Sweet clover mulch. Result of one year's growth on a gullied, barren field.
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SWEET CLOVER

CHAS. E. THORNE, Director Ohio Agricultural Experiment Station:

Sir: I have the honor to transmit herewith and to recommend for publication by this institution as a Circular, the accompanying manuscript entitled "Sweet Clover."

This manuscript is a short popular presentation of a field study of Melilotus (Sweet Clover), which has been made within the past year by W. A. Lloyd of this Department, and of which an elaborate and detailed report is presented in Bulletin 244 of this Station. In it are summarized the results of this investigation and are presented only its most essential details. The manuscript is submitted in the belief that most farmers will appreciate the tersest possible statement of this important subject, and the leaving of the mass of evidence upon which it is based, to those who are particularly interested and who especially request a copy of the bulletin.

Respectfully submitted,

L. H. GODDARD, Chief, Department of Cooperation.

Approved:

CHAS. E. THORNE, Director.
July 10, 1912.
Distribution general. Distribution occasional. Rarely found.

Fig. 1. Map showing distribution of Sweet Clover in Ohio as indicated by correspondence and personal field study.
According to the Federal Census there are in Ohio farms a round million and a half acres, other than woodland, that are unimproved. Much of this is waste land and has become so depleted by exhaustive cropping that it will no longer produce profitable farm crops. There are thousands of acres that have been heavily pastured after farm crops could no longer be profitably produced and these lands, particularly those in the southeastern or hill portion of the state, are badly eroded. These erosions for the most part occur in small areas of from a few square rods to thirty or more acres each and are to be found on almost every farm in some of the townships. While no survey has been made to ascertain the total area of these eroded lands in Ohio, the loss which these loafing acres entail upon agriculture is enormous. This loss is not readily appreciated even by the owners of the lands themselves, owing to their existence in small areas distributed over a large district. This eroded area is being continually augmented by the constant depletion of other lands similarly situated through the continuation of a system of agriculture ill adapted to the region. Cropping with corn, wheat and timothy followed by excessive pasturing with the use of very little or no manure has so reduced the organic matter as to make erosions begin very readily, particularly in cornfields left bare over winter, and in wheatfields. The district has also been the home of a very large number of sheep, and the close grazing habits of these animals and their habit of making beaten paths on the hillsides have started numerous washes. The destruction wrought by mining and by oil and gas development have converted great tracts into a semi-abandoned condition. None of the ordinary grasses will thrive in these locations and their reclamation presents a serious problem. Incorporation of organic matter and a surface turf are needed to stop further waste.

Sweet clover grows luxuriantly in roadside ditches, in the cuts of railways and generally in situations similar to these erosions and its ability to withstand these adverse conditions and often even to prosper under them attracted our attention to the possibility of its utility as a means of restoration of such waste areas.
SWEET CLOVER DESCRIBED

Sweet clover is commonly known as a wayside weed in Ohio. It is a native of Asiatic Russia and was early introduced into the United States by European immigrants. The time or method of its introduction is not known, but it was probably accidentally brought over in bedding, clothing, hay, etc. It is mentioned by Gronovius, in Flora Virginica, which was published in 1739.

Three or possibly four species are found in the United States: *Melilotus alba*, *M. officinalis*, *M. indica* and *M. azureus*. Of these, *M. alba* (White Melilot, Bokhara or White Sweet Clover) is most widely distributed. *M. officinalis* (Yellow Sweet Clover) is less common but is frequently met with. *M. indica* is found in large areas only in the far West, particularly in California, while *M. azureus* is occasionally found in the South, principally in Louisiana. Only the first two species are important in Ohio.

White Sweet Clover (*M. alba*), the most common of the sweet clovers, is a tall, branching biennial with white flowers in long, slender racemes. The leaves are rather broadly ovate and the young plant much resembles alfalfa, so as to be easily mistaken for it.

When drying the leaves have a sweet, vanilla-like odor. The plants reach a height of 5 to 8 feet the second season and bloom from June to October. After beginning to bloom the stems rapidly become woody and numerous side branches are thrown out. The roots are large and fleshy, much branched, and are sent down to a...
great depth. They die with the tops at the end of the second year. In common with a few other plants it contains an acid principle, cumarin, which gives to the plant a peculiar, bitter taste.

Yellow Sweet Clover (*M. officinalis*) is much similar to the White Melilot except that it has yellow flowers and is a somewhat less ambitious grower.

*M. indica* is a yellow-flowered annual species rather smaller than *M. officinalis*.

*M. azureus* is low growing and has a blue or purple flower.

They are all members of the leguminous family of plants and are closely related to alfalfa and the true clovers.
SCOPE OF THE INVESTIGATION

The investigation was undertaken first by correspondence with farmers in this and other States, with representatives of American Agricultural Colleges and Experiment Stations and, through United States Consuls, with Agricultural Experiment Stations, Colleges and Associations in Europe, Asia, Australia and South America.

In this manner a great mass of data was accumulated relative to the distribution, habits, soil requirements and agricultural utility of the plant both in this country and abroad. This correspondence study was supplemented by a field study covering eighty-four Ohio counties and by careful personal investigation of a large sweet clover growing district in northern Kentucky. This field study corroborated the opinions and experiences submitted by correspondents, and they together embody much that if correctly applied to the Ohio conditions which we have mentioned will we believe go far towards solving the problem of the hills.

DISTRIBUTION

The plant has a very wide distribution throughout the world being found on each of the continents and in many of the islands. It is quite generally distributed in England, Scotland and Ireland, and throughout Mediterranean Europe. It has been utilized as a hay and pasture and with marked benefit as green manure in many European countries. In Switzerland it is used as a flavoring in the manufacture of cheese and in France as a fibre plant. In Asia Minor it is used in the manufacture of pipe stems and in China and southern Europe the young plants are used as a "pot herb" (greens). In India it is sown in the rice fields and is much esteemed as a fodder plant for horses and cattle. From far off Tasmania comes the most enthusiastically favorable report. The Department of Agriculture for South Australia reports that this plant has transformed the barren, sandy waste of King Island into one of the most profitable dairy regions of Australia. The species grown there is known as King Island Melilot or *M. parviflora* which is very similar to our *M. officinalis*.

Sweet clover is found growing in most of the states as a wayside weed, and in large areas in Mississippi, Alabama, Kentucky, Iowa, Colorado, Nevada and California. Badly run-down and abandoned cotton plantations in Mississippi and Alabama have been restored to fertility and profit by the use of sweet clover as a mulch and green manure. It is being used in a similar way in the hills of northern Kentucky in restoring badly eroded tobacco lands and as a soil ameliorant in northeastern Iowa. In the far West it grows in profusion on the banks of irrigation ditches and in deserts where the soil is so alkaline that other plants will not thrive.
SWEET CLOVER

SOIL ADAPTATION

Throughout the world the large areas of sweet clover are usually to be found on soils very calcareous, showing the same fondness for lime that is common to the clovers and alfalfa. In Ohio it was found growing on almost every type of soil in the State: on the sand dunes of Fulton county, the old lake bed in Paulding and Henry, the level black lands of Montgomery, the gravelly moraines in Morrow, Delaware and Logan, the limestone hills in Hamilton, Clermont, Adams and Brown, the river valleys of the Scioto, Miami, Muskingum and Hocking, the sandstones and shales of Meigs and Athens and in similar situations in Wayne, on the red hills in Washington, Morgan and Athens and on the acid soils in Medina, Summit and Cuyahoga counties. While the plant shows this wide soil adaptation in Ohio, its most luxuriant growth is invariably associated with lime, either as a part of the geological formation, as a result of glaciation, or as accumulation from the sedimentary deposits from the flood waters of streams having their source in limestone areas.

A considerable number of Ohio farmers have made field experiments with sweet clover. The universal testimony is that the plant responds to an application of lime. A very striking example of this is brought out by a test privately conducted in Clermont county, where 30 acres of flat, loessal soil were seeded to sweet clover. The only part of the field where the sweet clover persisted was in an abandoned road where an approach to a bridge had been made
of limestone gravel, and here the plants were thick and luxuriant. The plant also shows a marked adaptation to the red soils in southeastern Ohio. While lime seems to be a limiting factor in the utilization of this plant, it is fortunate that the situations most needing the plant are seemingly well adapted to its growth. These consist of the limestone hills of southwestern and the red hills of southeastern Ohio. The plant will frequently grow luxuriantly on the subsoil when it will not grow at all on the surface soil by reason of its acidity. This makes it particularly well adapted to the eroded areas where much of the surface has been washed away.

THE KENTUCKY FIELDS

The sweet clover area in Kentucky is of particular interest to farmers in this state, as it lies just across the Ohio river from a region of similar topography and geological formation and agricultural conditions. The largest Kentucky fields of sweet clover are to be found on the limestone hills of Bracken, Robertson and Pendleton counties, which for more than a hundred years have been exhaustively farmed, principally in tobacco. The topography is very hilly and the surface full of loose limestone slabs. The prevailing farm practice has been to follow tobacco with wheat, then allow the land to grow up in brush for six to ten years, when it would again be cleared and planted to tobacco. Very little grass seed has been sown and almost no manure used. A century of abuse of this sort has resulted in a sadly depleted soil and deeply gullied hills. Sweet clover \((M. \text{alba} \text{ and } M. \text{officinalis})\) was accidentally introduced in this region about twenty years ago and upon plowing up an old field that had been "taken" by sweet clover a "bumper" crop of tobacco was secured. Gradually the farmers came to esteem it as valuable to use on the tobacco lands as a mulch and to plow down. It was found that if sweet clover was sowed in the winter on the wheat and allowed to stand for four years another good crop of tobacco could be secured. This meant a crop of tobacco every six years instead of every eight to ten as before. Other badly washed areas have been converted into profitable pastures; the sweet clover making the conditions favorable to bluegrass after a few years. The great scars in the hills have been healed. Hundreds of acres have been and are being reclaimed in the counties named, by the use of sweet clover as a mulch and as a crop to plow under, and there can be no doubt of its usefulness as an agent in working a similar transformation on many waste fields in Ohio.
SWEET CLOVER

AGRICULTURAL ADAPTATION

Eighteen hundred and eighty-two communications were received from Ohio farmers. These letters came from every county in the state and told of the situations in which the plant was found growing and of the writer's knowledge of its utilization for pasture, hay, green manure or mulch. It was reported growing in each of the 88 counties in the state. In 94.6 percent of the cases it was reported as growing along roadsides. It was found in pastures in but 3.7 percent of the cases and in cultivated fields in 1.6 percent. Of those reporting it 257 speak of personal knowledge of its being grazed upon by some kind of livestock, 125 had found it valuable for hay and 295 had used it as a soil restorer, either as a mulch or green manure. This is a rather remarkable showing for a plant which has been considered a pest and only recently was among the plants included in the Ohio weed law which made compulsory its destruction along the highways. The best definition of a weed is that given by Prof. L. H. Bailey of Cornell University, "A plant that is not wanted." By this definition sweet clover or corn may be either weeds or beneficial plants according to their location.

USE AS A FORAGE CROP

Incidentally to the investigation it has been ascertained that sweet clover is valuable as a forage crop. While many individual animals refuse it at first, all kinds of livestock learn to like it and eat it greedily and thrive on it. Stock take to it more readily than they do to rape or ensilage. Its analyses vary greatly as given by different experiment stations, owing doubtless to the stage of maturity at which the sample for analysis was taken. It does not differ greatly from alfalfa in its food value. The Wyoming Station Bulletin No. 78 gives the following comparative analysis of alfalfa and sweet clover hay.

<table>
<thead>
<tr>
<th>Digestible nutrients in 100 lbs. air-dry material</th>
<th>Sweet clover hay (Melilotus alba)</th>
<th>Alfalfa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry matter</td>
<td>56.12</td>
<td>59.10</td>
</tr>
<tr>
<td>Crude Protein</td>
<td>11.88</td>
<td>12.00</td>
</tr>
<tr>
<td>Crude fibre</td>
<td>8.32</td>
<td>14.06</td>
</tr>
<tr>
<td>Nitrogen-free extract</td>
<td>28.36</td>
<td>27.00</td>
</tr>
<tr>
<td>Ether extract (fat)</td>
<td>0.41</td>
<td>0.72</td>
</tr>
</tbody>
</table>

SWEET CLOVER HAY

For hay it should be cut just as it is coming into bloom and is handled in much the same way as alfalfa. A second cutting can usually be secured 40 to 60 days later if not pastured. The leaves shatter even worse than alfalfa and great care is necessary in order to make good hay. It has also been cut and put into the silo and fed successfully.
PASTURE

In 257 cases reported, representing 69 counties in Ohio, farmers have observed stock grazing upon it. In the Kentucky area mentioned thousands of acres are in sweet clover pastures. We saw horses, cattle, sheep and hogs in these pastures eating the sweet clover as readily as stock usually do bluegrass or red clover, and apparently thriving on it equally as well. Reports from farmers in Mississippi, Alabama, Pennsylvania and Iowa speak in enthusiastic terms of its value as a pasture. When fields are left in sweet clover pasture, the bluegrass usually supplants it after a few years. This is owing to the stock preventing the sweet clover going to seed and also to its rendering the soil favorable to the growth of other plants. Sweet clover is a non-competitive plant and likes to have the situation all to itself. The universal testimony of Ohio farmers is that it does not spread from the roadside to adjacent fields that are pastured. The same care to prevent harm from bloating should be exercised with sweetclover as with red clover or alfalfa.

Fig. 5. Sweet clover stores up nitrogen in the soil and provides inoculation for alfalfa. Lands which have not previously grown sweet clover should usually be inoculated before seeding.
INOCULATION

The nitrogen-fixing bacteria of alfalfa and sweet clover are very similar; those of one plant readily adapting themselves to the other. This makes sweet clover plots of great value as a source of soil inoculation for alfalfa. Fields which have been in sweet clover for a few years can usually be seeded to alfalfa quite easily and successfully. Sweet clover itself needs inoculation and when it is being introduced into new situations the soil should be inoculated if best results are to be obtained. Failure to do this is a probable cause of many failures.

SEEDING

Seed can be sown broadcast on wheat in midwinter when the ground is honey-combed, with oats in the spring or on a well prepared seed bed in May. In these latter cases the seed should be lightly covered. It may also be seeded the latter part of July or during August, as is frequently done with alfalfa. The seed usually germinates very poorly, owing to the presence of a large number of hard seeds. For this reason from 20 to 30 pounds of seed should be sown per acre. Even more of the unhulled seed can be used to advantage.

Fig. 6. The restoration completed. Ten years before the picture was taken this field was as bad as that shown in Fig. 2. It is now a profitable bluegrass pasture. About one-third of the grass is sweet clover.
A SOIL IMPROVER

It is, however, as a soil ameliorant that sweet clover gives promise of greatest benefit to Ohio farmers. When used in this connection on areas deficient in lime, this element should be liberally supplied. An application of manure or straw will aid the young sweet clover in getting started and hasten the work of restoration. It is probably best to delay the sowing of other grass seeds for two or more years after the sweet clover has been seeded.

The areas should not be pastured, but the sweet clover allowed to fall down and form a surface mulch. On badly eroded areas sweet clover and the yellow locust form an excellent combination. If the land is not leveled before seeding the young trees should be set in the bottom of the ditches. Probably the best plan to get sweet clover started on eroded or very thin soils is to transplant one-year-old plants in the spring. This is neither as slow nor as laborious as it might seem. One plant every four or five feet is sufficient. In this way the inoculation requirement is taken care of and the plants will thoroughly seed the area by the end of the season. It possesses the merit of being almost invariably successful. Plants are usually available in wayside sweet clover patches.

SUMMARY

1. Sweet clover is not a noxious weed.
2. It is of unquestioned value in restoration of worn and eroded soils.
3. It is a valuable forage crop and worthy of use as such in situations where better crops cannot be grown successfully.
4. It shows a very wide adaptation to Ohio conditions and its extensive use is advisable in the reclamation of much of the semi-abandoned land of the State.
5. In seeding its lime and inoculation requirements should be carefully looked after.

Bulletin 246 of the Ohio Experiment Station gives a tabulated report of sweet clover in each of the 88 counties and abstracts of letters from nearly 300 Ohio farmers; letters from 24 American Experiment Stations; reports from 29 foreign countries, American consuls and scientific associations; abstracts of the more important scientific experimental work done with the plant, together with numerous analyses by American and foreign Stations. The bulletin is profusely illustrated and is available on request to the Ohio Agricultural Experiment Station, Wooster, Ohio.
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