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Experiment Station Work, LXXV.

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GARDEN SWEET PEAS.
WINTER-FLOWERING SWEET PEAS.
SOUTHERN BUR CLOVER.
TYPE OF SHEEP FOR SOUTHWEST
COMBATING FLIES.

MARCH, 1913.

PREPARED IN THE OFFICE OF EXPERIMENT STATIONS
A. C. TRUE, Director.

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EXPERIMENT STATION WORK.

Edited by W. H. Beal and the Staff of Experiment Station Record.

Experiment Station Work is a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. True, Director, Office of Experiment Stations.

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ILLUSTRATIONS.

EXPERIMENT STATION WORK.[1]

GARDEN SWEET PEAS.[2]

The sweet pea can adapt itself to a variety of locations, but a position which provides for plenty of light and air at all times with a little shade from the midday suns of July and August is to be preferred. Plants grown in too much shade are usually weak and spindling with but few flowers. The drying summer suns tend to shorten the blooming period and also cause certain colors to fade. The effects of drought can be largely overcome, however, by early planting and by deep and thorough preparation of the soil. In seasons when the conditions are especially favorable sweet peas can be grown with fairly good results with no more preparation than is given ordinary vegetable ground, but as A. C. Beal writes in a recent bulletin of the Cornell station, "uniformly, year after year, the sweet peas with the strongest root systems will produce the finest flowers during the longest period." Vigorous root development can best be secured by planting just as early in the spring as the soil is dry enough to work, while the atmospheric conditions are such as to retard or even to prevent top growth for several weeks.

Any ordinary garden soil is suitable for sweet peas, providing it is well drained. Since sowing should be done at the earliest possible date, the soil should preferably be prepared in the autumn.

The soil should be broken up to a depth of 15 inches to 2 feet, and on some soils even deeper. Unless the soil is very uniform in composition, it is disastrous to bring the bottom soil to the surface; but this should be turned over in the trench, mixing with it, if heavy and compact, rather coarse stable manure or litter. Sometimes leaves are available for placing in the bottom of the trench. The use of these materials in subsoil promotes drainage, as well as improves the soil.

If a good layer (4 inches) of half-rotted stable or cow manure is placed between the top and bottom spadefuls, and the top soil, if heavy, made light with old manure, an excellent preparation has been made. The office of the manure is not only to increase the store of plant food, but also to increase the water-holding power.

[1] A progress record of experimental inquiries published without assumption of responsibility by the department for the correctness of the facts and conclusions reported by the stations.

[2] Compiled from New York Cornell Sta. Bul. 320.

An application of bone meal at the rate of 1 ounce per yard of trench, as well as a good dusting of air-slaked lime applied while working the soil in the autumn will both prove beneficial. The lime will not only correct any acid condition existing in the soil, but it will also aid in releasing the residual plant food of the soil.

Certain white-flowered sweet peas have light-colored seeds, while others have black seeds. The white seeds frequently split in the pod before harvesting and are likely soon to lose their vitality if planted early when the soil is cold. Hence the white seeds should be sown rather thicker than, or not so deep as, the black seed. In the sweet-pea plantings at Cornell it has been found that an ounce of seed will plant 50 to 60 feet of row, and if the seed is good it should plant still more. This allows for one seed to every 2 inches.

In some seasons sweet-pea seeds are slow in germinating. It is well to examine such seeds in order to ascertain their condition. If the seeds are found dormant but still fresh and plump, the seed coats should be cut with a sharp knife and replanted, when they will germinate well. This difficulty is not confined to the sweet pea, but some of the other Lathyri behave similarly. The trouble usually follows a very hot, dry season, when the seed becomes so excessively ripened as to render the seed coat impervious to water. Sometimes, in order to expedite germination, the seeds are soaked; a better method for the amateur is that recommended by Mr. Hutchins, the most prolific writer on sweet peas in America, who places the seed packets in moist earth for seven or eight days, then takes them out and examines them. The swollen seeds are planted, and the others cut with a knife.

In a test conducted at Cornell in 1909–10 the best results were secured from fall-planted seed. When to sow the seed in the fall will depend largely upon seasonal conditions in the locality. The ideal to be attained is to sow the seed long enough before freezing weather sets in to permit the roots to develop, without at the same time starting the leaves into active growth.

Fall planting.—In the season under discussion the finest and the earliest flowers were secured from plantings made in the fall. The preparation of the soil is the same as that already described, except that the soil is firmed and the trench filled level. On this a trench, or furrow, 2 inches deep is made, and the peas are planted at least as close as one seed every 2 inches. The row should be slightly ridged up so as to prevent water from standing and, as stated in the beginning, it is essential that the location be on a well-drained site. When the ground freezes a mulch of manure is placed over the row. In the spring when the bright weather comes the plants should be examined in order to see whether they are growing or whether the soil is soggy and cold. In either case the mulch should be removed from over the row and should be left in the center so that, in case any weather should come when the safety of the plants is at all endangered, the old mulch may easily be applied to protect them.

The seed of the standard varieties of sweet peas is cheap, and the advantage gained in obtaining early flowers, if the plants survive the winter, is worth the effort.

Spring planting.—As soon as the frost is out of the ground and the soil in workable condition in the spring, a heavy application of superphosphate of lime

should be made and raked in. Care should be exercised not to get the soil too loose, and for this reason it is best to confine all stirring of the soil to smoothing the surface. Especially is this true with light soils, which, if stirred deeply in the spring, must be well firmed. Heavy soils that are likely to bake may be improved by working in a light dressing of old, thoroughly rotted manure. * * *

One method recommended is to hollow out a broad trench, 24 to 30 inches wide and 2 inches deep, and then sow the seed 1 inch deep in single or double rows. The trench should be kept open for six weeks in order to retain the water. This system is very good in a garden where all cultivation is given by hand; but where many rows are grown and cultivation is done with a horse and cultivator, it is manifestly impossible to make or to maintain such a trench. Furthermore, when horse cultivation is to be used there would be difficulty in keeping the young plants, if planted below the surface, from being covered during the early cultivations. Therefore, planting on the level is necessary in field culture. It is advisable, however, in garden culture, to plant so that when covered the row will be 2 inches below the ordinary level.

Shall the planting be in single drills, broad drills, or double rows or drills? It matters little, provided sufficient room is allowed for the growing plants.

Another method of securing early blooms out of doors, which is practiced by many English growers and is especially valuable for exhibition purposes is to sow the seed in pots under glass, after which the plants are hardened in cold frames and planted out. Pot-grown plants should be started in February or March, the time depending somewhat on the latitude and seasonal conditions.

In order to secure suitable plants six seeds should be sown in 4-inch pots, using light, rich soil. * * *

When the plants are 2 or 3 inches high they should be given supports of short twigs and placed in a cold frame. Here they should be given plenty of air at every opportunity in order to secure a short, sturdy growth. If the plants do not catch hold firmly, they may be tied with raffia. When spring begins and the soil is in good condition the pots may be planted in the open 1 foot apart in a single row or 2 feet apart in a double row. In the latter case the plants alternate.

Sweet peas should be given some support from the time they begin to make tendrils. A variety of supports may be used, but, as Dr. Beal says:

In this country, where good, twiggy boughs can be obtained, such boughs unquestionably form the best support to use, since they are the most natural. In many places birches can be obtained in lengths of 12 to 14 feet. These may be prepared in the lengths desired. * * *

If the soil has been prepared properly and the plants look strong, and if the grower sees that the plants are watered and given every care, then the support should be 6 feet high. If the soil is only moderately fertile or has not been deeply prepared, or if the grower does not intend to keep all seed pods picked off or can not water the plants in order to overcome drought, the support should be kept down to 4 feet. The variety has something to do with the height of the support, whatever the care bestowed, some varieties being naturally dwarfer growers.

The sticks should be cut in late winter or very early spring, so that they are still rather green and tough enough to bear the load until the end of the sea-

son. They should be inserted in the soil at least a foot, because when clothed with vines to a height of 6 feet a strong windstorm exerts a tremendous leverage on them. Unless the sticks have been inserted deeply, or if they have become too dead and brittle, the row will go down under the force of the wind and the great weight of the wet vines. In order to guard against disaster, strong stakes are sometimes placed every 10 feet and wire is run lengthwise through the sticks and fastened to the stakes. It is desirable to have the sticks bushy at the top, so that they spread out more than at the base; if not naturally so, leaning the sticks alternately outward will produce this result. This gives greater freedom for the vines when in flower.

Netting.—When other systems of supporting are to be employed it is quite imperative to provide a support of small, short twigs as soon as the seedlings begin to produce tendrils. This method prevents the rain from beating the small plants down and enables them to get up to the other support. In city gardens, owing to the difficulty in procuring suitable sticks, wire netting makes a very satisfactory support. The peas do not cling to it so well, but it is cleaner and neater in appearance, which is a compensating advantage.

The large 4-inch mesh is preferable, but in many places this is not procurable, and the ordinary chicken netting or fence is used instead. Strong stakes at intervals not to exceed 10 feet are used to support the netting. One advantage of wire netting is that if stakes 6 feet high are used a 42 or 48 inch strip of netting may be placed in position, and if the season or soil is favorable and the peas grow above this, a narrow strip of netting may be added or a string or wire stretched from stake to stake over the row. A well-galvanized netting can be used repeatedly for several years, and will last longer if taken off in the fall and stored.

Frequent but extremely shallow cultivation should be the rule in growing sweet peas. They should not be allowed to suffer for lack of water, but watering should not be done until it is absolutely necessary, since if the soil has been deeply prepared the roots will go down after both moisture and plant food. When water is needed it should be applied thoroughly and at least two or three times a week in very dry periods. When it becomes necessary to water the plants a mulch of thoroughly rotted manure around the plants will be of great assistance in preventing too rapid evaporation.

The above-mentioned writer lays great stress on the necessity of dispodding.

In order to have fine flowers and a long succession of bloom, it is infinitely more necessary to keep the seed pods rigorously picked off than it is to cultivate, mulch, or water. The latter operations go for naught unless the pods are picked off. The writer thoroughly believes that the importance of watering has been overemphasized and that too many amateurs prefer to use the hose rather than to pick pods; then they assert that the sweet pea is not what it used to be—that it has lost constitution and the like. Of course the more highly developed the variety the less certain it is to bear up under neglect. There were on the trial grounds at this station in 1910 some of the oldest varieties, introduced from 1865 to 1890, then the latest hooded and grandiflorus, and finally the waved type. Although no pods were picked from the first two types after July 20, there was a noticeable difference in the flowering habit. The old varieties were continuously blooming profusely, while the second class were

sometimes completely destitute of flowers. The same holds true with regard to length of stem. Some plants of Countess Spencer were treated likewise in order to note the effect, and for them the season was over early in August.

The lesson is that if the grower does not intend to comply with the requirements of the improved types, it is better to grow Butterfly, Captain Clarke, Peach Blossom, and other small-flowered, precocious varieties.

Fertilizers.—After sweet peas are in full flower fertilizers may be applied. The best and safest fertilizer to use is liquid manure, diluted to the color of weak tea and applied once a week. It is often advantageous to alternate this with sulphate of ammonia or nitrate of soda at the rate of 1 ounce to 6 gallons of water. The plant usually responds better to phosphorus than to nitrogen, and even potash is often beneficial. Nitrate of potash and phosphate of potash dissolved at the same rate as the above-named fertilizers is of the proper strength to apply.

The most troublesome insects that attack sweet peas in the United States are the red spider and the pea aphis.[1]

The most serious fungus disease attacking the sweet peas in this country is the powdery mildew, which is often found late in the season when the plants are almost through blooming. The stems, leaves, and other parts of the plant become covered with the white, powdery coating. The disease may appear after a rain followed by very cold nights and hot days. The plants should be sprayed with potassium sulphid or dusted with sulphur or with a mixture of lime and sulphur, 2 parts of the former to 1 of the latter.

WINTER-FLOWERING SWEET PEAS.[2]

Sweet peas have been grown under glass to a limited extent for a long time, but the commercial importance of their winter culture dates back only to the development and introduction some 10 or 12 years ago of true winter-flowering sweet peas.

In a recent bulletin of the New York Cornell station, A. C. Beal traces the origin of the various groups of winter-flowering sweet peas, tells how they are grown, and describes over 70 varieties which were tested for two seasons under glass and also grown for one season out of doors.

The distinguishing characters of the winter-flowering type are described as follows:

The winter-flowering type is absolutely distinct in its habit of growth and its early flowering character. Unlike the garden types, which apparently stand still for a time when only a few inches high while side shoots are developed, the winter-flowering peas grow rapidly until they attain a height of 2 to 4 feet; then they begin to flower freely, after which time side shoots are devel-

[1] The red spider (*Tetranychus bimaculatus*), also known as the greenhouse red spider, is treated in detail in Circular 104 of the Bureau of Entomology, a copy of which may be obtained upon application. Readers interested in the pea aphis, an insect which attacks peas practically throughout the country and which is a very injurious pest, may obtain full information in Circular 43 of the Bureau of Entomology.

[2] Compiled from New York Cornell Sta. Bul. 319.

oped. In trials at this station the varieties of the winter-flowering type, planted September 24, came into flower between Thanksgiving and Christmas; while some varieties of the waved and the older types, planted at the same time, did not flower until the last week in April. Many varieties of the first-named type were flowering freely at the holidays, but the record would have been surpassed had it not been for the fact that during the month of November the region about Ithaca had not an entire day of sunshine and had only two partly sunny days. December was almost as dark and cloudy.

The winter-flowering peas make their greatest growth under glass. When planted in the spring in the open ground they make a very slender growth as compared with the garden type, and flower early in the season when a few inches high. However, they flower very profusely and continuously.

The garden type stools out well when planted under glass, but requires the entire winter for growth if planted in the fall. It is said by a practical grower that seed planted in January will flower as soon as that planted in August. This difference in habit of growth, manifesting itself very early, is of great value to the florist in enabling him to guard against loss from procuring the wrong seed.

The flowers of the winter-flowering type are generally of the open form of Blanche Ferry, a dwarfed garden variety introduced in 1889. They show either a direct or indirect relationship to that variety. Some of the English and American raised varieties are hooded, and one grower is perfecting a waved-flower group. As tested at the Cornell station the open-flowered type was superior in substance in midwinter, and the flowers remain open, whereas the hooded varieties are often too much hooded and do not show their real size to advantage.

Winter-flowering sweet peas grow 6 to 10 or more feet high. They need all the light they can get to promote free blooming; hence low or dark houses are not practicable. They should be grown preferably in solid beds, since the plants require a deep, moist, cool soil. Thorough drainage should be provided, and this will be assisted by raising the beds at least 1 foot above the walks.

When planning to grow sweet peas under glass in solid beds the house should be cleared as early as possible. Trench the soil 2 feet deep. If the beds have been manured annually the bottom soil may be brought to the surface. In new houses, in case the beds are to be raised a foot, trench the soil 18 to 24 inches deep if it is a good loam; if not, remove the soil and fill the beds with good soil. This gives an additional foot of loosened soil when the bed is full, but it is needed for additional drainage. In turning this original soil in a new bed apply a heavy coat of good decomposed cow manure in the trench. Then spread on top a 3-inch coat of manure and fill in with the prepared soil. In the old beds put a 3-inch layer of manure in the bottom of the trench and another about a foot below the top. The soil should remain thus until about the time for sowing; if a month or more intervenes, it is much better. At this time fork over the top layer 1 foot deep, which mixes the upper layer of manure with the surface soil.

While good crops of sweet peas may be grown on benches, yet they require more care than when in beds. The sweet pea is frequently grown as a crop to succeed chrysanthemums, particularly by those florists who do not devote a

great amount of space to pot plants. In order to have flowers for Christmas the early chrysanthemums should be cleared from the house by October 20 and the space filled with good sweet-pea plants transplanted from pots.

The best results will be secured from strong-germinating, outdoor-grown seed of this type. Seed procured from exhausted greenhouse-grown plants often germinates poorly or produces weak plants. The first row should be sown at least 5 feet away from steam pipes along the side walls. East and west rows may be planted 5 feet apart; north and south rows 3 feet apart. Sow the seed in drills 1 to 1½ inches deep and about the same distance apart in the drill. The surface should be kept level.

The winter-flowering varieties may be started in pots and transplanted later on, but they give better results when started in permanent position. A day or two before planting, the beds should be thoroughly saturated with water or with a strong dose of liquid manure. The seed may be sown as soon as the surface has dried off. White-seeded varieties suffer from retarded germination or excessive moisture, hence may best be soaked in water for several hours and then lightly stratified with sand in flats until they begin to swell. The seeds may then be sown in moderately dry soil, as with the other varieties.

If the soil has been saturated before planting, no more water should be applied for perhaps a week, or only when the soil is no longer moist 3 inches below the surface. When a thorough watering is not applied first, and the seed is sown and watered in, as a rule not enough water is given to saturate the soil very deeply. The result is that the plant confines its root area to this shallow moist layer and does not root deeply. It therefore suffers from extremes, and any lack of moisture is followed by a check from which it never recovers. On the other hand, if the preparatory watering is given and water withheld until there is need of it, the roots strike downward into moist and cooler soil, where they overcome, as far as possible, the effects of the hot days. The sweet pea must be kept growing steadily from the day the seed is sown. When water is needed do not apply near the plants, but between the rows, where it should be given liberally. This treatment is especially important with the early plantings. One reason why water should not be applied too near the plants is that they are especially subject to damping off. This trouble becomes more prevalent in October and November, when there are more cloudy days, cool nights, and like conditions. Because of this no soil should be heaped around the stem.

To secure the best returns from winter-flowering sweet peas they should be blooming freely during holiday or festive seasons. The rate of growth will be influenced somewhat by the amount of daily sunshine during the fall and early winter. In the Cornell tests a good crop of Christmas blooms was secured by sowing the seed in August.

When a good crop of sweet peas is desired for Christmas, the seed should be sown the 20th of August. When sown September 1 the plants will flower in January; when sown September 15 the main crop will be in February; and

when sown in October the crop will be ready in March. November sowings flower in the latter part of March; December sowings in April; January sowings in April and May; February sowings from May 1 on; and a March sowing in May or June. This gives the time when a reasonable crop can be expected, although flowers will be cut, especially with certain varieties, in a shorter interval than that given.

Some of the varieties in the tests at this station, sown October 20 and benched December 20, gave flowers during the last week in January, but not freely until about March. Some sown November 20 and benched December 20 began flowering in February and gave an abundance in March. Seed sown in beds September 24 this year gave flowers on Thanksgiving Day, although during the whole month of November there was not one clear day and there were only two partly clear days.

Winter-flowering peas grow very rapidly, hence training should commence as soon as they are up. Supports may consist of string, wire and string, or wire netting. Wire netting was preferred at Cornell, although it is condemned by commercial growers, who claim that the vines do not cling to it well and that more crooked stems occur than when the vines are trained on string.

Special effort must be made to keep the temperature down during the early growth period, for the nearer the natural outdoor spring conditions are approximated, the stronger and healthier the plants will be. Give full ventilation day and night, as late as possible, without freezing.

When the flower buds can be felt in the tips of the growing stems the temperature should be raised 1° a night until 50° is attained, which is the proper temperature during December, January, and February. From about the end of February on a night temperature of 48° is better. On bright days a rise of 10° or even 15° may be given. On cloudy days 55° is high enough, for higher temperatures promote soft, succulent growth that wilts when the sun comes out. Plenty of ventilation should be provided at every opportunity, as this, with careful regulation of temperature, causes a firm growth.

Sweet peas are subject to attack by the more common greenhouse insects and are also apt to become diseased unless proper attention is paid to soil conditions, temperature, and ventilation.

Sweet peas are especially subject to attack by the red spider, but unless the plants are too near heated pipes such attacks do not often occur except in the fall months. The careful use of water after the plants have attained a height of a few inches will eradicate this pest.

The pea aphis attacks sweet peas from the time they appear above ground. It can soon destroy the young plants, as well as weaken the plants at any stage. Treatment for this insect has already been referred to on page 9.

Climbing cutworms and snails, if present in greenhouses, will destroy sweet peas. The former insects * * * are combated by using compost that has not been covered by a rank growth of weeds and grass. When their work is noticed a search should be made for the worms under any mulch or lumps of

earth on the bench, where they are coiled up during the day. They may also be picked from the plants at night while feeding. Snails can be controlled by the application of lime and soot to the surface of the bed or benches.

The damping-off fungus has already been mentioned as causing the loss of young plants. Sometimes plants are seen with white or yellow streaked foliage. From experience at this station it appears that such a condition may follow the use of any soil that is not sweet. An instance occurred when a mold growing over the ashes of a bench entered the bottom of some pots of peas, causing the soil to become stale and musty. All the plants where this occurred showed streaked foliage later. The disease is undoubtedly physiological in its nature and is thought by practical growers to occur sometimes from the use of too much or too fresh manure on young plants.

The dropping of flower buds is often a cause of complaint from growers. The first flower buds frequently do not set on vigorous, thrifty plants. Usually this condition soon disappears, but sometimes it is necessary to keep the plants a little dry and to abstain from the use of fertilizers until the plants are blooming freely. The loss of the buds will follow a sudden fall in the temperature or will result from overwatering. Another cause is growing the plants in too cool an atmosphere. Plants that are grown in the proper temperature, with careful attention to watering, ventilation, and feeding, do not fail to give an abundance of flowers.

Mildew sometimes attacks sweet peas during the autumn, unless the temperature and ventilation receive attention. It has been found at this station that mildew yields readily to applications of sulphur to the pipes, and to the use of flour of sulphur dusted on the infected leaves. As soon as the fires are started in the fall some sulphur should be applied to the pipes as a preventive. This should be used judiciously, however, for an interesting case came under observation at this station during the past winter of the danger of using sulphur too strong. An application had been made, and on a very cold night the pipe covered with the sulphur was turned on, the result being that every flower which was well advanced or open was scorched so that most of the flowers had to be thrown away. No injury to the plants occurred.

SOUTHERN BUR CLOVER.[1]

E. F. Cauthen, of the Alabama station, states that "many southern farmers have long felt the need of winter crops for pasture purposes and soil improvement. As the ability of legumes to secure nitrogen from the air becomes more generally understood, the greater is the inquiry for a winter legume that will fill these important needs. Southern bur clover, or winter bur clover, as it is sometimes called, meets these requirements remarkably well. It is easy to grow, is adapted to many kinds of soil, and to begin its growth in a small way does not require much expense."

Bur clover (fig. 1) is not a true clover, but belongs to the Medicago family,[2] being closely related to alfalfa and melilotus. The plant is a native of southern Europe and western Asia. It is a low, spread-

[1] Compiled from Alabama College Sta. Bul. 165; Texas Sta. Bul. 108. See also U. S. Dept. Agr., Farmers' Bul. 147, p. 23.

[2] For a full discussion of the nonperennial species of this family see U. S. Dept. Agr., Bureau of Plant Industry Bul. 267.

ing annual that readily reseeds itself when left alone and spreads slowly over old fields and pastures. It is easily destroyed in cultivated crops and need not prove a troublesome weed to the farmer.

Bur clover seems to be adapted to any territory in which cotton can be successfully raised, and it grows in all the Gulf and South Atlantic States. If the plants become well rooted before cold weather they will stand a considerable freeze, the tops, if frozen, renewing their growth upon the resumption of warm weather.

The plant will grow on almost any kind of soil, but makes its best growth on rich, well-limed, sandy loams. On poorly drained soils, which are frequently acid and cold and not favorable to the development of nitrogen-fixing bacteria, the clover is often "scattering and small and of a yellow, sickly color; but as the soil becomes better drained, sweeter, and more completely inoculated, the clover becomes thicker and makes a heavier growth."

FIG. 1.—Bur clover.

Artificial inoculation is necessary for the successful growth of bur clover unless the land has grown California bur clover, melilotus, or alfalfa.

A very satisfactory way to secure this necessary inoculation is to sow the seed in burs. These are harvested by sweeping them up with a stiff broom, which brings together the dirt and litter which contain the bacteria peculiar to bur clover. When the seed and litter are sown they carry inoculation into the new soil. Hulled or recleaned seed do not carry the bacteria in a satisfactory quantity.

Soil from fields of bur clover, alfalfa, or melilotus scattered broadcast at the rate of 400 or 500 pounds per acre at the time of seeding is a very satisfactory way of introducing the bacteria, provided the cost of labor to handle and transport this soil is not too great. If this soil can be obtained close at hand and at small expense, it will doubtless pay to put it with the burs, thereby increasing the chances for better inoculation and of improved crops the first year. If the soil has to be transported a long distance and is expensive to handle, the amount per acre may be reduced to 200 or 300 pounds.

When soil is used for inoculating purposes it should be mixed with the seed and sown when the sun is not shining, as sunshine may kill the bacteria. It has also been found that a good application of well-rotted stable manure assists in the development of bacteria and of the first year's growth of clover;

southern bur clover requires two or three years for the soil to become sufficiently inoculated to assure a maximum stand and growth.

The uses of southern bur clover are many. It makes an excellent pasture for all kinds of live stock. For forage purposes it yields some hay, though the tendency of it to fall down when planted alone makes its mowing difficult. By planting it in combination with grain it is forced to grow more upright, and mowing becomes an easy operation.

Probably the greatest use of southern bur clover is that of soil improvement. In winter, when the cotton and corn fields are usually bare, a green cover crop of clover would lessen the loss of fertility by washing and leaching, and at the same time it would add to the soil a large quantity of atmospheric nitrogen.

FOR PASTURE.

Southern bur clover forms an excellent pasture in early spring and late winter for sheep, cattle, hogs, and horses. At first the animals may not like the taste of the clover, but if they are put on it while it is tender and other green feed is scarce, a relish for it may soon be acquired.

Enough animals should be kept on a clover pasture to keep it eaten down closely. Close grazing will not destroy it but will keep it tender. Even sheep, which are the closest grazers of our ordinary domestic animals, do not eat it so closely that it will not reseed itself.

The seeds germinate after the fall rains begin and, if the season is warm, light grazing will be furnished before the hard part of winter. During the warm spells of the winter and early spring the clover grows rapidly and often furnishes good pasturage. In this latitude it offers its maximum grazing in the middle of spring. As the grass comes up under the clover the stock quit the clover and take to the tender grass.

The amount of pasturage furnished per acre by southern bur clover during its growing season will compare favorably with our best native grasses.

Southern bur clover, so far as the writer knows, has never caused cattle to bloat, though it belongs to the class of plants that cause this trouble. Before they are accustomed to grazing the clover it might be well not to put them on it when they are very hungry or when the clover is wet with dew or rain.

Southern bur clover grows well on Bermuda sod. Late in the spring the grass becomes very tender, because it is shaded and fertilized by the clover. As the clover dies down the Bermuda grows rapidly. It is believed that its fertilizing effect upon the grass is equivalent to a top-dressing of barnyard manure. Another noticeable benefit of bur clover to the sod is the shading and smothering effect on early weeds that infest pastures.

There are two common methods of seeding southern bur clover on Bermuda sod. First, the burs are scattered broadcast over the sod in August or September, and the fall rains wash them into the low places and pockets, where the seeds germinate and grow; however, this method of seeding does not secure a uniform stand.

The second method is to open parallel furrows about 4 or 5 feet apart with a small scooter plow and drop or scatter the burs in these at the rate of 1 to 2 bushels per acre, depending upon the thickness of stand desired the first year. The seed is covered by dragging a brush or drag harrow across the open furrows.

This thin seeding will not furnish much grazing the first year, but it will give enough plants to grow an abundant seed for the second crop, and future seeding will take care of itself.

FOR HAY.

The spreading habit of southern bur clover and its tendency to fall down will prevent its common use as a hay crop. However, hay can be made of it if it is planted very thickly on highly fertilized soil. But the best way to make a hay crop of it is to sow it with fall grain.

Southern bur clover and oats or wheat may be planted together in September or October. Three to six bushels of burs and 2½ bushels of red rustproof oats or 1½ bushels of some early wheat should be seeded per acre. By crowding the grain and clover together the clover is forced to grow upright and a larger amount is harvested.

Cutting and curing.—The time for mowing southern bur clover for hay is when its blooms are appearing abundantly. If the cutting is not done at the proper time the plants fall down, and that portion which is next to the ground sheds its leaves, becomes woody and dark, and the market value of the hay is lowered.

If grain and clover are combined for hay they should be mowed when the grain is in the milk stage. If allowed to stand much longer the straw of the grain becomes woody and is not so palatable.

Curing of clover alone is not difficult. After the dew is off the mower may be started and run until noon. Before the dew appears in the evening the morning cutting should be raked from the swath to a windrow, where it may lie for one or two days. Then, if racks * * * are available the hay may be put on them and cured ready for baling without further handling. If the clover is allowed to remain in the swath a long time it becomes dry and brittle and loses many leaves, which form a valuable part of the hay.

A mixture of clover and grain cures rapidly in the swath, because the clover is held apart by the straw which permits the air to circulate freely through the hay. After curing two or three days in the swath it may be raked and thrown on racks to remain until it is completely cured.

Feeding value.—In two experiments at the Alabama station bur clover alone gave a yield of 3,493 pounds of hay per acre. Bur clover in a mixture of crimson clover and oats gave a yield of 5,520 pounds per acre of hay. These yields were obtained on land that in ordinary seasons produces a bale of cotton per acre. The soil was well limed and inoculated.

Chemical analysis of bur-clover hay showed water 7.59 per cent, crude fat 4.22 per cent, crude protein 19.5 per cent, crude fiber 25.7 per cent, and ash 9.89 per cent. This analysis shows that bur clover ranks very high in protein and fat. When cut at the right stage and carefully cured it yields a hay which compares well with the best cowpea-vine or clover hay.

AS A SOIL IMPROVER.

Probably the greatest value of this clover to the southern farmer is its use as a winter cover crop and a soil improver. During the winter it makes considerable growth and utilizes the soluble plant foods that might be washed or leached from the soil. Masses of fine roots penetrate and hold the soil together during the heavy winter and spring rains and prevent surface washing. In the spring the roots rapidly decay and add humus to the soil.

Southern bur clover like other legumes has the ability to gather nitrogen from the air and put it in the soil by means of nitrogen-gathering bacteria. The tubercles or nodules on the clover roots may be compared to fertilizer factories which gather [nitrogen] from the free and unlimited supply of [the atmosphere] and manufacture it into plant food. In order that the bacteria in the nodules may get an unlimited supply of nitrogen the air must circulate freely through the soil; this necessitates good drainage and thorough cultivation.

Nitrogen is the most expensive element of plant food in commercial fertilizers. By the use of bur clover and other legumes the farmer's bill for commercial fertilizer may be greatly reduced.

A crop of bur clover producing 3,400 pounds of hay leaves approximately 1,375 pounds in stubble and roots. If crimson clover may be used as a basis of calculation. From chemical analysis of bur-clover roots and stubble made at this station it was found that the roots and stubble from a crop of 3,500 pounds of hay put in the soil about 20 pounds of nitrogen. This amount of nitrogen is equal in round numbers to 133 pounds of nitrate of soda or 200 pounds of cotton-seed meal.

The entire growth of clover may be plowed under in the spring as a fertilizer; or it may be cut for hay or grazed, and the remaining part of the plant turned under for soil improvement.

Southern bur clover makes its most rapid growth in April and May. There is a tendency among farmers to plow it under too late in the spring and, as a result of the late plowing, the land is often poorly prepared, crops are not planted at the proper time, and their cultivation is made difficult. A period of two to three weeks is needed for the soil to settle down, then a second plowing and harrowing should be given the land before planting a crop of cotton or corn.

The practice of sowing southern bur clover in cotton and corn fields as a catch crop offers many advantages over the leaving of fields bare through the winter. The soil may be prevented from washing and leaching, and at the same time atmospheric nitrogen and other organic matter be added. The fields may furnish late winter and early spring pastures in addition to the soil improvement.

The seed in burs is sown at the rate of 3 to 6 bushels per acre, depending upon the amount of seed available and its cost. When they are grown on the farm, the burs and trash may be raked up and scattered over the land liberally.

The best time for seeding southern bur clover in the burs is August and September. The rains wash the burs down into the middle of the rows and cover them with soil. Those falling in depressions and on damp soil will soon germinate, while those falling on high places may not germinate till the late fall rains. Those germinating late will not make much growth before spring.

A better practice is to sow the seed in the cotton and the corn middles and cover it with a heel-scrape or spring-tooth cultivator. By using short singletrees and wrapping the traces little damage is done to the cotton or corn. If the cotton is open the seedling may follow the pickers without much loss.

GROWING AND HARVESTING SEED.

The greatest problem for the farmer to solve in introducing southern bur clover on his farm is the matter of securing seed cheaply. At present very few farms are growing seed for the market. Scarcely enough seed is obtainable at the present time to supply a limited number of farms.

The scarcity of southern bur clover seed is due largely to the difficulty in harvesting it. At present no machine has been made that will do satisfactory work.

The invention of an inexpensive huller would greatly encourage the growth of more seed. Until these problems have been solved the method of seeding in burs will be followed, which is desirable where inoculation of the soil must be done at the time of seeding.

Most of the seed for sale is harvested by sweeping or scraping it together with stiff brooms after the plants have died down. This method gathers not only the seed but stems and other litter and soil and makes a bulky mass to ship. If the seed is to be used on the farm where it is grown the matter of bulk is of little consequence. It may be raked up, hauled, and scattered upon the land to be seeded. To avoid interference with weeds and grass the seed should be gathered as soon as the plants die down.

Probably the best way for the average farmer to supply himself with seed is to grow a small seed patch. A small area of fertile soil may be set aside for this purpose. It should be well prepared, highly fertilized with stable manure, well limed, and seeded at the rate of 8 to 10 bushels of burs per acre. In case of a poor growth the first year the plants should not be destroyed but allowed to mature their seed. In the early autumn another dressing of stable manure should be applied, the seed evenly scattered over the ground, and covered smoothly with an Acme or spring-tooth harrow. The second year the yield of seed will be greatly increased. Growers have reported yields of from 75 to 150 bushels of seed in burs per acre. A bushel of seeds in burs weighs 10 pounds.

RESEEDING.

Southern bur clover produces large quantities of seed. The plants die down in the spring and leave the seed on the ground where it remains through the summer. When the fall rains come the seeds in the low places germinate and begin their growth without any further preparation of soil. After the seed has matured the land may be plowed and planted to some other crop, as cotton, corn, etc. The cultivation necessary for these hoed crops will not destroy the clover seed; at the proper time the seed will come up and make a cover crop. It has been observed that it continues to come up each fall for two or three years.

Some farmers leave balks in clover sod in the spring when they prepare the land for cotton and corn and plow out the balk after the clover seed has matured. Where the rows are made wide this is a very satisfactory way to secure reseeding. A 2-foot balk will grow an abundance of seed.

The balk system must be employed with care. On hard clay lands the balk may become weedy and difficult to manage; especially is this probable if the season is extremely dry or extremely wet.

For crops like cowpeas, sorghum, peanuts, and sweet potatoes, bur clover will mature its seed in time for the land to be plowed.

IMPROVING THE TYPE OF SHEEP FOR THE SOUTHWEST.[1]

Each type of domesticated animal can thrive with the aid of man under a wide range of conditions, but the best development of any breed or type of live stock can never be obtained unless that type possesses the natural qualifications which render is specially fitted to the environment in which it is to be maintained. Thus, it is not to be expected that the breeds of sheep best suited to cold and humid

[1] Compiled from Arizona Sta. Bul. 69.

climates will he best adapted to the subtropical conditions of the southwestern United States.

Sheep raising has grown, largely through a process of natural selection and adaptation, to be a very important agricultural industry in this region. Arizona, for example, ranks thirteenth in the size of flocks, and "of the 52,362,000 sheep (1912) in the United States, valued at $181,170,000, about 1,510,000, valued at $6,493,000, are found in Arizona," but there is great opportunity for improvement both in wool production and mutton quality. The predominating blood of the native stock in Arizona is Merino, but the average clip of fine short-staple wool is only 6 pounds, and the shrinkage in scouring is stated to be about 65 per cent. A characteristic type of native sheep is the light-shearing Navajo, of which numerous flocks are found on the Navajo Reservation in Arizona and New Mexico. These furnish a long, rather coarse-staple wool, which is, however, of great value to the native weavers. Rambouillet rams were introduced into these native flocks some years ago in order to increase the wool production, but the results have been more or less disappointing, the shortening of the long staple of the sheep working much harm to the blanket industry. The introduction of the Oxfords and Shropshires to improve the mutton quality of the range sheep has proved of little value because of the high mortality of sheep of this type, both on the range and in the warm valleys, where they succumb to the sheep botfly. Moreover, the climatic conditions which exist render the rams sluggish and ineffective in begetting a high percentage of lambs.

In order to secure an improved sheep adapted to the conditions of the region the Arizona Experiment Station has been crossing natives with other types. The most successful crosses made thus far have been those obtained with Tunis sheep, which came originally from the dry climates of northern Africa. The crosses with this heat-hardy stock seem to possess special advantages over the native sheep for southern Arizona, including tolerance of hot weather, resistance to the sheep botfly, good range qualities, and excellent reproductive qualities, combined with better wool and a larger yield of mutton.

In a recent bulletin of the Arizona station, which contains an account of the sheep in Tunis and Algeria and the crosses obtained with native Arizona sheep, F. W. Wilson states that—

> In breeding a successful type of sheep for Arizona conditions it is necessary to improve (1) their breeding capacity or ability to produce a high percentage of increase; (2) their constitution or fitness for the peculiar conditions of a hot, semiarid country; (3) their herding qualities; and (4) the production of a heavy clip of good wool. Although mutton quality is generally considered secondary to wool production, it must not be overlooked where range lambs are to be produced for the early market.

He distinguishes between types adapted to the valleys and those adapted to the range.

The ideal type for the irrigated valleys should have five essential characteristics: (1) The ability to give a profitable clip of wool; (2) to produce good mutton lambs; (3) to breed with regularity at any season of the year; (4) to withstand the extreme heat of summer; and (5) to be active and alert, so as to adjust itself better to adverse conditions of climate and health. In cooler and more humid countries the modern improved mutton breeds leave little to be desired, but the native sheep of the Southwest possess better constitutions and adapt themselves more readily to adverse conditions than do the Oxfords, Shropshires, Dorsets, or Hampshires that have been under observation at the station farm. The native sheep of Arizona have been bred for wool production, and do not possess mutton conformation. They are small and do not dress out an entirely satisfactory carcass. * * *

Since the annual production of wool is expected nearly to pay the expense of keeping the flocks, leaving the lambs as profit, the ideal animal must be a heavy producer of both wool and mutton. * * *

The ideal type should thus conform more to the medium-wool mutton breeds than to the long-wool mutton breeds. * * *

The body should be well covered with a dense fleece, medium in fineness and length; face and legs should be bare, so as not to suffer from the awns of foxtail in the eyes or burs on the legs; the belly should be well covered and retain its wool permanently. The annual clip should be not less than 10 pounds.

The head should be short, well carried, and broad between the eyes; muzzle wide and prominent; face and legs black or dark in color; ears fairly long and pendent; horns absent, although scurs are not objectionable. The breast should be broad, deep, and prominent; shoulders well set, smooth, and prominent; body well filled and of good girth behind the shoulders; ribs well arched; loins well covered and of good width; across the hips level, carried well forward and smooth; hind quarters long and straight, with a good leg of mutton carried well down.

The body should be of great depth, and the bone fine; the general form, as is found in the ideal types of all beef and mutton breeds, should be rectangular or square, with legs well set; hocks should be gently sloping; pasterns and feet neat; and hind quarters larger than fore quarters. The animal should be symmetrical throughout, giving a pleasing appearance.

A vigorous constitution should be shown by a large heart girth and by depth and width of the fore quarters, as well as by carriage and activity.

Since the sheep hotly abounds in the warm irrigated valleys, the ideal type should be quick and alert in keeping it at a distance by stamping in the dust. They should, however, be neither so wild nor so timid as to interfere with putting on flesh.

The ideal ewe for valley conditions should be ready to breed as soon as the lambs are weaned late in the spring, so that yeaning will take place in the fall or early in the winter. The lambs should mature early, so as to be ready for the early market.

The ideal type of sheep for the range should possess four essential characteristics: (1) The ability to give a profitable clip of wool; (2) to produce good mutton lambs; (3) to herd together well in large numbers; and (4) to possess a good constitution. The wool-producing character should predominate to even a greater extent than with the valley type. They should clip from 12 to 14 pounds annually. Although mutton is a secondary consideration, they should

be large and mature fairly early, so as to produce early lambs and a good dressed carcass. Since on the range herding in large bands and frequent migration from one range to another are necessary, herding qualities are essential in the ideal type. They should also possess a constitution suiting them to the hardships of the range, especially intense heat and continued drought.

The description of the ideal type of range sheep would be as follows: The head should be medium in size and short; eyes large and clear; ears medium in size and covered with hair. The face should be covered with short, fine hair; nostrils wide; and muzzle smooth and white. The neck should be short, thick, and well rounded into the shoulders; shoulders smooth and wide at the top. The top and bottom lines should be parallel; depth over heart marked; loins thick and wide; pelvic arch smooth and not elevated.

The fore quarters and hind quarters should be uniform in size and smoothness; chest wide and deep; ribs well sprung; flanks full and carried down well;

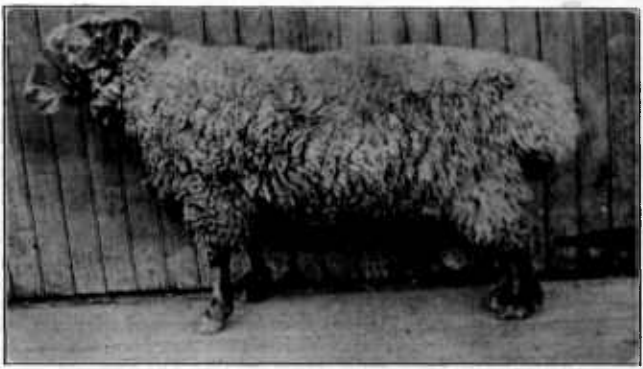

FIG. 2.—American-Tunis ram used in Arizona station sheep-breeding experiments.

hips large and wide, rounded rather than sloping. The legs should be well placed, smooth and wide apart, and medium in length.

The fleece should be long, dense, elastic, and strong. When opened it should show a bright, oily luster. The wool should cover the body entirely, excepting the face and lower part of the legs.

The characteristics of the types used in the Tunis-native crosses at the Arizona station were, in brief, as follows:

American Tunis.—Desirable characters: Hardy, breed at any season, herd well, early maturing, active, and long wool. Undesirable characters: Small size, and coarse-staple wool.

Native.—Desirable characters: Hardy, herd well, active, and fine-staple wool. Undesirable characters: Do not breed at all seasons, not early maturing, small size, and short wool.

The crossing of Tunis rams (fig. 2) on native ewes has resulted in a type of sheep which in many respects shows marked improvement over both the com-

ponent breeds. As this experiment develops along the lines laid down under the general plan of breeding further improvements are expected to become apparent, as has been indicated by the first crop of second-generation lambs yeaned late in the spring of 1911, into which Shropshire blood has been introduced.

The first-generation Tunis-native lambs are vigorous, active, and early maturing. Their vigor is indicated by the very low mortality at yeaning time and by their general good health and ability to withstand adverse conditions of climate and surroundings. Their activity enables them to feed over considerable areas of scant pasture and to protect themselves against the sheep botfly, and their early maturing qualities have made them especially valuable for the production of early lambs.

The general conformation of the cross is on the order of the Tunis, with improved quality of wool. The large tail of the Tunis is greatly reduced in the first generation, and, by close docking, the fat that otherwise would have formed in the heavy tail is placed more advantageously on other portions of the carcass. Of nearly 200 Tunis-native lambs only 2 have been of the same type as the dam. The first generation shows uniformity in conformation, in characteristics of the fleece, and in weight.

The fleece of the first-generation Tunis-native has a staple longer than that of the native dam and somewhat shorter than that of the Tunis ewe, but is still rather coarse and mixed with a few long hairs. It is, however, an improvement over that of both Tunis and native as regards quantity, and over the Tunis as regards quality. While the yolkiness of the fleece is greater than was expected, this may be attributed to abundance of feed and to the peculiar climatic conditions of the warm irrigated valleys.

The superior mutton qualities of the Tunis-native over the native is also easily apparent. The lambs have been uniform in conformation and size, they mature earlier than either the native or the Shropshire-native, dress to advantage, and furnish mutton of excellent quality. The rams were alert and active on the range and begot a much greater yield of lambs than the Oxford rams of the same lot.

It is evident, therefore, that "improvement has been effected in both wool production and mutton conformation. The breeding qualities and constitution have been improved, the production of early lambs assured, and the excellent herding qualities of the native types have not been lessened."

The work is an illustration of the value of selecting as foundation breeding stock for any region types which are already accustomed to the soil, climatic, and other conditions which exist in the new environment.

COMBATING FLIES.[1]

With the widespread realization of the fact that flies spread diseases as well as cause almost intolerable annoyance, there has devel-

[1] Compiled from Rpt. State Ent. Minn., 14 (1911–12), p. 62; Minn. State Ent. Circ. 24, 1912; Jour. Econ. Ent., 4 (1911), No. 5, p. 418; 5 (1912), No. 5, p. 400; 6 (1913), No. 1, p. 110; Trop. Agr. and Mag. Ceylon Agr. Soc., 38 (1912), No. 4, p. 332; Queensland Agr. Jour., 29 (1912), No. 2, p. 101. Consult also U. S. Dept. Agr., Farmers' Bul. 459.

oped a demand for efficient means of abating or controlling the nuisance.

The use of formaldehyde (or formalin) seems to offer one such means. R. I. Smith, of the North Carolina station, found that 1 ounce (2 tablespoonfuls) of formalin (40 per cent formaldehyde) in 16 ounces (1 pint) of a mixture of equal parts of milk and water in shallow dishes with a piece of bread in the center for the flies to light on, proves very attractive and destructive to the flies, especially when placed on the front and back porches of houses. It is less effective when used inside the house, although the method was used with good results in ridding dairies of flies.

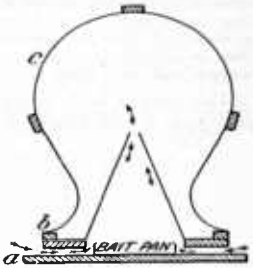

FIG. 3.—Cross section of the Minnesota fly trap.

E. E. Green, of Celon, has used the following method with success: Fill a soup plate with damp sand, cover with a disk of blotting paper, spread sugar on the blotting paper, and sprinkle it with a mixture of 1 part of formalin (40 per cent formaldehyde) with 20 parts of water.

Various forms of fly traps have been used with good results. F. L. Washburn, of the Minnesota station, describes an efficient and easily constructed form of trap (fig. 3), as follows:

The trap is 24 inches long, 12 inches high, and 8 inches wide. The upper part (*c*), which may be oval or rectangular as preferred, serves as a receptacle which the flies enter through the opening in the top of the middle portion (*b*) made of ordinary mosquito wire screen and shaped like the roof of a house. Under this is the base board (*a*), upon which rest two tin bait pans. The space between the base board and the middle portion is about one-half inch, and between this and the bait pans through which flies enter pans, about one-fourth of an inch. Stale meat, bread, and milk are used as bait. The trapped flies are killed by immersing in hot water.

FIG. 4.—Cross section of a large fly trap for use in windows.

The essential details of a successful fly trap devised by C. F. Hodge especially for use in windows of dairies, stables, markets, etc., are shown in figure 4. This shows that—

At the bottom is a crack, about a quarter of an inch wide, running the length of both sides. This crack admits the flies to a space covered by a ridge or roof of screen wire with holes large enough for flies to go through (punched with an

ice pick) every 2 inches. Large pans of fly bait—fish heads, poultry cleanings, brewers' waste, blood, or anything available which is found on the premises to attract flies can be set on the bottom board and thus establish a whirlwind focus for all the flies about the place. The other essential in the construction is the fold or folds in the screen walls. These are simply folds or open pleats running horizontally across the trap, pointing upward and inward. The flies, in trying to get in or out of the window, collect in these folds, run back and forth in them until they pop through one of the holes which occur every 2 inches, and they have never been seen to find a hole on the convex inside surface of the wrinkle and crawl down and out again.

This trap is built in a frame which fits closely in a window, preferably on the best lighted side of the building.

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