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SWEET CLOVER FOR KENTUCKY

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Important Points

Sweet clover is one of the most valuable of all legumes for pasture and soil improvement on Kentucky farms. Properly managed, sweet clover pastures will support at least one steer or dairy cow per acre from early spring until late fall, which is two or three times the capacity of Kentucky pastures at the present time. The growth of grasses is greatly stimulated by sweet clover when it is included in pasture mixtures.

A good stand of sweet clover will add from 100 to 250 pounds of nitrogen per acre to soil if pastured or plowed under. This equals the amount of nitrogen contained in from 10 to 25 tons of farm manure. Even when utilized as a catch crop, it may give almost as large nitrogen returns.

Most Kentucky soils must be limed in order to grow sweet clover successfully, but the ability to grow this crop amply justifies the expense of liming. Two tons per acre of limestone that will pass a 10-mesh screen and containing the dust is recommended.

A majority of experienced growers believe late winter or early spring seeding with scarified seed to be the most reliable method of getting a stand. Commercial cultures afford the most convenient method of inoculation.

Probably the best way of utilizing sweet clover for permanent pastures, either alone or in mixtures, is to divide the pasture area into two parts, so that both young and old sweet clover will be available each year. Mixtures are preferable to sweet clover alone, a mixture of sweet clover, lespedeza and orchard grass being indicated as the best for Kentucky outside of the Bluegrass Region, where bluegrass may replace the orchard grass.

The use of sweet clover for hay should be confined to the first-year crop, altho the second-year crop may be utilized in case of a shortage of other hay. Sweet-clover hay should not be fed continuously unless other kinds of hay are fed with it.

The production of sufficient sweet-clover seed on Kentucky farms for home use is recommended. Growing seed for market may be profitable in some cases, but as a rule the crop can be utilized more profitably in other ways.

The most economical way of obtaining the benefits of sweet clover for soil improvement is to utilize the crop for pasture. Great opportunities of improving soils are afforded thru its use as a catch crop.

CIRCULAR NO. 218

Sweet Clover for Kentucky

By E. J. KINNEY

Perhaps no other crop has gained more rapidly in popularity in the United States than has sweet clover during the past few years. In nearly every state in the union the acreage devoted to this crop has increased in a striking way, and in many sections it is fast becoming one of the most extensively grown legumes. Interest in sweet clover first developed when its remarkable value for soil improvement, especially for depleted soils, was recognized. Its ability to make a vigorous and even rank growth on badly worn land, practically devoid of organic matter, is not approached by any other legume. The rapid progress that the crop has made in recent years, however, has been due largely to the discovery that, in addition to its value for soil improvement, it is one of the most productive, if not the most productive, of pasture crops. The forage produced is just as palatable to stock, when once accustomed to it, as that of other standard pasture plants, and just as nutritious. Sweet clover is extremely drouth resistant, a characteristic which makes it particularly dependable for summer pasture. In many parts of the Corn Belt and in the northwestern wheat-growing areas sweet clover has taken a front rank as a pasture crop. Sweet clover produces an abundant crop of seed under all ordinary climatic conditions. This makes the seed relatively cheap, an important factor in increasing the use of any forage crop.

Undoubtedly, sweet clover can be of very great help in putting the agriculture of Kentucky on a more profitable basis. It seems certain that any marked increase in farm income in the State can be brought about only by developing the livestock industry, partic-

ularly dairying and sheep raising. This cannot be done, however, without an increase in the carrying capacity of pastures and a greater production of other feed crops. Even under the most favorable soil conditions, the carrying capacity of pure grass pastures is not large. On worn lands or on soils of only moderate fertility, grass pastures are very unproductive. By substituting sweet clover for the grasses or by including it in pasture mixtures, the productivity of Kentucky pastures can easily be doubled. In addition, the use of sweet clover will make it possible to add to the pasture area lands so badly worn that they have been practically abandoned. It is not only its pasturage value that makes sweet clover of such potential importance to Kentucky. Its use is certain to result in a rapid and substantial increase in soil productivity, thus insuring better yields of all kinds of crops.

Most Kentucky soils must be limed in order to grow sweet clover successfully. It is safe to say, however, that no investment that the Kentucky farmer can make will pay larger returns for the money invested than that spent in liming his land. Liming is necessary for the production of alfalfa and red clover as well as sweet clover. Lime greatly increases the yield of annual legumes also, the most important of which are soybeans, cowpeas and lespedeza. Limestone is so widely distributed in Kentucky that no region is far from a source of supply. Marl, a good substitute, is present in many localities. Probably in no other state can land be limed at a lower cost.

Where soils are deficient in phosphorus, as are practically all Kentucky soils outside of the Bluegrass area, the best crop yields cannot be obtained without the use of phosphatic fertilizers. In sowing sweet clover on badly worn land, it is especially necessary to use a carrier of phosphorus to insure satisfactory results. The liberal use of phosphate fertilizers on pasture lands where the soil lacks phosphorus is a real economy. It benefits the pastures and most of the phosphorus is returned to the land for the use of other crops.

TYPES OF SWEET CLOVER

Sweet clover is the popular name used in this country for members of a group or genus of legumes known botanically as *Meli-*

lotus. In some sections this group name, *Melilotus*, is used instead of sweet clover. Sweet clover is native to Europe and Asia and only a few types have been introduced into America. By far the most important of these is white sweet clover (*Melilotus alba*). Yellow blossom sweet clover (*Melilotus officinalis*) is also quite widely distributed and in some cases is preferred to the white. Yellow sweet clover does not grow so large as the white and produces finer stems, making it more desirable for hay production. It also matures somewhat earlier. Both the white and yellow are biennials. Seed is produced the second year, after which the plants die. An annual variety of white sweet clover known as Hubam was discovered several years ago, but it has apparently not proved so valuable in most cases as the common biennial type. The possibility of discovering new varieties of sweet clover better adapted for certain purposes or for certain conditions than the common types is now attracting the attention of investigators. In almost any field of sweet clover, plants may be found that are distinctly different from the average type. Already several varieties of merit have been developed from such plants, among them the early-flowering Grundy County, a rather dwarf type with fine stems, especially adapted for hay production. A type has recently been found in Canada that has many more and finer stems than the common sorts and resembles alfalfa in appearance. Undoubtedly many more valuable varieties will be found. A number of new types from Europe and Asia are under test in this country and it is hoped that some of these may prove of value. A later-maturing variety giving a longer pasture period the second year of its growth would be especially desirable for Kentucky.

THE GROWTH OF SWEET CLOVER

Sweet clover ripens its seed crop during August under normal conditions, but early clipping or pasturing may cause later maturity. The seeds are enclosed in a hull and quickly shatter from the plants after ripening. Very few, if any, germinate until the following spring even under the most favorable moisture conditions. The young plants appear during March or early April and, after becom-

ing well rooted, grow rapidly, reaching a height of three to four feet and branching quite freely. During the first season a bud crown is formed, carrying the buds which produce the new shoots the following spring. The crown does not persist, however, and but one set of buds is formed. Both the first and second year any renewed growth following grazing or cutting the plants must, therefore, come from buds on the stem and not from a crown. In this it is distinctly different from red clover or alfalfa, which have a persistent crown giving rise to new shoots during the life of the plants.

LIMING FOR SWEET CLOVER

Where financial conditions permit and limestone can be obtained without great difficulty, it is most practical to use fairly large amounts, one and a half to two tons an acre, for the initial treatment. This will insure favorable conditions for sweet clover or other lime-loving plants for 6 to 8 years or longer, on practically all soils. There is no doubt, however, that good results may be secured with much smaller applications. Even as little as 500 pounds per acre of fine limestone or burned lime may permit raising one or two fair crops of sweet clover on some soils, but it is scarcely advisable to use less than 800 to 1,000 pounds. When a ton or more per acre is used, limestone ground to pass a 10-mesh screen (100 openings per square inch) is sufficiently fine, but for lighter applications much finer grinding is necessary. All the material should pass a 40-mesh screen, or in case of very small applications a 100-mesh screen. In using small amounts of limestone, it is necessary that it be spread very evenly. The best results are obtained by using a grain drill with fertilizer attachment. It may be necessary to go over the field twice in order to sow the desired amount. If the sweet clover is to be sown on fall-sown grains, the limestone may be drilled in with the grain.

Burned lime is about twice as effective, pound for pound, as ground limestone, and where finely ground burned lime can be obtained, as is possible in some places in Kentucky, it is especially suitable for small quantity applications because less need be used than of ground limestone. Slaked lime (hydrated lime), which may

be obtained almost any place in paper bags, is also more effective than ground limestone, 3 pounds being equivalent to 4 pounds of the latter in neutralizing soil acidity. For a more complete discussion of the use of limestone, Kentucky Extension Circular No. 59 should be obtained. A list of manufacturers of ground limestone and other forms of lime can be secured from the Kentucky Experiment Station.

The soils of Kentucky, as a rule, are not strongly acid, and in some cases fair crops of sweet clover can be grown without lime. This is most likely to be true on rather fertile soils well supplied with organic matter. The best way to determine a soil's ability to grow sweet clover is to include a pound or two of seed when sowing grass or other forage crops. Thoro inoculation is especially necessary on unlimed land.

GROWING THE CROP

Seed and Seeding. Both the unhulled and hulled seed are used, but in recent years most of the seed on the market has been hulled. The hulled seed usually is of better quality because in hulling the light, immature seeds are removed. The hulled seed is also somewhat easier to sow. In nearly all lots of sweet clover seed some of the seeds—frequently a large percentage—have such hard seed coats that they cannot absorb water and germinate, at least not until after long exposure to moisture. In tests it has been found that many of these hard seeds require at least a year in the ground to germinate. If the seed coats are scratched, germination is prompt. A machine known as a scarifier has been devised for scratching sweet clover seed and a large proportion of the seed crop is now scarified. The use of scarified seed is generally recommended, especially for late winter and spring seeding. For fall or winter seeding, which is preferred by some growers, the unscarified seed should be used. There is always considerable risk connected with the use of unscarified seed, as it is practically impossible to determine its value by germination tests. New seed which may give excellent germination under field conditions may give very low germination in the laboratory, especially if the tests are made in the fall or early win-

ter. There are equal chances, however, that a small percentage will germinate in the field.

Usually sweet clover is sown in late winter or early spring, following the methods practiced with red clover. If natural agencies—freezing, thawing and rains—are depended upon to cover the seed, January or early February seeding is advisable. Sowing on a so-called “honeycomb” frozen surface gives the best assurance of good covering. Possibly somewhat more reliable results can be secured with either red clover or sweet clover by sowing with a clover seed drill as early as possible in the spring. A grain drill with clover seeding attachment may also be used or the field may be harrowed with a spike-tooth or rotary harrow after broadcasting the seed. Little of the seed is covered directly by these operations, but rains wash the loosened soil over the seeds, covering them very satisfactorily. This method of seeding is somewhat expensive and occasionally unfavorable weather prevents seeding as early as is desirable.

Fall and early winter seeding of sweet clover is practiced by some growers, apparently with good results. Unhulled or unscarified seed may be sown as early as October, or even earlier if new seed is used, with little danger of fall germination. Thus it is possible to sow with fall grains. Tests at the Virginia Station, however, gave fewer plants from both fall and early winter seeding and a smaller yield of forage than from late winter and early spring seeding. In sowing in old pastures, meadows, or untilled land, early winter seeding might be advantageous, as it would give an opportunity for the seeds to work down thru the vegetation. As stated, however, there is considerable risk in sowing unscarified seed, and in the latitude of Kentucky scarified seed sown in the fall or winter may sprout during mild weather and be killed. In sowing in pastures, it is advisable to disk the ground before seeding, if possible. This may be done in late fall and the seed sown during the winter.

Seeding with oats is satisfactory, but not over a bushel and a half of oats per acre should be sown as a nurse crop. Since sweet clover needs a firm seed-bed, disking is a better preparation than plowing. If the land is plowed for oats, it should be well firmed.

The writer prefers to use the cultipacker after seeding the oats and before sowing the sweet clover seed. Covering the seed is unnecessary. Sweet clover may be sown alone on corn stubble, old wheat stubble, oats stubble, etc., without much danger of being choked out by weeds, provided the ground is not plowed previous to seeding.

Summer seeding of sweet clover, as practised with alfalfa, is not advisable.

The amount of seed to sow will depend upon whether the seed is sown alone or in mixtures. For sowing alone, 10 or 12 pounds of hulled seed, or slightly more of the unhulled, is sufficient, while from 3 to 5 pounds is enough in mixtures. Very heavy seeding in mixtures is not desirable, as the rank-growing sweet clover may smother out the other plants in the mixture.

Inoculation. Natural inoculation apparently occurs more freely with sweet clover than with alfalfa, so that artificial inoculation is not quite so essential. It is always advisable, however, on land where the crop has not been previously grown. Commercial cultures, if fresh, are very reliable and are very convenient to use. The cost is slight—about 15 to 20 cents per acre. The use of soil from a thoroly inoculated alfalfa or sweet clover field or from a patch of roadside sweet clover usually gives good results, but probably is not quite so reliable as a good culture unless rather large amounts are used. The soil should be screened, partly dried, and mixed thoroly with the moistened seed at the rate of about a half peck of soil to a bushel of seed. Another method often used is to mix inoculated soil with twice as large a volume of water. The mixture should be stirred vigorously for some time and then, after the heavier soil particles have settled, the liquid portion is used to moisten the seed. Whether cultures or soil are used, the seed should be sown a few hours after inoculation. The directions accompanying commercial cultures should be followed precisely.

UTILIZING SWEET CLOVER

Pasture. On the majority of Kentucky farms sweet clover can doubtless be utilized for pasture more profitably than for any other

purpose. Since the plants mature in midsummer of the second year after seeding, grazing for the rest of the season must be secured from the young sweet clover in pure sweet clover pastures. When the crop is grown in a regular rotation with other crops and a new seeding is made each year, a field of young sweet clover is always available for late summer and fall grazing. A satisfactory plan of management, where it is desired to keep land more or less permanently in sweet clover pasture, is to divide the pasture land into two approximately equal areas and to seed and graze them alternately—that is, to have one field containing young sweet clover while the other is occupied by the second year crop. Usually enough seed is produced in grazed fields to provide for natural reseeding. Very heavy grazing, however, may result in a scanty seed crop, requiring the sowing of additional seed, at least on the most heavily pastured areas. If but one field is used for pasture, seed should be sown for two or three successive years so that the field will contain both old and young sweet clover. This plan does not always accomplish the desired result, however, because in a dense stand of old sweet clover the young plants may be smothered. This can be prevented to some extent by close grazing, but close grazing is injurious to young sweet clover, and even where a stand persists, the second year growth may lack vigor.

Usually, it is much better to sow other pasture crops with sweet clover than to use it alone. Sweet clover, orchard grass and lepedeza make a desirable mixture for Kentucky and one that will give excellent pasture for a number of years. Four pounds of sweet clover, 4 to 5 pounds of orchard grass and 5 pounds of lepedeza is a good seeding. They may all be sown together in late winter or early spring. Lespedeza is especially desirable for growing with sweet clover, as it is at its best during late summer and in the fall after the old sweet clover has matured, and furnishes grazing until killed by frost.

The growth of grasses is greatly stimulated by sweet clover when it is included in pasture mixtures, hence old pastures often may be greatly benefited by seeding to sweet clover, using 3 to 4 pounds of seed per acre. Before sowing the seed, the sod should be disked

lightly or, in bluegrass pastures, burned over, so that the sweet clover seed may come in contact with the soil.

Recent experiments have shown that grazing young sweet clover very heavily, especially early in the season, may result in considerable winter killing or a less vigorous growth the second year. It is best, therefore, to let the young sweet clover get well established and from 6 to 8 inches high before pasturing. In mixtures, stock will not often graze the young sweet clover much until other forage becomes short; consequently, early pasturing in such cases is not so likely to be injurious. The second-year sweet clover must be grazed heavily enough to prevent the plants becoming stemmy but not so close as to kill them. Sweet clover grows with remarkable rapidity and in many cases two or three head of cattle per acre are necessary to keep it grazed properly.

Sweet Clover for Hay. For the production of hay, sweet clover has a rather limited usefulness. This is true, at least, of the common types. Possibly some of the newly developed varieties may prove more useful. In the opinion of most experienced growers, efforts to utilize sweet clover for hay should be confined to the first year's growth. This is quite leafy and the stems are not coarse; in fact, it makes hay approaching alfalfa in appearance. In dry seasons, however, the yield of hay is small, especially on the less productive soils. The second year sweet clover grows very rank and coarse and the proportion of leaves is small. It is extremely difficult to cure if cut before blooming, and if allowed to stand longer the hay is so "stemmy" as to be of little value. Probably where it is necessary to use it for hay, the best plan is to pasture the sweet clover for a short time in early spring or to clip with a mower when the plants are about a foot tall, leaving a 7- or 8-inch stubble. The renewed growth will be finer and not so tall, making the hay more easily cured and handled. This will also make the crop two or three weeks later in reaching the cutting stage, giving more settled weather for haying, as a rule. If the hay is left long in the swath, the leaves will dry and crumble, while the stems remain green. It is best to rake into windrows after the plants are well wilted or to put into very small cocks to complete the curing. Where sweet clover is cut in the

early bud stage and cut high enough so that live buds and some branches are left on the stubble, new shoots usually are produced and some pasture or a light seed crop may be secured in addition to the hay crop. Not less than a 10-inch stubble should be left, and in some cases even higher cutting is necessary to prevent killing the plants. Where the stand is thin and the plants carry branches low on the stems, closer cutting is possible than in dense stands.

Young sweet clover should not be cut for hay until October. The later the cutting is deferred the better from the standpoint of possible injury to the stand.

Tests indicate that bright, well cured sweet clover hay is as nutritious and digestible as alfalfa or red clover hay. Where the hay is coarse and stemmy, however, animals usually reject the coarser parts. At the Kentucky Experiment Station there has been no difficulty in getting stock to eat sweet clover and this is the general experience, altho there are some exceptions.

Sweet clover hay has generally been regarded as a wholesome roughage, altho occasional cases of cattle poisoning have occurred from feeding it. In a few instances the losses have been rather heavy. Until recently it was believed that injury was caused only by mouldy or spoiled hay. During the past year or so, however, a decided increase in the number of cases of poisoning has been reported, especially from sections where sweet clover hay is used extensively. While some investigators still believe that only spoiled hay is dangerous, others believe that any sweet clover hay will cause poisoning if fed continuously in large amounts. There seems to be good evidence to support the latter view. In animals affected, the blood loses its clotting power, resulting in internal bleeding. Apparently, there is little, if any, danger from this disease if other kinds of hay are used along with the sweet clover hay or if it is not used as the sole roughage for long periods.

Seed Production. Sweet clover seeds freely, yields of 8 to 10 bu. of seed per acre not being uncommon. The seeds shatter very readily, however, and great care is necessary in handling the crop to prevent losing a large proportion of the seed. At one time considerable

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seed was produced in North Central Kentucky, the harvesting and threshing being done entirely by hand. In recent years the price of seed has been too low to justify such expensive methods of production and but very little is now harvested in this region. A large part of the seed crop is now grown in the western and northwestern parts of the country, altho considerable is produced in certain sections of the northern Corn Belt. The crop is cut with grain binders fitted with pans to catch the shattered seed, or with self-rake reapers. The seed is threshed with an ordinary grain separator, a clover huller or is flailed out by hand. The combined harvester now coming into use so extensively in the wheat-growing regions of the West and Northwest is said to handle sweet clover very economically and with little loss of seed. Probably this will result in confining the commercial production of seed in the future to those areas where these machines are used.

There has been little tendency among Kentucky farmers to save sweet clover seed and doubtless the crop can generally be used to better advantage in other ways in this State. Saving seed for home use is always a desirable practice, however, where it can be done without hiring extra help. Small crops can be harvested with the mower, but to prevent shattering it is necessary to follow the machine and fork the swath aside so that the team will not run over the plants on the next round. The self-rake reaper or hemp harvester, which is a special type of self-rake reaper, should be used if available, as these machines are far superior to the mower for harvesting the seed crop. After drying in small shocks for a few days, the seed can be beaten off the plants very easily. After threshing, the seed should be put thru a coarse screen and cleaned on the fanning mill. Those interested in commercial seed production should send for Farmers' Bulletin 836 of the United States Department of Agriculture.

Soil Improvement. By far the most practical way of realizing benefits from sweet clover for soil improvement is to use it for pasture. The income from the crop is thus secured and from 75 to 85 percent of the plant food in the crop is returned to the soil. Where little stock is kept, it is much more difficult to utilize

legumes economically for soil improvement. At least part of the legumes grown must be plowed under in order to maintain an adequate supply of soil nitrogen to meet the requirements of other crops. To devote an entire season to growing a crop to plow under is an expensive practice, but this may not often be necessary if full advantage is taken of opportunities of growing legume catch crops in the intervals between regular crops. As a matter of fact, recent studies at the Illinois Experiment Station and at the Ohio State University have shown that surprisingly large quantities of nitrogen can be added to the soil by growing catch crops of sweet clover. The Illinois Station determined the amount of nitrogen in sweet clover at various stages of growth on nine experiment fields in the state. It was found that, on an average, crops sown in the spring showed an accumulation in tops and roots of around 250 pounds of nitrogen per acre by May 1 of the following year. This is as much as is contained in 25 tons of average farm manure or over 1,600 pounds of nitrate of soda. This seems almost incredible and probably such results could not be expected except under extremely favorable soil and climatic conditions. Willard, however, reports that as a result of four years' experiments on upland soils at Ohio State University the least amount of nitrogen found in the crop on May 1 of the second year was 120 pounds per acre. He also found that sweet clover at this date contained four-fifths as much nitrogen as at any subsequent stage of growth. This means that sweet clover sown in small grains in the spring and plowed under the following spring in time to plant the land to corn adds almost as much nitrogen to the soil as if it were left to make its maximum growth. These discoveries are of great significance and tend to establish sweet clover as the most remarkable crop in existence from the standpoint of possible value for soil improvement. It is scarcely necessary to point out the wonderful opportunities presented for increasing crop yields if the results obtained in Ohio and Illinois can be duplicated under average farm conditions. Nitrogen is the limiting factor in crop production in Kentucky and the problem of maintaining an adequate amount in the soil economically has always been a difficult one to solve. If 100 pounds or more of nitrogen per acre can be added to the soil by growing a catch crop of sweet

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clover, the solution of the problem seems to be at hand. Such a return every two years in a rotation of corn and wheat or any two-year rotation involving a cultivated crop and a small grain crop would maintain a very favorable nitrogen balance, especially if supplemented by crop residues. Ten tons of manure per acre are required to furnish 100 pounds of nitrogen and any farmer who could use 10 tons of manure per acre on his land every two years would have little cause to worry about the productivity of his soil.

Apparently there is no good reason why the sweet clover crop will not be equally as effective in Kentucky, except where drought the first summer prevents a good stand, as is perhaps more apt to be the case than in Illinois and Ohio. It is essential for success that a thick stand of plants be secured regularly. This is largely a question of careful management. A good growth of plants is also necessary and this can be obtained in most seasons on well inoculated soils, provided, of course, liberal amounts of lime and phosphate fertilizers are used. Potash fertilizers may be necessary, also, on some of the poorer soils. Where soils are badly worn, it will be advisable to plow under at least one mature crop of sweet clover so as to add the maximum amount of organic matter and nitrogen to the soil. Wheat or rye may then be sown in the fall and the regular rotation started.

The sweet clover catch crop should not be plowed under in the fall but should be allowed to grow as late in the spring as possible without unduly delaying the planting of corn or other succeeding crop. On thin land, where it is desirable to get the greatest nitrogen returns, it may be profitable to delay plowing until after May 1. Around this date sweet clover is making an extremely rapid growth and accumulating much nitrogen. At the Illinois Experiment Station it was found that from April 22, at which time the plants were about 6 inches high, to May 4, when they were 8 inches high, the nitrogen content of the tops had increased about 15 pounds per acre. Young sweet clover decays rapidly in the soil and there need be no fear of injurious results from late plowing.

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Figure still good

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