sided fertilizer, being excessively rich in nitrogen in comparison with potash and phosphoric acid. A ton of good stable-manure contains 10 pounds of nitrogen, 5 pounds of phosphoric acid, and 10 pounds of potash.

Now, if we compare these proportions of plant food with those found in different plants or with commercial fertilizers which are successfully applied to different crops, we are readily impressed with the one-sided character of stable manure as a nitrogenous plant-food. Where there is in the soil a sufficient amount of available potash and phosphoric acid to balance the excess of nitrogen furnished by the application, then most excellent crops are secured by the exclusive use of stable-manure. But it must be evident that, under such treatment, the crops each year take from the soil more potash and phosphoric acid than is replaced by the stable-manure. Hence, each year the available supply of these two constituents in the soil becomes less; and, when they are insufficient to balance the nitrogen applied, then crops become smaller and further exclusive applications of stable-manures fail to produce the results once secured. It is therefore easily possible to exhaust a soil by long-continued, exclusive use of stable-manure; and this is just what has occurred on many farms in this state.

In order to use our farm-produced manures to the best advantage on the average soil as found at present in this state, we need to supplement them with commercial fertilizers containing available phosphoric acid and potash. To give a roughly approximate idea, we might say that for every ton of stable manure applied, it would be well to use with it from 50 to 100 pounds of acid phosphate and from 25 to 50 pounds of high-grade muriate or sulphate of potash.

The statements below apply to fresh manure containing only small amounts of coarse litter. It appears to be the prevailing belief, both in theory and practice, that best results are ordinarily secured by applying stable-manure to the soil in as fresh condition as possible. Mixed with the soil, fresh manure decomposes readily, having its own constituents made more available as plant-food, and, moreover, rendering available some of the insoluble plant-food previously in the soil. In this way losses from destructive forms of fermentation, leaching, etc., are mainly prevented.

Fresh manure gives better results than rotted manure on heavy clay soils, when one desires to lighten the condition of the soil. However, when one desires direct fertilizing action promptly, fresh manure gives sufficiently quick returns on light soils, becoming available as fast as the plant needs it, if the season is not too dry. On heavy clay soils, manure decomposes slowly and the constituents of fresh manure may not become available as fast as needed. On this account it may happen that on heavy soils little benefit is seen from the application of fresh manure until the second season after its application.

In dry, hot seasons an excessive application of fresh stable-manure tends to "burn out" the soil, this tendency being more noticeable in light than in heavy soils.

Fresh manure has a tendency to favor rapid growth of foliage and stems at the expense of fruit and grain. It is therefore more suitable for grasses, forage plants and leafy crops than for grains.

Such crops as potatoes, sugar beets and tobacco appear to be injured in quality by the direct application of stable-manure. It is advised in such cases to apply the manure in the fall previous to the spring in which the crops are to be put in, thus allowing time for a considerable amount of decomposition.

When fresh stable-manure contains much coarse, undecomposed litter, it is better not to apply it until the coarse portion has become more or less decomposed.

In rotted manure, the fertilizing constituents, as a whole, are in readily available form for the use of plants. Such manure is less bulky and more easily distributed than fresh manure. It is also less likely to promote the too rapid growth of stems and leaves as in the case of fresh manure. For the improvement of the mechanical condition of the soil, the best results come from using rotted manure on light soils. It must, however, be remembered that on such soils there is more or less danger that some portion of the valuable fertilizing constituents may be leached out and lost. On this account it is found advisable to apply such manure to light soils only a short time before it is needed by the crop. In general, rotted manure is better adapted to spring applications. It is better to apply rotted manure on light soils at frequent intervals in small amounts.

In warm, moist climates, it makes much less difference whether the manure is applied in fresh or rotted condition. In cold climates, however, the use of decomposed manure is preferable.

PREPARATION AND IRRIGATION OF NEW LANDS.

Prof. Elias Nelson, Horticulturist of the Weiser Valley Land and Water Co., Council, Ida., formerly Irrigationist Idaho Experiment Station.

Clearing the Land of Sagebrush.

Grubbing sagebrush land with a mattock is laborious, and at contract prices costs close to $5.00 per acre, including burning. A less expensive method is that of using railroad irons. Two rails, 16 feet long, are bolted together and drawn by four horses over the ground, the team doubling back over the same tract. In this way more than half of the brush is torn up. The remainder has to be grubbed by hand. By means of a special horse rake, the brush is raked into windrows ready for burning. At contract prices clearing in this way costs $3.00 per acre. A machine grubber, known as "steel grubber," has been used in some sections of the Northwest. That machine takes out every brush and does very satisfactory work where rocks or coarse gravel does not occur.

Laying Out Ditches.

The ditches should be surveyed before the land is leveled. Make them "square with the world" whenever the conformation of the ground permits of it. Plan to run the water in the direction of the greatest slope. The head ditches should be about 300 feet apart and when they cannot be at right angles to the line fences run them on a grade of one-tenth to fifteen one-hundredths of a foot to 100 feet. As regards the location of the ditches and laying out of a system for the distribution of water, each farm is a problem in itself. When a whole forty or eighty acre farm has one regular and uniform slope it is a simple matter to locate the ditches. Where there is question as to the practicability of any proposed ditch or as to its proper location the services of a surveyor should be secured.

Leveling.

To prepare the land well for irrigation is very important. In its natural state the surface of the ground has slight inequalities and often washes occur here and there, hence a certain amount of leveling is required. Generally it is not necessary to scrape off more than a few inches in depth on the high places to spread over the low places. Heavy grading should be avoided in so far as possible. For the rough work, that is, moving earth at the outset, there is no better tool than the Fresno scraper. To loosen the soil on the high places a disk harrow is used. For the final smoothing over the rectangular leveler is a serviceable implement.

The rectangular leveler is made of 2x12 inch stuff and four horses are required to pull it. It is 20 feet long and five feet wide. The cross piece near the center is shod with steel and acts as a scraper. The cross pieces at the ends are inclined backward and placed high enough so as not to load up with earth. This leveler loads on the high places and drops the soil in the low ones.

The less slope there is the more carefully should the land be leveled. The ground should be made level across the slope as nearly as possible. Up and down the slope no more grading is necessary than to permit the water to flow along without flooding. The cost of leveling at contract prices will range from $5.00 to $10.00 per acre, depending upon the character of the ground.

Plowing.

Plowing should be deep, at least 8 inches. That will open up the soil for the roots of plants and will permit irrigation water to enter the soil more readily. Disking before plowing makes plowing easier and puts the soil in better tilth. The best time to plow is when the soil is neither so wet that it puddles nor so dry that it turns up in large lumps. Early in spring suitable weather for plowing is uncertain, hence when plowing is done in spring, planting is delayed longer than desirable. It is therefore advisable to do considerable plowing in the fall even though it must be done with the soil dry. If left rough the elements will disintegrate the lumps of soil during the winter and in spring it can be worked down in good shape. Where irrigation water is available the land may be irrigated before plowing.

Method of Applying Water.

To facilitate the irrigation of small grain and new seeding of alfalfa, shallow furrows 5 inches wide and 3 inches deep are made. By means of these furrows the water is distributed evenly over the land and the surface of the ground is not puddled and compacted as when flooding is practiced.

The furrower consists of a platform 3x5 feet to the under side of which are bolted 3 runners, 16 to 18 inches apart. The front ends of the runners are pointed and shod

with steel. A tongue is fixed solidly to the platform. This tool is drawn by two horses and makes 3 furrows at a stroke.

A crude way of letting the water from the ditch into the furrows is to cut the ditch bank with a shovel. To distribute the water evenly in that way is difficult, especially where the ditches are new. It is therefore advisable to set tubes in the ditch bank through which the water flows into the furrows. The tubes are made of lath, four lath making 2 tubes, each two feet long. They are set just below the surface of the water and the stream that issues from each is divided among 3 or 4 furrows on steep land or 2 furrows on flat land.

At certain distances in the head ditch boxes are set to check the water and hold it at the desired level, the excess water in each section flowing through the check into the section below. The distance apart of the check boxes will depend upon the grade of the ditch. With a fall of .15 of a foot per 100 feet the check boxes will be 135 feet apart. When the splash boards in the check are out the water drops below the level of the lath tubes.

To divide the water from each spout evenly among several furrows means considerable work, hence smaller tubes, one for each furrow, are sometimes used. These are made of tin and are one-half inch in diameter. The tubes should be at least 18 inches long. Set one-half inch below the surface, they discharge one quart of water in 16½ seconds, which amount is about right for one furrow.

For small grain and other crops that are not intertilled the furrows are made with the "marker" immediately after planting. For potatoes and other rowed crops the furrows are made with a double shovel plow before the first irrigation.

Where the slope is slight and uniform, levees, called "borders" may be made 3 to 4 rods apart. The borders confine the water to narrow strips of land extending down the slope and permit of flooding or the use of large heads of water. The strips of land must be perfectly level across. Furrows are made at the outset on these strips called "lands." The border system is suitable for the irrigation of alfalfa on flat land. Where the slope is considerable and not uniform the furrow system without borders is the proper one.

The borders are about one foot high and four feet wide at the base. They are made by throwing together four furrow slices and smoothing them over with a ridger. These borders should be seeded the same as the rest of the ground in order that weeds may not get a foothold on them.

Irrigation.

The length of time it will require to irrigate will depend upon the character of the ground. An irrigation generally consumes from 15 to 24 hours. Soils that contain an ample amount of humus absorb water much more readily than those that lack that essential constituent. The irrigation should be continued until the water has percolated across between the furrows, not necessarily on the surface, but a few inches underneath.

Crops suffering for lack of moisture take on a dark green color. Water should be applied when the soil four inches below the surface is so dry that it will not mold when pressed together in the palm of the hand.

What to Grow at the Outset.

To be very successful the farmer of today must specialize to a certain extent. He must decide upon some particular line of farming and adapt his cropping to the production of one main product. It may be some orchard fruit or small fruit or milk or butter or wool and mutton, or pork, or potatoes or sugar beets or fine stock. Each one of these lines will require a particular system of farm management and most of them will presuppose some crop rotation.

The settler in laying his plans should consider the character of the soil. We find that our soil is well supplied with all mineral elements essential to the plant growth but lacks humus (decayed organic matter) and nitrogen. To supply this deficiency is imperative. That may easily be done by growing alfalfa. The various field crops yield nearly, if not twice, as much after alfalfa has occupied the land as before. To get the land into alfalfa as soon as possible is therefore a desirable expedient.

Alfalfa yields but lightly, or scarcely any, the first year, hence some other forage crop must be grown on a part of the land. Field peas and oats sown together at the rate of one bushel of peas to one of oats will yield some early feed for stock. Small grain will give some income. On soils that are not too heavy potatoes are a good crop.

Alfalfa is our banner irrigated crop and is just as important as an improver of the soil as it is as a hay crop.

The land must be leveled in the best possible manner for alfalfa as it occupies the land for several years.

Another method of getting the new land in perfect condition for alfalfa is to grow small grains the first year and starting alfalfa the second. Any defects in the leveling can then be noted and rectified at the end of the first year. If the land has been prepared in the fall alfalfa should be seeded early in the spring while there is moisture to bring it up, and irrigation water should be withheld as long as possible to induce the roots to strike deep into the soil.

Though delaying the planting of alfalfa until the second year has some advantages I would advise the settler to start some the first year for it is quite possible to prepare some new land for alfalfa in a tolerably satisfactory manner. The weather will generally not be suitable for leveling and plowing until in May. By the time the land has been prepared the soil will be too dry to germinaate the seed and give a good stand, hence it is advisable to irrigate before planting. Alfalfa may be started in this way any time from May to August.

The best way to plant alfalfa is with a seeder that sows it in drill rows and covers the seed. Plant without a nurse-crop and at the rate of 12 pounds per acre.

Alfalfa may be expected to do no more the first year than get well established. Clipping it once is a benefit as that induces stooling. The second year it will give three cuttings and the third year it will yield a little more than the second.

Alfalfa may occupy the land from 3 years to as many as desired.

When alfalfa fields are plowed up it is found that the soil has gained greatly in humus and nitrogen. A much greater amount of these constituents, however, are added to the soil when a green crop of alfalfa is turned under. Such green manuring prepares the land for sugar beets or for orchards planting and is beneficial to any crop that is to follow. A crop of alfalfa turned under is worth 10 tons of sugar beets per acre as a fertilizer.

Red clover may be used to improve land in the same way as alfalfa. It is less difficult to kill. Sow at the rate of 8 to 10 pounds per acre.

Pasture grasses should be sown early in spring and the seeds covered slightly. If moisture is lacking to germinate the seed irrigate to bring the grasses up. As a pasture mixture we would recommend the following:

	Pounds.
Blue grass	7
Orchard grass	6
Meadow fescue	4
White clover	1½
Alsike clover	1½
Red clover	1½

Wheat should be sown as early as the ground can be prepared. If planted early it will not require irrigation until some time after it has stooled. Irrigate when the crop requires it. Under average conditions irrigation is not needed until heads are in boot. After the first irrigation see that the crop does not suffer for lack of moisture. Do not, however, apply too much. The last irrigation should be during the early stage of filling. One to three irrigations is required by wheat or other small grain according as soil conditions vary.

Potatoes should be planted in rows 36 to 42 inches apart, the particular distance being determined by the character of the soil. The essential points in the irrigation of potatoes is to never allow them to suffer for lack of moisture as second growth is then induced. Do not, however, apply too much water or in too shallow furrows. Let the water be applied in deep furrows and let cultivation follow each irrigation as soon after as the ground can be worked satisfactorily. Irrigating every other row at one time and alternate furrows a week or ten days later is a good practice, especially where irrigation water is readily absorbed by the soil.

To facilitate irrigation, vegetables should be planted in long rows and but one kind of vegetable in each row, as some sorts require more or less water than others and different treatment is necessary. The hardy vegetables may be planted early where there is natural spring moisture to bring them up. The ones that are generally planted late may require irrigation before planting. Most vegetables require frequent irrigations. Careful attention to cultivation in connection is essential for good results. Vegetables for the farmer's own use can always be grown with irrigation on new land. For large yields or for commercial gardening the soil should be fertilized with stable manure.

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 different elements of plant food have been improperly handled or wastefully cropped until badly out of condition. These can best be restored to 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 anaylses 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 contents of all soils west of the Cascade Mountains is usually low and for those crops like fruits 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 an 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 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 additions of humus forming fertilizers or manures or the plowing under of leguminous crops will give very 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 thruout the season, no crops would grow in it. Again a soil might contain abundant available fertility and plenty of moisture but remain frozen thru 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 only 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 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 its 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 or 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 itself 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, artificial fertilizers may be often profitably 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 fertilizers is, of course, the profit which may be obtained from their use. This can only be determined by actual field trials. The object of such trials should be to determine whether the increased yield due to the use of the fertilizers more than pays the cost of application of the fertilizing material.

LIME FOR SOUR LAND.

The farmers of Western Washington and Western Oregon should study this matter very closely, for if some of the commercial fertilizers, such as Muriate of Potash and Nitrate of Soda, are used on land which is sour, the result will be injurious instead of beneficial, but, by first sweetening the land, fertilizers can then be used to good advantage. To ascertain if the land is sour, you can test it with litmus paper, which you can procure at any drug store, and any druggist will tell you how to make the test.

To correct acidity in the soil, apply from one-half ton to one ton of air slacked lime per acre. Do not use land-plaster or gypsum for this purpose, for lime is what is required. One application should last for several years, but if the land again becomes sour, a much smaller application than the first will again correct it. After the land is sweetened, as above described, you can then use commercial fertilizers and get big results.

The following is copied from Garden and Farm Almanac:

"Liming is a very old agricultural practice, and the importance of lime as a fertilizer has long been recognized, although its true value is being largely explained by investigations that are now in progress. As a rule, the beneficial effect of lime has heretofore been ascribed mainly to its action in improving the texture and drainage of the soil, in hastening the decomposition of organic matter in the soil, in rendering the inert nitrogen of the soil humus more available to plants, and in assisting in set-

ting free the potash and other inert fertilizing constituents of the soil. While all these benefits may fairly be expected to result from the use of lime under proper conditions, recent investigations have shown that it performs other equally important functions in the soil, and that its abundance or deficiency there is a matter of greater importance than it was formerly supposed to be.

It has been generally assumed that there is a sufficient quantity of lime in most soils to meet the demands of ordinary crops. The Minnesota, Rhode Island and other stations have shown that except in limestone regions it is as likely to be deficient as potash or phosphoric acid. Especially is this true of soils derived from the decomposition of granite. In testing the fertilizer requirements of soils it becomes as important, therefore, to determine whether lime is deficient as whether potash and phosphoric acid are lacking. A deficiency of lime may be due to the continued growth and removal of crops without liming, or to leaching out the lime, a process which is continually going on and which is hastened by the use of certain fertilizers, especially muriate of potash. The liberal use of muriate of potash and similar fertilizers on a soil not abundantly supplied with lime should be accompanied by periodical applications of lime.

A deficiency of lime in the soil is accompanied by a state of acidity or sourness, fatal to the vigorous growth of many crops. The Rhode Island Station has shown that this condition of acidity is widespread even in upland soils which are well drained and not supposed to be sour, as well as in low, wet soils. It was found in experiments in this station with different forms of nitrogen that sulphate of ammonia was positively poisonous to plants on such soils when it was not used in connection with lime. When the acidity of the soil was corrected by applications of air-slacked lime, the sulphate of ammonia was beneficial. This beneficial effect of lime was probably largely due to the fact that the lime restored the alkaline condition of the soil necessary to the transformation (by nutrition) of the sulphate of ammonia into nitrates so necessary to most crops."

NITRATE OF SODA FOR GARDEN CROPS.

From 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 plant 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.

CHEMISTRY OF FERTILIZERS.

From "Plant Food," published by German Kali Works.

The systematic scientific study of agriculture was commenced about fifty years ago, and it is to the celebrated German agricultural chemist Justus von Liebig we owe the following four elementary laws, which are the foundation of the best modern practice:

I. A soil can be termed fertile only when it contains all the materials necessary for the nutrition of plants, in the required quantity, in the proper form.

II. With every crop a portion of these ingredients is removed. A part of this is again added from the inexhaustible store of the atmosphere; another part, however, is lost forever if not replaced by man.

III. The fertility of the soil remains unchanged if all the ingredients of the crop are given back to the soil. Such a restitution is effected by manure or fertilizers.

IV. The manure produced in the course of farming is not sufficient to maintain permanently the fertility of a farm; it lacks the constituents which are annually sold in the shape of grain, hay, milk and live stock.

It is generally understood that all manures or fertilizers are valuable for the nitrogen, potash, or phosphoric acid they contain. Though other substances are needed for plant growth, they are almost always present in the soil in sufficient quantity. Lime might be made an exception, although its use is largely to improve the mechanical condition of the soil, and cure it of sourness. Lime also aids in rotting the vegetable matter.

Nitrogen as a Fertilizer.

The influence of nitrogen in its various forms upon plant growth is shown by at least three striking effects.

First. The growth of stems and leaves is greatly promoted, while that of buds and flowers it retarded. Ordinarily, most plants, at a certain period of growth, cease to produce new branches and foliage, or to increase those already formed, and commence to produce flowers and fruits, whereby the species may be perpetuated. If a plant is provided with as much available nitrogen as it can use just at the time it begins to flower, the formation of flowers may be checked while tne activity of growth is transferred back to and renewed in stems and leaves, which take on a new vigor and multiply in luxuriance. Should flowers be produced under these circumstances, they are often sterile and produce no seed.

Second. The next effect of nitrogen upon plants is to deepen the color of the foliage, which is a sign of increased vegetative activity and health.

Third. Another effect of nitrogen is to increase in a very marked degree the relative proportion of nitrogen in the plant.

Nitrogen is a gas, and, in this form, canot be used in fertilizers. Therefore, whenever we speak of nitrogen in fertilizers, we do not mean that nitrogen exists in them as simple nitrogen. The nitrogen in fertilizers is always combined with other elements, and may be present in one or more different forms: (1st) in the form of nitrates, as nitrate of soda; (2nd) in the form of ammonia compounds, as sulphate of ammonia; and (3rd) in the form of organic matter, animal or vegetable, as dried blood, meat, tobacco-stems, etc. Chemical analysis according to official methods does not attempt to ascertain and state in which form or forms the nitrogen is present in a fertilizer.

The mineral forms of nitrogen, such as nitrate of soda and sulphate of ammonia, both dissolve easily in water, hence they would soon wash into the subsoil and out of reach of the plants. The so-called organic forms of nitrogen like cotton-seed-meal, tankage, fish scrap, dried blood, etc., are less soluble, and experience indicates that they are largely retained in the soil. It is a matter of observation also that there is little loss of nitrogen by drainage when the soil is covered with vegetation, because the roots of the growing plants absorb nitrogen very readily.

Potash as a Fertilizer.

Potash is essential in the formation and transference of starch in plants. Starch is known to be first formed in the leaves of plants, after which in some way it becomes soluble enough within the plant cells to enable it to pass through the cell-walls gradually and later to be carried into the fruit, where it accumulates and changes back to its insoluble form. It is well established that potash is intimately connected with the formation of starch in the leaves and with its transference to the fruit. No other element can take the place of potash in performing this work. Potash is important on account of its influence upon the development of the woody parts of stems and fleshy portions of fruits.

Potash, as used in connection with fertilizers, always means a compound containing potassium and oxygen, known chemically as potassium oxide. Potash is never found as such in fertilizers, but chemists use this form of expressing the results of analyses as a convement standard for reference. Fertilizers generally contain potash in such forms as sulphate of potash, muriate of potash, or carbonate of potash. Instead of stating the amount of sulphate, muriate or carbonate of potash present in a fertilizer, its equivalent amount is stated only in the form of actual potash in giving the results of analyses Potash soluble represents the amount of potash that dissolves in water and is available for the use of plants. The different forms of potash commonly used in fertilizers are readily soluble in water.

It has been found by experience that the potash salts do not wash away to any appreciable extent because they form certain combinations in the soil which are not so soluble, but which at the same time are readily available to the growing crop.

In addition it may be said, in general, that loss of plant food is greatest in sandy soils; the coarser the sand, the greater the loss, the other conditions being the same. Clay and humus have very marked power in retaining plant food.

Prosphoric Acid as a Fertilizer.

Experiments have shown that plants will die before reaching maturity, unless they have phosphoric acid to feed upon. Phosphates appear to perform three distinct functions in plants.

First. They aid in the nutrition of the plant by furnishing the needed quantities of phosphoric acid.

Second. They aid the plant, in some way not well understood ,to make use of or assimilate other ingredients. Phosphates are found in the seeds of plants, and, as already stated, a plant does not come to maturity and so does not produce seeds, unless phosphates are present in the soil for the plants to feed upon. The liberal application of available phosphate compounds appear to hasten the maturity of plants.

Third. Certain forms of phosphates render the albuminoids sufficiently soluble to enable them to be carried from the growing parts of plants to the seeds, in which they accumulate in quantity.

Phosphoric acid, as used in connection with fertilizers, is a compound containing phosphorus and oxygen, which in fertilizers is never found by itself, but in combination with lime. Phosphoric acid stands for a certain amount of phosphate of lime. We may say roughly that one part of phosphoric acid is equivalent to about two parts of phosphate of lime. But we know that phosphoric acid exists in several different forms.

Soluble Phosphoric Acid represents the amount of phosphate of lime that dissolves easily in water; it is formed by treating with sulphuric acid some form of insoluble lime phosphate, such as bones, bone-ash, South Carolina rock, etc. The phosphate thus formed is readily soluble in water.

Reverted Phosphoric Acid is soluble phosphoric acid which, under certain conditions, has changed to some extent, and which, while less soluble, is still quite readily available as plant-food.

Available Phosphoric Acid includes both the soluble and reverted forms of phosphoric acid, because both forms are available for the use of plants.

Total Phosphoric Acid represents the entire phosphoric acid compounds, both available and insoluble.

The phosphoric acid in raw materials such as ground bone or ground phosphate does not readily leach out of the soil. In especially prepared materials, however, like dissolved bone or dissolved phosphate (acid phosphate) the phosphoric acid is quite soluble and would be removed from the soil by drainage water, were it not for the fact that immediately after application the phosphoric acid becomes changed into another form which is not apt to leach away.

The Use of Fertilizers.

There is no way to tell, without experiment, what food constituents a soil lacks. The crops themselves give valuable suggestions. As a rule lack of nitrogen is indicated when plants are pale green in color, or when there is small growth of leaf or stalk, other conditions being favorable. A bright, deep green color, with a vigorous growth of leaf and stalk, is, in case of most crops, a sign that nitrogen is not lacking, but does not necessarily indicate that more nitrogen could not be used to advantage. An excessive growth of leaf or stalk, accompanied by an imperfect bud, flower, and fruit development, indicates too much nitrogen for the potash and phosphoric acid present. When such crops as corn, cabbage, grass, potatoes, etc., have a luxuriant, healthful growth, an abundance of potash in the soil is indicated; also when fleshy fruits of fine texture and flavor can be successfully grown. On the contrary, when plants fail of a luxuriant growth, or are very low grade in quality, it is a certain indication that potash is lacking.

When a soil produces good, early maturing crops of grain, with plump and heavy kernels, phosphoric acid will not generally be found deficient in the soil.

In order to ascertain with greater certainty what food elements are lacking in the soil, the surest way is for each farmer to do some experimenting on his own soil and crops. Apply different kinds of fertilizing materials in different combinations, using, for example, potash compounds in one place, phosphoric acid compounds in another, nitrogenous materials in another. Then different combinations can be made on other portions of the crop. Some portions of the field can be left without applications of any kind. The result can then be studied in the yield of crop. In carrying on such field tests, several difficulties may be met. The reason may frequently be such as to interfere seriously with the favorable action of the fertilizing materials applied. Thus, a severe drought may counteract all other conditions and prevent a satisfactory yield. The difference of mechanical condition of the soil on the same farm or even in the same field may prevent a fair comparison of the action of different kinds of fertilizing materials and elements. But, notwithstanding such difficulties, valuable suggestions will be gained from an experimental study of one's soil through the behavior of the crops.

It is a fact of great interest and importance that one form of fertilizing constituent is preferred by some plants to the same constituent in another form. This preference is indicated by greater yield or better quality of product, or by both. Thus, wheat seems to give better results when nitrogen is applied in the form of nitrate of soda than in any other form. The quality of tobacco is injured by potash in the form of muriate and, hence, only sulphate should be used for fertilizing purposes. The quality of sugar beets and of potatoes appears to be better when sulphate of potash is used.

Farmyard manure, and similar refuse substance, should always be used with hoed crops, in which case it is plowed under; otherwise it is best used as a top dressing. When plowed under, farm manures should be applied for fall plowing, unless the crop to be grown covers the entire growing season, as, for example, Indian corn. The fertilizer in such manures becomes available very slowly.

Nitrate of soda, when used alone, should always be applied to growing crops, and for quick effects. For young fruit trees or for vegetables, one or more applications may be made with benefit. Complete fertilizers usually have a small proportion of their nitrogen in the form of nitrate of soda, and the remainder in a less active form, so that by the time the nitrate of soda is utilized, the other nitrogenous products become effective.

Sulphate of ammonia is a quick-acting nitrogenous fertilizer, but should be used only when the soil has been lately limed. Dried-blood, dried-fish and other similar materials are less effective than nitrate of soda, but more so than nitrogen of farm manures. They are generally used in complete fertilizers, and are best plowed in, or drilled in at seeding time. All forms of potash are equally available, but should be applied as early in the season as possible, even fall applications are advisable, as there is little danger of loss through drainage. Lime also aids the effectiveness of potash salts. Phosphates in the form of "supers" or acid phosphates, are very quickly available, resembling nitrate of soda in this respect, though it is hardly advisable to make more than one application, early in the season or at planting time. All other forms of phosphates are best applied in the fall, or very early in the spring.

FERTILIZING OREGON ORCHARDS.

By D. I. Duncan.

In its valuable Bulletin No. 101 the Department of Horticulture of the Oregon Agricultural College gives some information concerning the use of commercial fertilizers in the orchard that should interest every fruit grower in the Northwest.

The idea is too prevalent that when no crops are removed from between the rows of fruit trees, very little plant food is taken from the orchard soil. Circular No. 68 of the Illinois Experiment Station gives a relative idea as to how many pounds of available elements are consumed by some of the common field crops as compared with apple and other fruit trees. Seventy-five bushels of oats remove 69 pounds nitrogen, 11 pounds phosphoric acid, and 49 pounds potash. Forty bushels of grain and two tons of straw remove 65 pounds nitrogen, 10 pounds phosphoric acid, and 45 pounds potash. Six hundred bushels of apples, with the necessary leaf and wood growth, draw upon the soil for 112 pounds nitrogen, 11 pounds phosphoric acid, and 45 pounds potash. Since the leaves fall to the ground and much of their plant food is returned to the soil, the amount of plant food actually removed with the apples was 47 pounds nitrogen, 2 pounds phosphoric acid, and 57 pounds potash, while 6 pounds nitrogen, 2 pounds phosphoric acid and 5 pounds potash were required to make the necessary new wood growth.

It can thus be readily seen that large amounts of valuable plant food are removed each year by the fruit alone. While it is true that some of the Oregon orchard lands are seemingly well supplied with the three necessary elements of plant food, a continuous cropping will in time exhaust the most fertile soil. These plant food elements, if added now, would be of very little expense to the fruit grower, and it would well repay him, for he would be assured of a fairly good crop each year. If, on the other hand, they are not added until the soil becomes practically exhausted, a year or two is lost in bringing the trees back to their normal yield.

"The common idea among growers," says Bulletin No. 101, "is that a chemical analysis will tell them all they need to know about the soil. Fortunately, if samples are selected so as to represent the whole field, we are able to tell what plant foods are present in the soil, but we cannot tell in what forms they exist, and thus cannot tell how much of the plant food is immediately available. The grower will have to experiment with his own orchard to determine the best foods to apply." Each grower should make individual tests, using the three essential elements in various combinations, and watch the results carefully as to growth of leaf, tree, yield and quality of the fruit, until a mixture is secured that promises satisfactory results.

It is pointed out that only five per cent of the 473 fruit growers in Jackson County, Oregon, use commercial plant food, yet the increase in the yield of their crops realized by this five per cent well repaid them for the expense and trouble.

When nitrogen is needed, nitrates, such as nitrate of soda, are found to be very valuable, since they can be utilized by the trees at once. Organic nitrogen, i. e., nitrogen in the form of ground fish, dried blood, etc., when it can be obtained cheaply, gives satisfactory results, but it takes some time before all of the available nitrogen is set free. This, however, is very desirable in some orchards.

The most available form of phosphoric acid is superphosphate, although the animal forms, bones, tankage and fish scrap, are more continuous feeders.

Potash is obtained in the form of kainit, muriate of potash and sulphate of potash. The latter two are the forms which will prove most economical in practical use. Potash is of great importance, since it not only constitutes a large proportion of the ash of the wood and more than fifty per cent of the ash of the fruit, but because it forms the base of the well known fruit acids, which insure early ripening, rich color, superior flavor and good keeping quality.

While it is true that an analysis of some Oregon soils shows the presence of considerable potash, evidently only a limited amount of this is in available form. Some growers may consider the commercial forms of plant food more expensive than other forms, but they can be relied upon to give good and quick results. The more concentrated fertilizers are higher priced, but they are really the cheapest to use because they contain a lager percentage of plant food.

If the orchardist will experiment on a small scale before purchasing and using at random, he will soon learn how to buy and use a mixture that will not only mean a better and stronger growth of wood, but a larger yield of superior fruit, which means increased profits.

FERTILIZING FOR BERRIES.

By D. I. Duncan.

The growing of small fruit has proved to be a profitable industry in many parts of the Northwest. As new grounds are cleared for orchards, and while the young trees are coming into bearing, strawberries planted between the rows are the source of a satisfactory income. The growing of strawberries on open and older fields is done with excellent returns, and small fortunes are literally being picked from blackberry and raspberry patches.

There is some difference in the fertilization of berries that grow on canes and strawberries. The former occupy the same ground for a number of years, while the stawberries are renewed every two or three years.

The three prime elements of plant food are nitrogen, phosphoric acid, and potash. Other elements are required, but in small amounts, and they are so readily supplied by the average soil that it is not necessary to buy them. The three prime elements are required in large quantities, and when they are present in the soil in the right form and amount, the soil is said to be fertile. The heavy growth of canes, leaves and berries draws large amounts of these three chief ingredients from the soil each year, and after a time, unless they are returned in some form or other, there is a falling off in the quantity and quality of the berries.

The element nitrogen is supplied by using nitrate of soda, dried blood or fish tankage. It is necessary to make a quick growth of the cane and sufficient leaves. When there is a heavy growth of leaves of dark green color, nitrogen will probably

not be needed for a few years. One of the best ways to supply that element is to grow some green manure crop. This subject is receiving considerable attention in the Northwest at the present time, and it is the opinion of many that in a few years most of the orchards will be sown to green manure crops in the early fall. Such crops as clover, vetch, etc., have the power of taking atmospheric nitrogen from the air and storing it in their roots and vines. When such a crop is turned under, and decays, the nitrogen becomes available, and can be used by the canes and berries. Not only is a cover crop of value because it supplies nitrogen, but it protects the ground from washing during the winter. It also supplies, when turned under, humus or vegetable mold, which keeps the soil open and friable, and at the same time more retentive of moisture.

Phosphoric icid is furnished by using bone meal or the superphosphates. Potash comes from the mines of Northern Germany. The forms most commonly used on the Pacific Coast are muriate of potash and sulphate of potash. Since both contain about the same amount of actual potash, there is but little diqerence in their use. The muriate might cost a trifle less per ton than the surphate, yet the latter is in such fine mechanical condition that it is preferred by many.

Potash is the element of special importance to the fruit grower, since it not only supplies a large percentage of the ash of the wood, but is the base of the well known fruit acids. This means that the fruit will mature more evenly, will be of more uniform color and more solid and heavy, which allows it to be handled more easily and shipped greater distances.

Several members of one fruit growers' association in Western Washington who made heavy applications of sulphate of potash last season, received twenty-five cents more per crate, because the berries were of superior shipping quality.

In using fertilizers in the berry field, it is important that they be mixed well with the soil. Where it is customary to plow in the fall, the potash and phosphoric acid may be applied at that time. If fall plowing is not practiced, the application should be made in the spring as early as possible. The potash and bone meal or superphosphate may be mixed together and broadcasted between the rows, to be plowed under, or applied to the ground after plowing, and worked in with a disk or harrow.

On light sandy soils from one hundred to one hundred and fifty pounds of sulphate or muriate of potash should be used per acre, together with one hundred and fifty to two hundred of bone meal or superphosphate. On heavy clay lands no more than one hundred pounds of potash need be used. Where there is a lack of foliage, nitrate of soda may be used at the rate of fifty to seventy-five pounds per acre. Since this substance is very soluble, it should not be applied in the fall, but rather in the spring, and it can be used either as a top dressing or by working it into the soil.

TABLE GIVING THE AMOUNTS OF FERTILIZER INGREDIENTS
(Potash, Phosphoric Acid and Nitrogen)
CONTAINED IN THE CROP FROM ONE ACRE.

Crop.	Yield.	Straw, etc.	Potash.	Phosphoric Acid.	Nitrogen.
Apples	15 tons	.....	60 lbs.	30 lbs.	39 lbs.
Barley	30 bu.	2000 lbs.	51 lbs.	17 lbs.	57 lbs.
Beans	30 bu.	2700 lbs.	53 lbs.	30 lbs.	75 lbs.
Buckwheat	34 bu.	2800 lbs.	40 lbs.	14 lbs.	56 lbs.
Cabbage	30 tons	.....	270 lbs.	70 lbs.	200 lbs.
Clover, green	.....	15 tons	140 lbs.	40 lbs.	130 lbs.
Clover, dry	.....	2 tons	88 lbs.	18 lbs.	82 lbs.
Corn	70 bu.	6000 lbs.	55 lbs.	48 lbs.	83 lbs.
Grapes	2 tons	7000 lbs.	39 lbs.	11 lbs.	32 lbs.
Hops	600 lbs.	2700 lbs.	53 lbs.	23 lbs.	84 lbs.
Mixed Hay	.....	5000 lbs.	77 lbs.	18 lbs.	70 lbs.
Oats	60 bu.	3200 lbs.	62 lbs.	22 lbs.	55 lbs.
Onions	45,000 lbs.	.....	72 lbs.	37 lbs.	72 lbs.
Pears	16 tons	.....	26 lbs.	10 lbs.	32 lbs.
Peas	30 bu.	3000 lbs.	52 lbs.	33 lbs.	108 lbs.
Plums	8 tons	.....	40 lbs.	4 lbs.	30 lbs.
Potatoes	200 bu.	1500 lbs.	74 lbs.	21 lbs.	46 lbs.
Rye	30 bu.	4250 lbs.	45 lbs.	26 lbs.	51 lbs.
Sugar Beets	15 tons	6000 lbs.	143 lbs.	32 lbs.	69 lbs.
Timothy Hay	.....	4000 lbs.	94 lbs.	23 lbs.	89 lbs.
Tobacco	1600 lbs.	1400 lbs.	200 lbs.	16 lbs.	76 lbs.
Tomatoes	10 tons	.....	54 lbs.	20 lbs.	32 lbs.
Turnips	700 bu.	5 tons	180 lbs.	52 lbs.	80 lbs.
Wheat	35 bu.	3000 lbs.	31 lbs.	24 lbs.	59 lbs.

METHOD OF APPLYING FERTILIZERS.

New York Agricultural Experiment Station Bulletin No. 94.

The method to be used in applying fertilizer depends primarily upon the efficiency with which the constituents of the fertilizers are distributed most thoroughly and uniformly throughout the portion of the soil where the plant roots are. The effect of a fertilizer is lost so far as it does not reach the plant roots. Pains must be taken to secure even and complete distribution of fertilizers on or in the soil, since it is desired to have the food reach every plant in the field. In order to distribute small quantities of concentrated fertilizers over a broad area, it is well to dilute by mixing with some such substance as dry earth, road-dust, sifted coal-ashes, or sand.

As between applying fertilizers with the drill or by broadcasting, the best results are given sometimes by one and sometimes by the other method, according to the crop and special conditions. Labor is saved by using the drill, while the best ultimate results appear more often to come from broadcasting, plowing or harrowing in, according to circumstances. When a fertilizer is especially needed by a crop in its earliest stages, there is advantage in drilling it in with the seed. When concentrated fertilizers are to be distributed broadcast, it is desirable that they should be somewhat diluted.

Materials which are readily soluble can be scattered over the surface. After the first fall of rain they distribute themselves throughout the soil very completely and uniformly. Such materials are nitrate of soda, sulphate of ammonia, soluble phosphates, and soluble potash salts. These materials are preferably used in case of top-dressing.

Materials which are not readily soluble are preferably well mixed through and beneath the soil. Thus, dried blood, bone meal, fish scrap, and similar materials are best placed at greater or less depth beneath the soil, because under these conditions they become soluble more rapidly and are retained more surely by the soil.

Fertilizers which dissolve easily and diffuse through the soil rapidly and which are not readily retained by the soil are best applied only when the crop is ready to utilize them. If put on too early, there is danger of their being leached from the soil and carried more or less beyond the reach of the plant, and thus lost. Nitrates and, to a less extent, ammonia compounds come under this precaution. Hence, it is not wise to ordinarily apply guano, ammonia compounds or nitrate of soda in the fall, except in climates which have a dry fall and winter. This application should be deferred until spring. In wet springs, ammonia compounds are preferably applied rather than nitrate of soda; or, if nitrate of soda is used, loss may be avoided by making several small applications, instead of one at the start. Care should be taken, however, not to make applications of nitrate of soda too late in the season, as the maturing of the crop will be retarded, and there will be an excessive growth of stems and leaves.

Fertilizers which do not dissolve readily, or which do not diffuse through the soil rapidly, are better applied to the land before the crop commences its growth. To this class belong stable-manure, dried blood, tankage, cottonseed-meal, ground rock, and, to some extent, soluble phosphates and potash compounds.

In applying highly concentrated commercial fertilizers, it is wise to prevent the fertilizer coming in contact with the seeds or foliage of plants.

On soils of loose texture and small retentive power, it is best to use, for the most part, those forms of fertilizers which are not too easily soluble, in order to make as small as possible the losses occasioned by heavy rains. Animal and vegetable materials are especially suited for such cases.

ANALYSIS OF MANURES.

	Fresh Barnyard Manure	Rotted Barnyard Manure	Fresh Horse Manure	Fresh Sheep Manure	Fresh Hen Manure
Water	71.0	79.0	75.7	65.5	56.0
Organic substances	24.6	14.5	21.1	31.4	21.5
Ash	4.41	6.5	3.16	3.11	18.05
Nitrogen	.45	.58	.44	.55	1.63
Potash	.52	.5	.35	.1	.85
Soda	.15	.13	.06	.46	.1
Lime	.57	.88	.15	.15	2.4
Magnesia	.14	.18	.12	.31	.74
Phosphoric acid	.21	.32	.35	.14	1.54
Sulphuric acid	.12	.13	.16	1.75	.45
Silica and sand	1.25	1.7	1.96	.03	3.52
Chlorine and fluorine	.15	1.6	.02		

COMMERCIAL FERTILIZERS

WHY USE COMMERCIAL FERTILIZERS.

First—Because it costs no more to plant, cultivate and harvest a full crop than it does a half crop.

Second—If a crop is healthy and makes a vigorous growth, it is not nearly so apt to be troubled with insects and other pests.

Third—On a crop where fertilizers have been used, the product is not only greater in volume but is almost invariably better in quality and will sell at more per bushel or per hundred-weight.

Fourth—The use of Commercial Fertilizers releases the plant food that is already in the soil but which is unavailable until the Commercial Fertilizer has been applied.

WHAT FERTILIZER WILL DO.

Every crop that is taken off the land removes so many pounds nitrogen, so many pounds phosphoric acid and so many pounds of potash. If this is replaced each year, the land will never become poor but thru cultivation will improve.

PROFIT IN USING.

Whether or not you use fertilizer should depend on whether you can get more than a dollar's worth of produce back for every dollar's worth of fertilizer you use on the soil. If the fertilizer is used correctly, there is no question but what it will give the desired returns, but of course the soil differs and the requirements of the different crops differ, so that in order to get the biggest returns a grower must have more or less of an understanding of the fertilizer question. It is our object to sell fertilizer only to the man who would get returns and want to help every grower, and to give every grower information enough so that when he does use fertilizer, there will be a profit in using it.

WHEN AND HOW TO APPLY.

Fertilizers are either broadcasted evenly all over the field or drilled in; and which of these methods is preferable depends on conditions. As a general rule, where fertilizers are used in small quantities only, they are often more effective when applied with a drill, because they come closer to the rows of planted crops. It must be remembered, however, that fertilizers may produce injury when coming in direct contact with the seed or the young roots of plants, and this danger, of course, is greater when fertilizers are applied with the drill and at planting time, than when applied broadcast and previous to planting. To reduce the danger from injury when fertilizers are drilled in, it is well to dilute them by mixing them with several times their bulk of mellow earth.

A good method is to apply the mineral fertilizers; that is, potash and phosphoric acid, some time before sowing or planting, so that they may mix thoroughly with the soil. On some soils it would even be best if the potash and phosphoric acid were applied in the fall preceding the planting.

Nitrogen, however, especially when in the form of nitrate of soda, or other very soluble compounds, will always give best returns if used at planting time, or even after the planting, as a top-dressing. Nitrogen fertilizers generally are readily soluble, and if not taken up by the plants shortly after applying are apt to be washed away by rains, and lost. Herein again lies the great value of the complete mixed fertilizers prepred by reliable manufacturers, as they are compounded in a manner to blend perfectly and conserve all the elements, one holding or releasing the other as used by the plants, and allowing no dissipation.

At times it may be advantageous, however, to apply nitrogen fertilizers in two or three doses during the growing season, at intervals of several weeks.

COMPLETE FERTILIZERS

Complete fertilizers are those containing correct proportions of all the essential plant foods, viz.: Nitrogen, phosphoric acid and potash. Different crops require different proportions of these plant foods, and for convenience and best results to our customers we mix fertilizers for various crops, as described elsewhere.

When preferred, we furnish the various materials used in these fertilizers, individually, but unless the farmer has made a study of the subject, experimented, and knows exactly what his soil requires, better results will be obtained by using the complete mixed fertilizers.

All of our Complete Fertilizers are guaranteed to contain as much or more of each

of the plant food elements as is shown in analysis printed on each package, in accordance with the state law. The law is very strict in regard to this, and is a blessing to both the farmer and the reliable dealer. Without this law the value of commercial fertilizers would be very uncertain, as there is nothing in their appearance to indicate their worth.

There is little danger of purchasing a commercial fertilizer in the State of Washington which does not contain all of the plant food shown in the analysis printed on the packages. Still there is a great difference in Complete Fertilizers, in the ingredients of which the analysis is made up. Our Complete Fertilizers are composed of materials containing the required plant foods in the forms best adapted to the purposes for which they are intended.

LILLY'S LAWN DRESSING.

A High-Grade Complete Fertilizer for Lawn and Flower Beds.

GUARANTEED ANALYSIS:

Nitrogen	5.00%
Nitrogen expressed as Ammonia	6.07%
Available Phosphoric Acid	8.00%
Phosphoric Acid expressed as Bone Phosphate	17.46%
Potash	5.00%
Potash expressed as Sulphate of Potash	9.25%

This complete fertilizer is proportioned especially for the feeding of grasses, but will be found very satisfactory for flower beds and rose bushes as well as lawns, in any locality.

A portion of the plant food is immediately available and the balance is given up gradually as needed, consequently the results are lasting. The composition is easily handled, comparatively odorless and not unsightly, as there is no coarse material in it, and it is free from the unnumbered weed seeds contained in barnyard manure, of which one would have to use from one to two tons to get the same amount of plant food contained in 100 pounds of our Lawn Dressing.

One hundred pounds worked into each 1000 square feet of surface before seeding, or 100 pounds to 2500 square feet when used as a top dressing, gives good results. Put up in 100-pound and 25-pound bags.

LILLY'S FRUIT AND HOP FERTILIZER.

Increases Quantity and Improves Quality.

GUARANTEED ANALYSIS:

Nitrogen	4.00%
Nitrogen expressed as Ammonia	4.85%
Available Phosphoric Acid	8.00%
Phosphoric Acid expressed as Bone Phosphate	17.46%
Potash	9.00%
Potash expressed as Sulphate of Potash	16.65%

The largest and thriftiest looking tree or plant does not always yield the most and best fruit. An excess of nitrogen will cause too great a growth of wood and other ill effects such as plenty of blossoms but fruit fails to set.

This formula is made up with the fruit grower's object in view, viz., to get the most and best fruit from the minimum plants and acreage.

The plant food elements are proportioned so as to increase quality, and at the same time properly develop the plant without excess.

This fertilizer is of the greatest value to berry growers of the Pacific Coast, as it improves the color, flavor and texture of the fruit, and the firmness it imparts makes the berries stand up well on long shipments, one of the most important points of consideration to the commercial grower.

500 to 800 pounds per acre will give excellent results. Care should be taken when applied to growing plants, not to allow the fertilizer to get on the foliage, especially in warm weather. Put up in 100-pound and 25-pound bags.

LILLY'S FERTILIZER CATALOG WILL BE MAILED ON REQUEST.

LILLY'S POTATO FERTILIZER.

GUARANTEED ANALYSIS:

Nitrogen	3.00%
Nitrogen, expressed as Ammonia	3.66%
Available Phosphoric Acid, P^2O^5	6.00%
Phosphoric Acid, expressed as Bone Phosphate	13.16%
Potash	11.00%
Potash, expressed as Sulphate of Potash	20.36%

This formula is prepared for potatoes and other roots, such as beets, carrots, etc., which require greater percentages of potash and smaller proportions of nitrogen and Phosphoric Acid.

The elements in this composition promote root development without creating an excessive leaf growth, insuring the greater crop from smaller acreages of almost any kind of soil with proper cultivation.

The use of our potato fertilizer greatly lessens the danger of scab, black spots, and other diseases which are usually fostered by heavy applications of stable manure, and 1,000 lbs. per acre will supply plant food equal to eight to ten tons of manure.

If strict economy be practiced this fertilizer may be applied directly at the hill where the potato is to be planted, but should not be allowed to come in direct contact with the seed. Put up in 100-lb. and 25-lb. bags.

LILLY'S VEGETABLE FERTILIZER.

GUARANTEED ANALYSIS:

Nitrogen	3.00%
Nitrogen expressed as Ammonia	3.66%
Available Phosphoric Acid	11.00%
Phosphoric Acid expressed as Bone Phosphate	24.01%
Potash	5.00%
Potash expressed as Sulphate of Potash	9.25%

For general use where any one thing is not planted extensively, we prepare this formula containing an average percentage of each of the three plant food elements which combine to make all vegetation, to give the best results on the great majority of crops in all varieties of soils. Consequently it is the most satisfactory and economical fertilizer for the truck gardener and for the home vegetable garden.

At the rate of one thousand pounds to the acre would be a fair dressing, and would be equal in fertilizing value to about ten tons of ordinary stable manure. It is free from the millions of weed seeds invariably found in stable manure.

Like other Complete Fertilizers, it may be sown broadcast on the plowed ground, and harrowed in, before planting; or it may be drilled in close to the rows of seeds or plants after seeding or during the early growing season.

LILLY'S CONCENTRATED FERTILIZER.

GUARANTEED ANALYSIS:

Nitrogen	2.00%
Nitrogen expressed as Ammonia	2.43%
Available Phosphoric Acid	6.00%
Phosphoric Acid expressed as Bone Phosphate	13.10%
Potash	4.00%
Potash expressed as Sulphate of Potash	7.40%

A complete fertilizer prepared especially for those who require only a small quantity of fertilizer for general purposes, such as the vegetable garden, flower garden, roses, shrubbery, house plants, or the lawn, and do not care to purchase each of the special fertilizers. It is clean, almost odorless, and may be applied either dry or dissolved in water. Packed only in 5-lb. cartons and 25-lb. bags.

LILLY'S FISH AND BONE FERTILIZER.

For Strawberries, Orchards, Hops, Melons, and Tomatoes East of the Cascades.

GUARANTEED ANALYSIS:

Nitrogen	4.20%
Expressed as Ammonia	5.10%
Available Phosphoric Acid	11.00%
Expressed as Bone Phosphate	24.00%
Potash	2.00%
Expressed as Sulphate of Potash	3.70%

This is a well balanced fertilizer prepared especially to meet the needs of eastern Washington and Eastern Oregon, and will be found to give the best of results on the rich lava lands of those sections. It is especially adapted to fruit orchards, hop fields, melons and tomatoes, so extensively grown east of the Cascades.

The elements of plant food are derived from a number of sources, thereby obtaining varying degrees of solubility, giving a steady and continuous feeding of plant or tree.

Contrary to a common belief, the high priced and extremely rich lands of Yakima, Walla Walla, Lewiston, Wenatchee and Hood River districts, as well as other similar sections, are in need of commercial fertilizer to insure the best profits. These lands are for the most part used for the same crop year after year; rotation is not possible or even profitable from a commercial point of view, and without crop rotation each year a certain amount of plant food is removed from the soil, and it must be returned or the quality and quantity of crops will be impaired. Humus can and should be furnished by turning under green crops. For plant food use Lilly's Fish and Bone, as follows: Apply about 8 to 10 pounds per tree at time of plowing in the spring and follow this up by an application in summer or early fall of about half the quantity. This is for an orchard in full bearing; on young orchards the quantity may be materially reduced. For hops use about 700 pounds per acre, and for tomatoes and melons about 1200 pounds per acre.

CHEMICAL FERTILIZERS

Chemical fertilizers contain only the one chemical, and are consequently not complete fertilizers. They produce wonderful results when properly used, but you should experiment and study the matter carefully before investing in large quantities. Many persons know only of super-phosphate as a commercial fertilizer, and apply it promiscuously on any soil or crop, and, if it does not produce the desired results, condemn commercial fertilizers in general.

Most soils contain sufficient quantities of one or two of the three ingredients necessary for fertility, in which case, if by experimenting, you have ascertained what is lacking, it is only necessary to add that which is lacking. It is often advisable to use stable manure, or to plow under a green manure crop, and then apply chemical fertilizers to balance the chemicals which the manure contains in insufficient quantities.

MURIATE OF POTASH.

Guaranteed Analysis: Potash 50%.

Potash salts are especially valuable in western Washington and the Willamette valley, where most of the soil is very deficient in potash. It is much used by fruit growers, especially for berries, and in addition to increasing the yield, makes a marked improvement in the quality and color of the fruit. As it makes the fruit more firm, it stands shipping better. Muriate of potash contains chlorine, and is harmful when used for tobacco, and some claim that sulphate of potash is better for potatoes, although opinions differ in regard to that.

SULPHATE OF POTASH.

Guaranteed Analysis: Potash 50%.

This is similar to muriate of potash, but is free from chlorides, and in some cases can be used to better advantage. It contains the same amount of potash, 50%. It is applied in the same manner and quantities as muriate of potash.

When possible, potash should be applied several months before planting the seed, to give it time to become incorporated with the soil before being required by the plants. It may be applied in the fall before seed is to be planted in the spring, and as it is slow acting, practically none of it will be lost. It will also show good results if applied at time of seeding, and any that is not used by that crop will remain in the soil for future crops.

We have, for free distribution, several good books in regard to potash salts, and will be glad to mail them to all persons interested in fertilizers.

DOUBLE MANURE SALTS.

Guaranteed Analysis: Potash 20%.

A cheaper grade of potash salts, containing chlorides and 20% pure potash. In many cases it will be found to be more economical than the higher grades. It is usually applied at the rate of 200 pounds to 500 pounds per acre.

KAINIT.

Guaranteed Analysis: Potash 12%.

This is crude potash salt, contains a large proportion of chlorine, and should be used on celery, asparagus and other crops where chlorides are beneficial. It is also recommended for destroying grubs and maggots in the soil. Contains 12% pure Potash The quantity used depends upon the purpose for which it is used, 200 pounds to 2,000 pounds per acre.

NITRATE OF SODA.

Guaranteed Analysis: Nitrogen 13%.

Nitrate of soda is generally used as a top-dressing, acts as a tonic, and produces wonderful results when properly used. The effect is almost immediate, lasts for a short time only, and best results are obtained by three or four light applications of about 150 pounds per acre each, at short intervals early in the season. Care must be exercised in using it.

SUPER-PHOSPHATE.

Guaranteed Analysis: Phosphoric Acid 17%.

This is what is known as acid phosphate, being phosphate rock treated with acid to make the phosphoric acid available. While the phosphoric acid in this is not so valuable as that in bone meal, it is more quickly available, and for that reason is sometimes more useful. It contains 17% per cent phosphoric acid, and is generally used at the rate of 500 pounds to 1,000 pounds per acre.

LAND PLASTER, OR GYPSUM.

Land plaster is not really a fertilizer, as it is not a plant food, and adds nothing to the soil, but it causes a chemical change in the soil, releasing the potash which is already there in unavailable form. An application of about 100 pounds to 500 pounds per acre, sown broadcast, on clover, alfalfa, peas, beans or other legumes, will add greatly to the crop.

GROUND LIME ROCK.

Much of the soil in the Northwest, although containing sufficient quantities of the necessary ingredients for fertility, is unproductive on account of being sour. This is easily overcome by applying lime, and investigations by the Washington State Agricultural College show that the best form of lime for this purpose is ground lime rock.

An application of fifteen hundred to two thousand pounds will sweeten the soil, improve the texture and drainage, hasten decomposition of organic matter, and make available the inert fertilizing constituents which are in the soil.

LILLY'S FERTILIZER CATALOG WILL BE MAILED UPON REQUEST.

ANIMAL FERTILIZERS

Animal fertilizers, being made from animal matter, add warmth and life to the soil. Most of them contain both nitrogen and phosphoric acid, but do not contain potash, so that to make them complete, it is necessary to add the correct proportion of chemical fertilizers.

It would naturally be supposed that sufficient quantities of the required chemical would have the desired result, regardless of the form in which it is applied, but that is not a fact. For instance, for certain soils, crops and conditions, nitrogen and phosphoric acid in the form of bone meal is the most valuable, while under other conditions they would produce better results if applied in the form of super-phosphate, blood and bone, fish guano or stable manure. To decide which to use requires study and experience.

LILLY'S BONE MEAL.

Guaranteed Analysis: Nitrogen, 3%; Phosphoric Acid, 12% to 20%.

Bone meal is the basis of almost all mixed fertilizers, and for some purposes is the best and cheapest form of nitrogen and phosphoric acid. It is slow in action, and there is no waste, as the plant food is released only as fast as it is taken up by the roots of the plants. Our bone meal is made from fresh bones, and has not lost any of its value. The quantity to use depends entirely upon the purpose for which it is used. Light applications are beneficial, but on permanent work, such as forming soil for lawns, rose beds, etc., it should be used in very large quantities, the more the better.

LILLY'S BLOOD AND BONE.

Guaranteed Analysis: Nitrogen, 4%; Phosphoric Acid, 12%.

An animal fertilizer, rich in nitrogen and phosphoric acid, and having additional value on account of a certain warmth and vitality which it adds to the soil. It is a quick acting fertilizer, and for that reason it is for some purposes more useful than bone meal, although the effect is not so lasting. It should not be applied a great length of time before seed is planted. It is usually applied at the rate of 500 pounds to 1,000 pounds per acre.

LILLY'S FISH GUANO.

Guaranteed Analysis: Nitrogen, 8%; Phosphoric Acid, 8%.

Made from salmon fish scrap, contains about 8% nitrogen and 8% phosphoric acid, and will produce good results on any crop where a large growth of leaves is desired. It is splendid for lawns, but the odor is rather objectionable. Usually applied at the rate of 500 pounds to 1,000 pounds per acre.

LILLY'S PULVERIZED SHEEP MANURE.

Pure sheep manure is the best and strongest manure of all of nature's fertilizers, containing, as it does, nitrogen, phosphoric acid and potash in liberal proportions. However, to retain this high value, it must be handled properly, and the ammonia not allowed to escape.

Pulverized Sheep Manure is secured from the stock yards feeding sheds, where it is not exposed to the weather, is kiln-dried, thus reducing the weight more than one-half, but retaining all the valuable ingredients; is finely pulverized and screened.

NUMBER OF PLANTS TO THE ACRE

Dis. Apart.	No. Plants	Dis. Apart.	No. Plants	Dis. Apart.	No. Plants	Dis. Apart.	No. Plants
12 x 1 in.	522,720	25 x 18 in.	15,520	36 x 36 in.	4,840	60 x 60 in.	1,745
12 x 3 in.	174,240	30 x 1 in.	209,088	42 x 12 in.	12,446	8 x 1 ft.	5,445
12 x 12 in.	43,560	30 x 6 in.	34,848	42 x 24 in.	6,223	8 x 3 ft.	1,815
16 x 1 in.	392,040	30 x 12 in.	17,424	42 x 36 in.	4,148	8 x 8 ft.	680
18 x 1 in.	348,480	30 x 16 in.	13,068	48 x 12 in.	10,890	10 x 1 ft.	4,356
18 x 3 in.	116,160	30 x 20 in.	10,454	48 x 18 in.	7,790	10 x 6 ft.	726
18 x 12 in.	29,040	30 x 24 in.	8,712	48 x 24 in.	5,445	10 x 10 ft.	435
18 x 18 in.	19,360	30 x 30 in.	6,970	48 x 30 in.	4,356	12 x 1 ft.	3,630
20 x 1 in.	313,635	36 x 3 in.	58,080	48 x 36 in.	3,630	12 x 5 ft.	736
20 x 20 in.	15,681	36 x 12 in.	14,520	48 x 48 in.	2,723	12 x 12 ft.	302
24 x 24 in.	10,890	36 x 18 in.	9,680	60 x 36 in.	2,901	16 x 1 ft.	2,722
24 x 1 in.	261,360	36 x 24 in.	7,260	60 x 48 in.	2,178	16 x 16 ft.	170

QUANTITY OF SEED REQUIRED

Quantity per Acre.

Alfalfa ..... 8 to 15 lbs.
Alsyke ..... 6 to 10 lbs.
Artichoke, 1 oz., to 500 plants ..... 6 oz.
Asparagus, 1 oz. to 500 plans ..... 1 lb.
Barley ..... 100 lbs.
Beans, Dwarf, 1 lb. to 100 feet of drill ..... 50 lbs.
Beans, Tall, 1 lb. to 150 hills ..... 25 lbs.
Beet, Garden, 1 oz. to 50 feet of drill 5 lbs.
Beet, Sugar, 1 oz. to 50 feet of drill 5 lbs.
Beet, Mangel Wurzel, 1 oz. to 50 feet of drill ..... 5 lbs.
Broccoli, 1 oz. to 2000 plants ..... 4 oz.
Brussels Sprouts, 1 oz. to 2000 plants 4 oz.
Broom Corn ..... 12 lbs.
Buckwheat ..... 45 lbs.
Cabbage, 1 oz. to 1500 plants ..... ½ lb.
Carrot, 1 oz. to 125 feet of drill .... 3 lbs.
Cauliflower, 1 oz. to 2000 plants .... 3 oz.
Celery, 1 oz. to 5000 plants ..... 1 lb.
Cheat ..... 100 lbs.
Chicory, 1 oz. to 100 feet of drill .... 4 lbs.
Clover, White and Alsyke ..... 6 to 10 lbs.
Clover, White, for Lawns ..... 25 to 100 lbs.
Clover, Red, Mammoth and Crimson ..... 12 to 20 lbs.
Collards, 1 oz. to 2000 plants ..... 4 oz.
Corn, Sweet, 1 lb. to 200 hills ..... 152 lbs.
Corn, Field ..... 12 to 20 lbs.
Corn, Fodder ..... 125 lbs.
Corn, Pop ..... 8 to 10 lbs.
Corn, Wheat ..... 125 lbs.
Cress, 1 lb. to 100 feet of drill ..... 1 lb.
Cucumber, 1 oz. to 60 hills ..... 2 to 3 lbs.
Egg Plant, 1 oz. to 2000 plants .... 4 oz.
Endive, 1 oz. to 100 feet of drill ... 4 oz.
Flax, for seed 30 lbs. to acre. For fiber ..... 50 lbs.
Grass, Lawn, 1 lb. to 300 square ft. . 145 lbs.
Grass, Kentucky Blue, Canadian Blue ..... 20 lbs.
Timothy ..... 25 lbs.
Red Top, in chaff 60 lbs. Solid ... 30 lbs.
Rye Grass, Oat Grass, Fescue Grasses ..... 30 lbs.
Orchard Grass ..... 40 to 60 lbs.
Hemp ..... 40 to 50 lbs.
Horse Radish Roots ..... 15000 to 20000
Kale, 1 oz. to 150 feet of drill ..... 1 lb.
Kale, Thousand Headed ..... 1 lb.
Kohlrabi, 1 oz. to 150 feet of drill .. 2 lbs.
Kaffir Corn ..... 6 to 8 lbs.
Leek, 1 oz. to 100 feet of drill ..... 4 lbs.
Lettuce, 1 oz. to 150 feet of drill .... 3 lbs.
Melon, Musk, 1 oz. to 60 hills .... 2 to 3 lbs.
Melon, Water, 1 oz. to 30 hills ... 3 to 4 lbs.
Millet ..... 30 lbs.
Nasturtium, 1 oz. to 50 feet of drill 15 lbs.
Oats ..... 75 lbs.
Okra, 1 oz. to 100 feet of drill ..... 8 lbs.
Onion, 1 oz. to 100 feet of drill ..... 8 lbs.
Onion, for sets ..... 30 to 80 lbs.
Onion Sets, 1 lb. to 75 feet of drill .. 400 lbs.
Parsley, 1 oz. to 300 feet of drill .... 3 lbs.
Parsnip, 1 oz. to 200 feet of drill .... 6 lbs.
Peas, Garden, 1 lb. to 50 feet of drill 200 lbs.
Peas, Field ..... 150 lbs.
Pepper, 1 oz. to 100 plants .....
Potatoes ..... 400 lbs
Pumpkin, 1 oz. to 30 hills ..... 3 to 4 lbs.
Radish, 1 oz. to 100 feet of drill .... 10 lbs.
Rape, Dwarf Essex ..... 5 to 10 lbs.
Rutabaga, 1 oz. to 150 feet of drill .. 2 lbs.
Rye ..... 90 to 120 lbs.
Salsify, 1 oz. to 50 feet of drill .... 8 lbs.
Speltz ..... 100 lbs.
Spinach, 1 oz. to 100 feet of drill ... 8 lbs.
Spurry ..... 15 lbs.
Squash, Summer, 1 oz. to 25 hills ... 3 lbs.
Squash, Winter, 1 oz. to 12 hills .... 4 lbs.
Sugar Cane ..... 10 lbs.
Sunflower ..... 8 lbs.
Tobacco, 1 oz. to 10000 plants ..... 3 oz.
Tomato, 1 oz. to 2000 plants ..... 4 oz.
Turnip, 1 oz. to 150 feet of drill .... 2 lbs.
Vetches, Spring ..... 60 to 90 lbs.
Vetches, Winter ..... 30 to 60 lbs.
Wheat ..... 90 to 120 lbs.

USUAL DISTANCES FOR PLANTING

Beans, Bush, drills 2 to 3 feet apart.
Beans, Pole, 3 to 4 feet each way.
Beets, Early, drills 12 to 18 inches apart.
Beets, Late, drills 2 to 3 feet apart.
Blackberries, erect growing, 6 to 9 by 4 feet.
Blackberries, Mammoth and Himalaya, 8 by 24 feet.
Cabbage, Early, 16 by 30 inches.
Cabbage, Late, 24 by 30 inches.
Carrots, drills 1 to 2 feet apart.
Corn, Sweet, 3 to 3½ feet by 9 to 24 inches
Corn, Field, 3½ to 4 feet each way.
Cucumber, 4 to 5 feet each way.
Currants, 5 by 3 feet.
Egg Plant, 3 by 3 feet.
Lettuce, drills 18 inches apart.
Melon, Musk, 5 to 6 feet each way.
Celery, rows 3 to 4 feet 6 inches in row.
Cherry Trees, 15 to 20 fete each way.
Cauliflower, 2 by 2 to 2 by 3 feet.
Apple Trees, 20 to 30 feet each way.
Asparagus, 3 to 4 by 2 feet.
Gooseberries, 5 by 3 feet.
Grapes, 8 by 8 to 10 by 12 feet.
Melon, Water, 7 to 8 feet each way.
Onions, drills 14 to 20 inches apart.
Parsnip, drills 18 to 36 inches apart.
Peach Trees, 18 to 24 feet each way.
Pear Trees, standard, 20 to 25 ft. each way.
Pear Trees, Dwarf, 12 to 15 feet each way.
Peas, drills 2 to 3 feet apart.
Pepper, 15 to 18 inches by 2 to 2½ feet.
Plum Trees, 15 to 20 feet each way.
Potatoes, 12 to 18 inches by 2½ to 3 feet.
Pumpkin, 8 to 10 feet each way.
Quince Trees, 15 feet each way.
Radish, drills 10 to 18 inches apart.
Raspberries, 6 to 8 by 3 feet.
Rhubarb, 2 to 4 feet by 4 feet.
Salsify, drills 18 to 24 inches apart.
Spinach, drills 12 to 18 inches apart.
Squash, Bush, 3 to 4 feet by 4 feet.
Squash, Running, 12 feet each way.
Strawberries, Hills, 36 by 18 inches.
Strawberries, Matted Rows, 48 by 12 inches.
Sweet Potatoes, 2 feet by 3 to 4 feet.
Tomato, 4 feet by 4 to 5 feet.


LILLY'S