UNIVERSITY OF IDAHO
AGRICULTURAL EXPERIMENT STATION

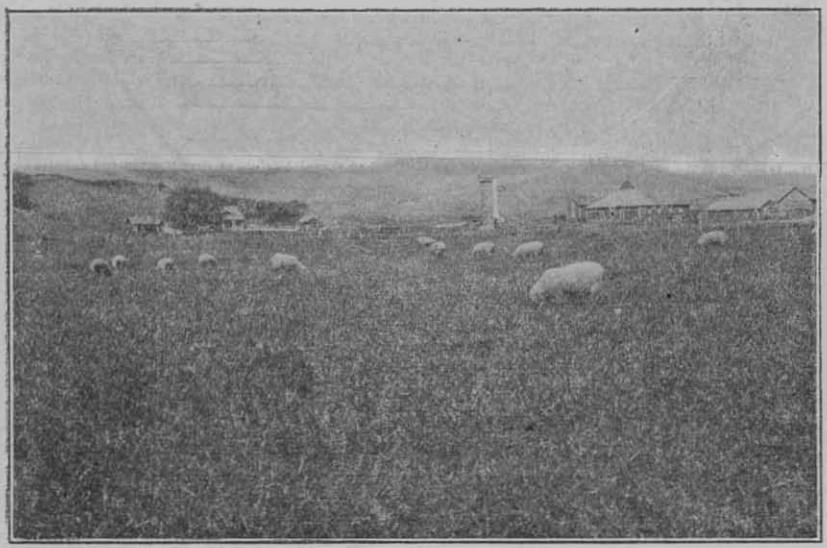
Department of Agronomy

SWEET CLOVER

Growing and Handling the Crop in Idaho

by

H. W HULBERT



Sweet Clover furnishes excellent pasture thruout the growing season.

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*In cooperation with U. S. Department of Agriculture.

SWEET CLOVER

Growing and Handling the Crop in Idaho

H. W. HULBERT

During the last few years sweet clover has rapidly become an important forage crop in Idaho. For a long time it was commonly regarded as a weed, but in spite of the prejudice against it and misunderstanding regarding its agricultural value, its importance as a farm crop has been definitely established. In Idaho, sweet clover is probably of greatest value in the area north of the Salmon River and in the dry farm areas of the Snake River Basin. In these sections it is of great importance as a pasture and soil improvement crop, and of some importance as a hay crop. In the irrigated areas it is of value chiefly for pasture and soil improvement.

SPECIES OF SWEET CLOVER

Only four of a large number of known species of sweet clover are common in the United States. These are biennial white sweet clover (Melilotus alba), biennial yellow sweet clover (M. officinalis), annual yellow sweet clover (M. indica), and annual white sweet clover or Hubam (M. alba annua). Not more than three, and for general purposes only two species are of any particular importance in Idaho.

Biennial Sweet Clover.

Both the biennial white and biennial yellow species are commonly found in the various sections of Idaho. However, the biennial white is by far the most popular because it ordinarily yields about a ton of hay to the acre and an equivalent increase in pasturage more than the yellow-flowered species. The biennial yellow is somewhat finer stemmed, thus producing a finer quality of hay, but this factor is of little importance if the crop is harvested at the proper stage. In some sections of the United States the yellow species is preferred because it branches and produces seed closer to the surface of the ground than the white. This enables a grower to pasture his field continuously and still enable the crop to reseed itself. Thus, a permanent pasture of sweet clover is maintained. As yet this practice has not proven successful in Idaho.

During recent years a few new varieties of biennial white sweet clover have been given publicity. Grundy County sweet clover, developed in Illinois, is showing little promise in Idaho. Arctic sweet clover, developed by the University of Saskatchewan, appears to be more promising. Both of these varieties are finer stemmed, shorter, and earlier,

and are heavier seed producers than the ordinary biennial white. Neither can be recommended for Idaho conditions without further trials, since they do not seem to have the forage producing ability of the biennial species.

Annual Yellow Sweet Clover.

The yellow-flowered annual has no place in the state's agriculture, since under Idaho conditions it rarely attains a height of more than 15 inches before setting seed. Certain seed houses have sold seed of this species to growers when the biennial yellow was ordered. In buying seed of the yellow-flowered sweet clover, therefore, it is well to make certain that the biennial is being obtained.

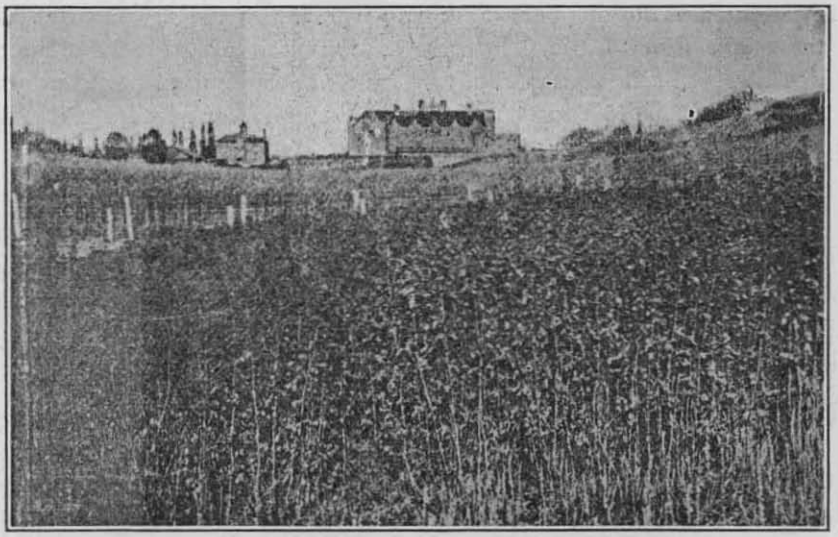

Fig. 1—Sweet Clover on the University Farm at Moscow. Biennial yellow (left); biennial white (right).

Annual White Sweet Clover.

Hubam, the annual white sweet clover discovered by H. D. Hughes of Iowa State college, has been grown for seed with some success by a few growers in southern Idaho. As a seed crop it will be less profitable than many other legumes which yield unusually well in the irrigated sections of the state. From results secured at University Farm, Moscow, seed yields of approximately 200 pounds per acre may be expected. Tests conducted on the University Farm, and in other parts of Idaho have shown that this variety does not produce as heavy a yield of forage as the second season's growth of the biennial white. The quality of hay obtained from the biennial variety is also superior

to that obtained from Hubam. It is possible that this species may be of value as a soil improver in the dry farm areaas, although experiments at Moscow, have shown that in this respect, also, it is less valuable than the biennial species.

HABITS OF GROWTH*

The young biennial sweet clover plant closely resembles alfalfa, from which it can be distinguished by the bitter taste of the foliage and by thicker leaflets. It grows into an erect, branching, stemmy plant. Growth is slow the first year, the plant spending its energy in the development of a strong root system. The plant food which is stored up in this root system the first year is used to supplement the second year's growth. The plant starts very early in the spring of the second year from buds formed on the crown at the end of the first season's growth. If the crop is mowed the first season before these buds are formed it must be cut high enough to leave buds on the stubble. If this is not done the plants will be killed. The first cutting the second year also must be made high enough to leave buds on the stubble. The last cutting of the season may be made just as close to the ground as desired. The second year's growth may be used either to produce a seed crop or one or two cuttings of hay, depending upon moisture and climatic conditions. At the end of the second year, or after the production of seed, the plant dies.

Adaptation

The adaptability of sweet clover to a wide range of soil and climatic conditions is a strong factor in its favor. The plant will grow on soils too poor for alfalfa and under conditions where other grasses have failed to produce a crop. Besides, it seems to thrive equally well under wide extremes of heat and cold. It is grown in Idaho on high, dry land where the rainfall is too light to produce other crops successfully. In the same section it may be found growing as a weed on the banks of irrigation ditches, close to the waters' edge, or on alkali lands which are unfit for other crops.

It is a well established fact that sweet clover will grow on soils which are strongly alkaline. In many sections of the west it is considered the most alkali-resistant plant that can be grown. It also has given very satisfactory yields when grown on alkali seepage land which does not produce other crops profitably, and has produced good results on soils too alkaline for all crops except salt grass. It is, therefore, better adapted to alkali soils than any other of the well known forage crops.

*Beginning here the discussion concerns only biennial sweet clover.

PRODUCING THE CROP

The requirements for obtaining a good stand of sweet clover are somewhat exacting. It must not be assumed that because the plant is found growing vigorously in waste places, a stand can be secured by planting in any manner or under any conditions.

Seed Bed Preparation

A firm, moist seed bed free from weeds is important. It is especially important that the seed bed be firm and moist, and it is hardly less essential that the seed bed be free from weeds. In order to secure such a seed bed in the more humid sections of the state, fall plowing is essential. Under irrigation fall plowing, early spring discing, and harrowing are necessary for best results. Fall plowing not only puts the soil in excellent condition, but also makes it possible to work the seed bed into proper condition early in the spring. If the sweet clover follows a cultivated crop or field peas in the rotation, plowing will not be necessary, early spring discing being sufficient to put the seed bed in satisfactory condition. In the drier areas, where the crop will ordinarily follow one of the small grains, the soil in most cases cannot be worked until early spring. If the stubble is light the use of the disc is sufficient to put the seed bed in condition. In any case tillage should be shallow, and should be followed by the use of the harrow and the roller.

Inoculation

Sweet clover, being a legume similar to alfalfa, depends for its best growth upon the presence of the proper nitrogen-fixing bacteria. It happens that the same bacteria which form the nodules on the roots of alfalfa are the proper ones for sweet clover; consequently, where alfalfa thrives without inoculation the same may be expected of sweet clover. If there is any doubt regarding the presence of the proper bacteria in the soil, it is a wise precaution to introduce them artifically. In the dry land areas it is especially important that sweet clover be inoculated when sown for the first time. At the Winchester demonstration plots inoculated biennial white sweet clover outyielded the uninoculated nearly 35 per cent.

There are two principal means by which sweet clover can be inoculated: the soil-transfer and the pure culture method. The former consists simply in securing soil from a field which has previously successfully grown a crop of sweet clover and scattering it broadcast over the field to be seeded. Pure cultures are more satisfactory, since there is less chance of failure when properly used. They are cheaper than the soil-transfer method, and there is no danger of introducing weed disease pests, as in the latter case. Although pure cultures of bacteria may

be purchased from firms preparing them on a commercial scale, the cost is greater than that of the same cultures when obtained from an experiment station laboratory. Such cultures are prepared by the Idaho Agricultural Experiment Station. Farmers interested should order from the Department of Bacteriology, University of Idaho, Agricultural Experiment Station, Moscow, a few weeks in advance of planting, stating the kind of legume to be seeded and the acreage.

Gypsum and Lime

Experimental work conducted at the Sandpoint Experiment Station has shown conclusively that gypsum should be applied to legume stands if maximum returns are to be secured. Similar trials with farmers in cooperation with county agents has demonstrated the value of this product. At Winchester increases of from 25 to 40 per cent have been secured from the application of 200 pounds of gypsum to the acre. In the Palouse area this product has produced only slightly positive results and further work is needed before its general use can be recommended.

Gypsum may be applied at any season of the year by scattering it broadcast over the field. The desirable time of application is before the sweet clover is seeded. After the seed bed is prepared the product may be applied and harrowed in. If not applied at seeding time, fall applications are desirable. When applied then the chemical is carried into the soil by the winter precipitation and is made available for use by the next season's crop. Spring applications usually are not made available to the crop until the following season.

Sweet clover is nearly as sensitive to an acid condition of the soil as alfalfa. Therefore, maximum yields of the crop cannot be expected on acid soils. In general, little trouble will be experienced with acidity in the sections of the state to which this crop is adapted. While there are undoubtedly some acid soils in Idaho, it has not been shown that lime is needed over any very large portion of the state. In many cases, the degree of acidity is so slight that no difficulty is experienced in obtaining a stand and the application of lime produces no increase in the yield of the crop. In case there is any doubt concerning the condition of the soil the matter should be taken up with the county agricultural agent.

Choice of Seed

Since much of the sweet clover seed offered for sale is somewhat low in germination, it is very important that the seed be tested before planting. This low germination is usually due to the presence of "hard seeds." seeds that do not readily germinate because of a hard seed coat which renders them impervious to water. These hard seeds can be made to germinate readily by running them thru a scarifying machine. This

machine scratches the seed coats so that when they are planted water is more readily absorbed, thus causing more rapid and uniform germination. Scarified seed may be purchased on the market at a slight increase in price over unscarified seed. Such seed, because of its more rapid and uniform germination, is easily worth the slight difference in price.

There is always the chance of importing noxious weed seeds with sweet clover seed, as well as a possibility of the order being filled with the wrong species. For these reasons, it is advisable to send a sample of the seed under consideration to the State Seed Laboratory, Boise, or the Branch Seed Laboratory, Moscow, for free analysis. If desired, both a purity and germination test will be made upon the sample and the results reported free of charge.

Methods of Seeding

Sweet clover may be seeded with a special grass seed drill or with a grain drill provided with a special grass seed attachment. In either case, it is essential that the seed be covered thoroughly but not too deeply. If neither of these implements is available, very good stands can be secured by broadcast seeding. This may be done either by hand or by the use of some mechanical broadcast seeder. If the seed is broadcast the field must be harrowed to cover the seed, and after harrowing, it is well to go over the field with a roller. This implement not only helps to cover the seed but packs the soil, thus insuring more rapid and uniform germination. In fact, the grower will find it advisable to follow drilled seedings with the roller. Under the average non-irrigated conditions the drill not only distributes the seed evenly, but covers it to a uniform depth. Satisfactory stands have been secured by broadcasting the seed on "honey-combed" soil in early spring.

The depth to which to seed sweet clover varies with the type of soil. On heavy soils containing plenty of moisture, the seeds should not be covered to more than an inch in depth. On lighter soils the seed may be covered to a depth of one and one half inches. In any case, the seed should be put down to moisture to insure rapid germination.

Time of Seeding

In any section where the rainfall is light early seeding of the crop produces best results, because the plants get well established before the beginning of warm, dry weather. From the standpoint of yield, the results secured at University Farm, Moscow, show that early seedings not only produce higher yields the first season, but due to the better stand ordinarily secured, produced a larger yield and better quality of hay the second season. These data are shown in Table 1. It was also found that a delay of two weeks in the date of seeding reduced the

first season's yield of forage fully 25 per cent. If delayed a month, practically no returns are secured the first season.

Table 1—Showing the effect of date of seeding upon the second season's yield of biennial white sweet clover, at Moscow, Idaho 1920-23 inclusive

Date of Seeding	Nurse Crop Treatment		4 Yr. Average Yields	Average all Nurse Crop Treatments
	No Nurse Crop	Nurse Crop Cut for Hay	Nurse Crop Cut for Grain	
	Lbs.	Lbs.	Lbs.	Lbs.
Early	6749	5538	5500	5929
Medium	6367	4147	4537	5017
Late	5591	3644	3558	4264

The early seedings, shown in Table 1, were made as soon as the seed bed could be prepared in the spring. The other seedings followed at two week intervals. In this experiment, Marquis wheat was used as the nurse crop.

Rate of Seeding

Over a four-year period equally good yields of hay have been secured at University Farm, Moscow, from seeding at the rates of 5, 10, 15 and 20 pounds of scarified seed per acre. The best quality hay is secured, however, from the heavier rates of seeding, since the plants are less stemmy. Taking this factor into consideration it would seem that 15 pounds of good, hulled, scarified seed is sufficient to plant an acre. In the dry farm areas, 10 pounds of seed should be sufficient. Under irrigation 20 pounds of good seed should be used. If the crop is to be used for pasture, the rate of seeding should be increased five pounds per acre. Tramping and close grazing of livestock injured the stand somewhat and the increased rate compensates for this loss.

Use of a Nurse Crop

As a general rule, sweet clover should never be seeded with a nurse crop under the dry farming conditions of the Snake River basin, because the soil moisture during most years is not sufficient to mature both crops. When this is the case, the sweet clover plants either die during the long, dry summer season or are seriously stunted in their development.

In the Palouse area, where the annual precipitation is a little more than 22 inches, satisfactory stands may be obtained only in the more favorable seasons when seeded with a nurse crop. Success is not at all certain when a nurse crop is used unless great care is exercised in the preparation of the seed bed and the crop seeded very early in the spring. As a nurse crop, an early maturing variety of field peas, such as the Alaska, has given the most satisfactory results. When such a variety is chosen the peas may be seeded at the normal rate. Some growers have

used small grains, seeded at about one-half the normal rate, as nurse crops, but the chance of success is much less than where peas are used. Table 1 shows the effect of a nurse crop of wheat upon the second season's yield. It will be noted that early seeding with a nurse crop produces about the same yield of hay as the late planting seeded alone. This indicates that a 25 per cent decrease in yield due to the nurse crop may be expected.

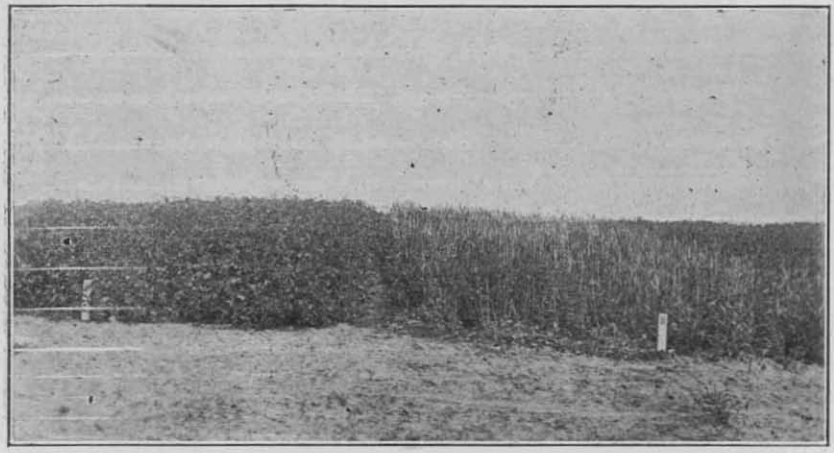

Fig. 2—Sweet clover does best when seeded alone (left). With nurse crop of barley (right).

The comparative value of the various nurse crops grown at University Farm is shown in Table 2. A study of the table shows that the highest yields of sweet clover were secured when the nurse crop was removed for grain. The value of the various nurse crops is also shown. When cut for hay nurse crops rank in order of desirability as follows: peas, oats, barley and wheat. When cut for grain the order is peas, oats, wheat and barley. An average of results from nurse crop treatments shows their rank to be peas, oats, barley and wheat, with little to choose between barley and wheat.

Table 2—Showing the effect of nurse crops upon the second season's yield of biennial sweet clover, at Moscow 1920-23 inclusive.

Nurse Crop	Four Year Average Acre Yields		Average of Nurse Crop Yields
	Cut for Hay	Cut for Grain	
	Lbs.	Lbs.	Lbs.
Wheat	4401	5429	4915
Oats	4792	5469	5130
Barley	4475	5411	4943
Peas	4961	6587	5774

As previously stated, there was little to choose between different rates of seeding when the sweet clover was seeded without a nurse crop. When a nurse crop was used, however, the lower rates of seeding did not produce average yields. Therefore, use of a nurse crop makes it necessary to increase the rate of seeding in order to secure a satisfactory stand. This increased stand increases competition and the resulting yield is lower than when the same rate of seeding is used without a nurse crop.

Decrease in the second season's yield obtained from sweet clover seeded with a nurse crop is due to two factors: (1), the legume plants are weakened by competition with the nurse crop, and (2), the stand of sweet clover is greatly lessened.

There is little question that the second season's yield of hay is materially decreased by the use of a nurse crop. On the other hand, when the nurse crop is harvested for hay the total yield of cured forage for the two-year period is nearly equal to that from sweet clover seeded alone. However, when seeded alone, only sweet clover, which is higher in feeding value than an equal amount of mixed grain and sweet clover hay is harvested. Then too, if the crop is to be utilized for pasture, sweet clover seeded with a nurse crop will not furnish pasturage the first season. Therefore, it seems evident that seeding sweet clover without a nurse crop is the desirable practice in the non-irrigated areas.

Under irrigation the crop can be seeded with a nurse crop successfully. However, since in most cases the crop will be utilized for pasture, it is best to seed it alone. In that event the crop will be ready for pasturing in midsummer. If a nurse crop is grown little pasturage will be secured until late in the season.

HANDLING THE CROP

The manner in which a stand of sweet clover is handled should depend somewhat upon the date of seeding, the purpose for which it is sown and whether it is seeded alone or with a nurse crop. In spite of the fact that sweet clover will withstand rather severe conditions, a heavy growth of weeds will greatly retard the growth of the plants and lower the yield the first season. As a rule, late seedings will be most seriously affected by weed growth. In some cases, it may even be necessary to mow the field to keep the weeds down. In mowing the new stand, the plants never should be clipped closer than five inches from the ground. The weed problem may be partially overcome by pasturing sweet clover the first season as soon as the plants have made a growth of from 8 to 10 inches, but even when pasturing is resorted to it sometimes is necessary to mow the field later in the season.

If the field is not pastured the first year and weeds are not trouble-

some, a cutting of hay may be made in the early fall. In most cases, when seeded with a nurse crop, it will be best to cut the grain for hay. If the nurse crop is left until maturity, it will use a great deal of moisture that is needed by the young sweet clover plants for their proper development.

Where sweet clover is to be used for pasture livestock may be turned in very early in the spring of the second season, since it starts growth earlier than most forage crops. It may be pastured during the entire second season, provided sufficient stock is kept on the field to prevent the growth from becoming woody. If the plants become coarse the pasture should be clipped, leaving a six to eight inch stubble, thus inducing a new growth which will be more palatable. When pasture is not desired the second season. one or two cuttings of hay, depending upon moisture conditions, or a seed crop may be secured.

Eradicating Sweet Clover

Since sweet clover is sometimes considered a weed when found in waste places, many farmers will not plant it for fear they will be unable to eradicate it from their fields in preparing their land for following crops. The results obtained each year by numerous farmers is sufficient proof that such fears are unfounded. At University Farm no difficulty has been experienced in getting rid of sweet clover. It is true that the plant is a weed along irrigation ditches, but there the plants are allowed to reseed each season. Under cultivation, farmers are having no difficulty with the problem of eradication. Unless the second year's growth is left for seed, it is easily eradicated by plowing up the sod at the end of the second year. The next season the land may be either seeded to spring grain or some cultivated crop such as corn. When the crop is left for seed there is apt to be quite a growth of young plants the following season. These can be killed easily by thoro cultivation the following spring. Under such conditions it would be best to follow sweet clover with a cultivated crop.

Feeding Value

The woody growth of sweet clover as it reaches maturity and the bitter taste due to the cumarin it contains have been the principal causes for refusal of livestock to eat it. On this account many farmers have thought it practically worthless as a feed. However, all kinds of livestock will not only eat sweet clover pasturage but also the hay when it is cut and cured at the proper stage.

Sweet clover, like most of the common legumes, contains a large amount of protein, thus making it a valuable feed for growing stock and milk production. Analyses made by the Agricultural Chemistry department of the Experiment Station indicate that sweet clover is about

equal to alfalfa as a feed for livestock. It carries about the same amount of protein, is only slightly lower in carbohydrates, and when cut at the proper stage is very little higher in crude fiber.

Fig. 3—One hundred pounds each of alfalfa (right), biennial yellow (center) and biennial white sweet clover (left) fed to cows on pasture. (see Fig. 4)

Sweet Clover Hay

The high protein content of sweet clover makes it a valuable feed. In fact, actual feeding experiments conducted at various experiment stations thruout the United States have shown that it is only slightly inferior to alfalfa for feeding purposes. The hay, which is cut the first year, is fine-stemmed and leafy and very similar to alfalfa in appearance. Unless the crop is cut at the proper stage the second year, however, it is likely to be stemmy and unpalatable.

Fig. 4—Feed bunks 24 hours later showing hay entirely consumed.

The total second season's acre yields of sweet clover for the season in northern Idaho are usually a little greater than those secured from alfalfa. This will undoubtedly be true in nearly all semi-arid sections. A yield of about three fourths of a ton of high quality hay may

be expected the first season, provided the crop is seeded early under favorable conditions and without a nurse crop. The second season yield should approximate two or three tons from two cuttings. In drier areas of the state the yield will be less, especially where, due to lack of moisture, only one cutting is secured the second year.

Altho sweet clover is a valuable forage plant, it will never be an important hay crop in Idaho. Its principal uses should be for pasture and soil improvement. The fact that sweet clover is a short lived plant, stemmy and hard to cure, makes alfalfa a better crop for hay under most conditions. In sections where alfalfa yields poorly sweet clover may take its place as a hay crop. Then too, a grower may occasionally need to cut part of his pasture for hay. A few other growers may need a biennial legume in their crop rotation and thus may use the crop for hay.

The first season's growth of sweet clover is not coarse and woody, and may be cut for hay in early fall. The proper time to cut the first crop of the second season depends very much upon rainfall, temperature, and fertility of the soil. In non-irrigated sections it is best to cut sweet clover as soon as the plants have made a growth of from 20 to 30 inches. In irrigated sections, it should not be allowed to attain a height of much over 30 inches before cutting. In no case should the plants be allowed to reach the flower bud stage before being cut for hay. The relationship of the stage of cutting to feeding value is shown in Table 3. It will be noticed that as the plants get older the yield becomes less, the protein content diminishes, and the per cent of crude fiber increases. The analyses in Table 3 were made by the department of Agricultural Chemistry.

Table 3—Showing the effect of stage of cutting sweet clover upon its feeding value. Data secured at University Farm, Moscow.

Stage Harvested	Yields Per Acre		Analysis (dry basis)	
	Green Weight	Dry Weight	Protein	Crude fiber
	Lbs.	Lbs.	Per cent	Per cent
Early bud	18,177	4890	21.87	30.83
Early bloom	14,525	4663	19.02	33.83
Late bloom	8,383	4054	13.99	38.02

The second crop of sweet clover comes from the buds formed in the axils of leaves on the lower portions of the stalks which constitute the first crop and, therefore, a stubble of 5 to 8 inches in height should be left when the first crop is cut. Such a height will ordinarily leave buds on most of the plants so that the new growth will start. In order to leave such a stubble, care must be taken that the cutter bar of the mower runs high enough off the ground. To accomplish this many growers have

special shoes made to replace those ordinarily found on the mower, which elevate the cutter bar to the proper height.

The curing of sweet clover is more difficult than curing of either red clover or alfalfa, as the leaves are very apt to shatter before the stems are cured. Every possible means should be used to save the leaves, since they constitute the best part of the hay. In non-irrigated sections, the mower should be started early in the morning. The hay should be left in the swath until next day and when well wilted raked into small windrows. After being left in the windrows for a day it should be put up into small bunches to cure. These bunches should be small, not only so that they cure quickly, but so that they may be loaded on the wagon entire, thus reducing the loss of leaves to a minimum.

Recently a few cases of sweet clover hay stock poisoning have been experienced in Canada, Colorado, Minnesota, and the Dakotas, The North Dakota Experiment Station investigated a large number of farms where such losses occured and found in every case that sweet clover hay or silage of a musty or moldy nature was the cause. This same station followed up its investigations by feeding moldy sweet clover hay to calves. The animals were killed in approximately 40 days of feeding. *Therefore, do not feed moldy sweet clover hay.*

Sweet Clover as a Pasture Crop

In the non-irrigated sections of the state no other leguminous or grass crop will furnish as much nutritious pasturage from early spring until late fall as sweet clover when it is properly handled. The fact that it may be pastured earlier in the spring than most pasture plants and that it will continue growing thruout the dry summer months makes it a valuable addition to many non-irrigated farms in Idaho. It is especially valuable on steep slopes and poor soils where other crops make but little growth. In many cases, native pastures which have a low carrying capacity, particularly during the dry season, can be improved by the addition of a little sweet clover. Under such conditions a satisfactory stand usually can be secured by harrowing or discing the pasture in early spring and broadcasting a few pounds of sweet clover seed to the acre. Worn out hillside pastures can be improved by scattering seed when the soil is "honeycombed" in early spring. A few growers use sweet clover as an ingredient of permanent pasture mixtures. Such a practice increases the yield of the pasture the first two years and enables the grasses in the mixture to get a better start.

The crop may be used for pasturing all kinds of livestock, hogs, cattle, horses and sheep doing equally well upon it. For sheep the biennial yellow species probably is best, since it will stand closer pasturing

than the biennial white. In many sections, excellent results have been obtained with sweet clover as a pasture for hogs. In fact, at the Iowa Experiment Station hogs made better gains on sweet clover than upon either rape or red clover. Dairy cattle, hogs and sheep have been successfully pastured on biennial sweet clover at the Idaho Experiment Station. Alfalfa is a better hog pasture, however, due to its longer life and habit of growth. Sweet clover is preferable to alfalfa for pasturing cattle, since it rarely causes bloat. There is even less danger of bloating if the animals have been given all of the dry feed they will consume just before being turned out on pasture in the spring.

Where the pasture enters into the regular rotation, maximum returns can best be secured from sweet clover by maintaining two fields, one of which is seeded each season. Newly seeded sweet clover will furnish pasturage after reaching a height of from 8 to 10 inches. Under non-irrigated conditions, the crop will not attain this height until approximately the middle of July. If care is used, it may be pastured the remainder of the season. The two year old seeding will furnish pasturage from early spring until the new seeding is available. The stock can then be transferred to the new field and the old field either left for hay or pastured alternately with the new one. Thus, by seeding a field every spring sufficient pasturage can be maintained thruout each season.

Under irrigation, the same system of pasture management could be used successfully. In addition to having the one and two year old fields, it would be well to subdivide each of these into two parts. Then one-half of the field could be pastured while the other half was being irrigated and making a new growth.

Sweet Clover Silage

In some sections of the United States, sweet clover is used as a silage crop, either alone or in mixtures with other plants. As a rule, where it is used for this purpose, the climatic conditions are such that it is difficult to cure the crop for hay. Unlike most legume plants sweet clover does not become slimy when made into silage. From the results secured by the Experiment Station Department of Agricultural Chemistry, sweet clover silage is high in digestible nutrients. Like all other legume silages it is high in protein and low in carbohydrates. It will, therefore, be necessary to supplement such silage with some feed high in carbohydrates, which is unnecessary in the case of silage made from corn or sunflowers.

Sweet clover to be used for silage should be cut in the earlier stages of growth, since it is at these stages that the plants are highest

in digestible nutrients. The crop is more easily handled if cut with a binder. If the plants are exceptionally green the bundles should be allowed to wilt somewhat before they are put into the silo.

Sweet Clover for Seed

Idaho farmers produce very little sweet clover seed. Undoubtedly the crop would produce very satisfactory yields of seed in the irrigated areas, but it cannot compete in price with the seed of red clover or alfalfa. In the non-irrigated sections the low acre yields prevent farmers from competing with those of other sections where yields are higher and where they are usually taken after removal of a hay crop. Most of the sweet clover seed produced in Idaho is grown in isolated sections and at the higher elevations where other seed crops are not successful.

Unlike alfalfa sweet clover produces seed under practically all climatic conditions. Very little, if any, seed is produced the first year. During the second season it is possible in many sections to secure a hay crop, or early spring pasturage, and a good seed crop. Under such conditions seed production is more profitable, because the second cutting produces the highest yield and ripens more uniformly. Under any conditions the chief objection to the use of the crop for seed is the fact that all the pods do not ripen at the same time. At harvest time some of the pods will be shattered, others will be just ripe, and still others from the late bloom will just be formed. Such a condition means that no matter when the crop is cut for seed, there is always considerable loss from shattering, resulting in a lower seed yield and volunteer plants the next season. It is when sweet clover is used as a seed crop that it is likely to become a weed. There is no doubt that there is little place for sweet clover as a seed crop in the non-irrigated sections of Idaho. Its chief value for these areas will be for pasturage and soil improvement.

The seed crop should be cut when about three-fourths of the seed pods have turned brown. The ordinary grain binder, especially equipped to prevent the loss of shattered seed, is the most satisfactory implement to use in harvesting the seed crop. (Fig. 7) It not only cuts the crop with a minimum amount of shattering but the bound material may be handled and threshed more easily.

The self-rake reaper is an efficient machine with which to harvest sweet clover seed. This implement deposits the plants with the tops turned one way at one side so that they are not trampled by the horses when cutting the next round. In some sections, the combined harvester has been used successfully in harvesting sweet clover seed. Corn binders and headers have also been utilized with success by growers in seed producing sections.

The mowing machine is sometimes used but it causes great loss of seed thru shattering, and is not satisfactory. Regardless of the implement used the shattering will not be nearly so great if the plants are harvested when they have been toughend by a light shower or heavy dew.

The crop may be threshed in the ordinary threshing machine, providing the speed of the cylinder is decreased, the fan slowed up, and a red clover or alfalfa riddle used in place of the one ordinarily used for grain.

Fig. 7—A grain binder equipped with pans and with extensions to the rear elevator plate and binder deck. This arrangement saves the sweet clover seed that shatters in cutting and binding. (Courtesy United States Department of Agriculture.)

Sweet Clover as a Honey Plant

Beekeepers have long recognized the value of sweet clover as a honey plant. The yield of nectar from sweet clover is heavy; the honey produced is light in color and ordinarily of good quality.

The Montana Experiment Station recommends the seeding of the yellow biennial, white biennial and Hubam together for honey production. By using all three strains a continuous flow of nectar is provided over a long period of time. In fact, the Hubam will continue to bloom until heavy frosts occur in the fall.

Sweet Clover as a Soil Improver

Sweet clover will make a good growth on soils too poor to produce

other leguminous crops profitably. In addition to its ability to grow well on such soils, it adds much nitrogen and organic matter. The large, extensive root system of the plant does much toward breaking up the subsoil, thereby providing better aeration and drainage. This is often noticeable in the spring, as the land which has grown sweet clover for several years will be in condition to plow earlier than nearby fields upon which the crop has never been grown. After the death of the plants the roots decay very rapidly and are often entirely decomposed by spring. In fact, it has been noticed that the decay is much more rapid than that of alfalfa. The deeper roots add much organic matter to the soil below the usual depth of plowing. Those in the surface soil, together with the stubble and stems which are plowed under, add more organic matter than is possible with any other legume which may be grown in a short rotation. The crop not only adds organic matter to the soil by the decay of plant residues, but also, like other legumes, adds nitrogen to the soil by means of the nitrogen-gathering bacteria in the nodules on the roots. It has been noticed that much larger yields of other crops are obtained following sweet clover than after non-leguminous crops. This is due to the large amount of nitrogen which the crop adds to the soil.

In some sections of the United States sweet clover is of value as a green manure crop, but it is doubtful if this practice will be of any value in the dry-farm sections of Idaho. Experimental work in other sections of light rainfall indicates that the practice is too expensive for general use. While increased yields of various crops were obtained by this method, the profits were less than where the usual cropping system was practiced. Another factor that is not favorable to the use of green manure crops in dry farming sections is the slowness with which they decay after being plowed under. They also tend to dry out the soil because of the large amount of moisture required for their decay. In case a green manure crop is plowed under in the dry-farm areas of the state, it is necessary to follow the next season with the usual summer fallow.

A method of using sweet clover as a soil improvement crop in the dry farm sections recently has been tried out by farmers in Power County under the direction of L. E. Tillotson, County Agricultural Agent. Unscarified sweet clover seed was seeded with fall wheat at the rate of five pounds per acre. After the wheat was removed the crop furnished considerable pasturage until late fall. The next spring the field was plowed and summer fallowed as usual. After fallowing another fall wheat crop was seeded. This method has increased the yield of wheat from three to eight bushels per acre and it does not interfere with the usual method of wheat farming in the dry land areas. In addition, nitrogen and organic matter are added to the soil, thus maintaining the fertility of the wheat land. This season a large number of farmers in

nearly all of the dry farming sections of Idaho are trying out the method under the supervision of county agricultural agents.

Such a method may be of value in the wheat growing sections of Northern Idaho. However, there is a possibility that fall-planted seed might germinate during the frequent "warm spells" occuring during the winter and be killed by subsequent freezing. Therefore, experimental work is needed to determine if such a method of handling the crop would fit into the regular farming system.

Hubam or annual white sweet clover might be used in a similar system of soil improvement, especially in sections where spring wheat is grown. By planting unscarified seed this species might be used satisfactorily with fall wheat, since most of this seed would not germinate until spring under conditions where seed of the biennial would remain dormant.

In the irrigated sections sweet clover can be used as a green manure crop by seeding in the spring with wheat or other cereals. After the grain is harvested it will make a rank growth which can be plowed under in late fall or early spring. This practice is especially desirable in sections where alfalfa is used for this purpose, since sweet clover makes a more luxuriant growth the first season than alfalfa. In addition, the price of sweet clover is considerably less than that of alfalfa. If desired, the crop may be left the following season and utilized for pasture. By leaving the crop an extra season a larger amount of nitrogen and humus will be stored up in the soil.

Sweet Clover in the Rotation

Since sweet clover lives only two years it is a comparatively easy crop to fit into the rotation. Unlike alfalfa it may be rotated over the entire farm in a relatively short time.

In the area north of the Salmon River sweet clover may precede either a cultivated crop or wheat in the rotation. If sufficient livestock is kept so that silage is profitable, the sweet clover may be followed by either corn or sunflowers. In some sections potatoes may be grown following sweet clover. In case a cultivated crop is not desired in the rotation, wheat may be seeded after the sweet clover is plowed under. If moisture permits early fall plowing winter wheat may be seeded; otherwise it will be necessary to use a spring-sown grain such as oats. In some cases, where a suitable cultivated crop cannot be found for use in the rotation, an occasional year of summer fallow will often be desirable to keep weeds under control. In the dry-farm areas of the Snake River Basin, it will be necessary to summer-fallow after sweet clover, following this with the usual crop of wheat. In the non-irrigated sections of Idaho, the nitrogen content of the soil can be maintained by use of a suitable rotation including sweet clover.