

# Ohio Agricultural Experiment Station.

---

## BULLETIN 70.

---

WOOSTER, OHIO, APRIL 1896.

---

### *FORAGE CROPS.*

---

The Bulletins of this Station are sent free to all residents of the State who request them. Persons who may receive duplicate copies, or who do not care to receive any, are requested to notify the Station. All correspondence should be addressed to  
**EXPERIMENT STATION, Wooster, Ohio.**

---

COLUMBUS, OHIO:  
THE WESTBOTE CO., STATE PRINTERS.  
1896.



The Ohio State University

3 6267 01222719 8

# ORGANIZATION OF THE OHIO AGRICULTURAL EXPERIMENT STATION.

---

## BOARD OF CONTROL.

|                             |                     |
|-----------------------------|---------------------|
| SETH H. ELLIS.....          | Springboro          |
| R. H. WARDER.....           | North Bend          |
| J. T. ROBINSON.....         | Rockaway            |
| THE GOVERNOR OF THE STATE   | } <i>Ex-officio</i> |
| THE DIRECTOR OF THE STATION |                     |

## OFFICERS OF THE BOARD.

|                      |            |
|----------------------|------------|
| SETH H. ELLIS.....   | .President |
| R. H. WARDER.....    | .Secretary |
| PERCY A. HINMAN..... | .Treasurer |

## STATION STAFF.

|                                  |                   |                                       |
|----------------------------------|-------------------|---------------------------------------|
| CHARLES E. THORNE.....           | Wooster           | ..... Director                        |
| WILLIAM J. GREEN.....            | “                 | .....Horticulturist and Vice-Director |
| J. FREMONT HICKMAN, M. A. S..... | “                 | ..... Agriculturist                   |
| FRANCIS M. WEBSTER.....          | “                 | ..... Entomologist                    |
| AUGUSTINE I. SELBY, B. SC.....   | “                 | ..... Botanist and Chemist            |
| PERCY A. HINMAN.....             | “                 | ..... Bursar                          |
| WILLIAM HOLMES.....              | “                 | .....Foreman of Farm                  |
| CHARLES A. PATTON.....           | “                 | ..... Ass't Foreman and Meteorologist |
| W. A. PORTER.....                | “                 | ..... Florist                         |
| H. O. MCFADDEN.....              | “                 | .....Foreman of Gardens               |
| WILLIS G. HARRY.....             | “                 | ..... Dairyman                        |
| ANNIE B. AYRES.....              | “                 | .....Mailing Clerk                    |
| S. J. BLAKE.....                 | “                 | .....Mechanic                         |
| J. E. BARCLAY.....               | Neapolis          | .....Supt. Northwestern Sub Station   |
| EDWARD MOHN.....                 | Strongsville..... | Supt. Northeastern Sub-Station        |

---

*The Bulletins of this Station are issued at irregular intervals. They are paged consecutively, and an index is included with the Annual Report, which constitutes the final number of each yearly volume.*

# BULLETIN

OF THE

## Ohio Agricultural Experiment Station.

---

NUMBER 70.

April, 1896.

---

### FORAGE CROPS.

BY J. FREMONT HICKMAN.

Every year, since the Experiment Station began its work under the new organization in 1888, some experiments have been conducted on a small scale, with a view to gaining some information as to the adaptability of various forage crops to the soil and climate of Ohio. On the following pages the general results of these experiments will be given, together with methods of soil preparation, quantity of seed used, manner of growth, length of season required and such other data as they furnish. The general subject of Forage Crops will be treated under three heads, as follows:

- 1st. Leguminous forage plants.
- 2d. Gramineous forage plants.
- 3d. Miscellaneous forage plants.

#### 1. LEGUMENOUS FORAGE PLANTS.

ALFALFA—LUCERNE—(*Medicago sativa*). The name, Alfalfa, was given by the Spanish, Lucerne by the French, the plant having been named *Medicai* or *Medica* by the Greeks and Romans, because it had been brought from Media at the time of the Persian war, about 470 B. C.

Botanically it belongs to the same family of plants as the clovers, peas, beans, vetches, etc. It was introduced into Mexico from Spain, thence into South America, and from Chili into California and later into Colorado and Kansas. To the arid regions of these and other western states it is without question one of the most valuable plants ever introduced.

It prefers a light, sandy, or loamy soil, and a sub soil through which its long roots can readily penetrate. Soils underlaid with a shale or hard pan are not conducive to its successful growth, because the roots must

penetrate the sub-soil, until they find moisture. While alfalfa is well adapted to some of the western states it has also been successfully grown in some sections of Ohio, and while it prefers light and porous soils, yet it has been grown on clay land, giving good results.

The greatest difficulty with it in our experiments has been to get a stand. In this we have succeeded three years out of eight, but in none of these three has the alfalfa given sufficient growth to warrant either cutting or pasturing the first year. After it is once started the nature of the sub-soil is of vastly more importance than the surface. We have dug up roots of only five months' growth, measuring fifty-five inches in length. These tap roots have been found running eight and nine feet into the sub soil.

After it is once established it is one of the most tenacious of the forage plants, enduring more dry weather, more heat and perhaps more cold than any other of our forage plants, and seeming to defy the hottest suns, the driest soils and the widest variation of temperature.

*Preparation of seed bed:* We have been most successful in getting alfalfa started where the land was plowed deep and as early in the spring as possible, the surface thoroughly pulverized, the seed sown broadcast, at the rate of twenty-five pounds per acre and oats sown with it at the rate of one bushel per acre, all being harrowed lightly, covering the seed very shallow. The oats keep down the weeds until the alfalfa gets large enough to shade the ground, after which the oats should be cut, and if weeds come up and threaten to choke out the alfalfa they should be cut down with mowing machine, set high, and if heavy, raked and hauled off, for if left they will smother the alfalfa.

*Selection of seed:* Alfalfa seed is somewhat larger than common red clover seed; when fresh and good it should be glossy yellow and heavy. If the seed appears white it is an indication that it was not ripe when cut, and it should be discarded as an uncertain quantity.

As indicated above, alfalfa sown with the expectation of getting anything from it within the first year will prove a disappointment. The second year, however, in this latitude, it may be cut not less than twice nor more than three times. It will become stronger and of better growth the third and fourth years, but will not likely improve any after the fourth season. It may be continued almost indefinitely upon the same piece of ground; for this reason it is not calculated to occupy a place in any given rotation, but should be sown on land where it may remain permanently.

To get the most out of it, it should be cut and fed green or cured for hay. It is in the best condition for hay and should be cut just when it begins to blossom; if left longer the stems will rapidly become hard and

woody, and, we naturally conclude, less digestible. Within a very few hours after cutting the alfalfa should be raked into windrows, and before it is dry, cocked up and allowed to stand about forty-eight hours, or until it gets into a good sweat, when it should be opened out well, aired and dried, then hauled in. If allowed to dry before raking the leaves will nearly, if not all, be lost and only the stems remain to be gathered. To make good alfalfa hay in our climate is a more difficult task than to make hay from red clover.

The relative value of alfalfa hay is best understood by comparing it with ordinary, or small red clover, and this is most readily done by giving the digestible food ingredients in 100 pounds of each. The following comparative percentage composition of digestible ingredients in alfalfa and red clover hay is given in Bulletin 60 of this Station, Table XIII, this table having been compiled by E. W. Allen of the Office of Experiment Stations, U. S. Department of Agriculture, chiefly from American analyses and digestion experiments: Alfalfa—water, 8.4; protein, 10.58; carbohydrates, 37.33; fat, 1.33 per cent. Red clover—water, 15.3; protein, 6.58; carbohydrates, 35.35; fat, 1.66 per cent. Estimated in calories, or fuel value, alfalfa contains, according to the same table, 94,936 calories, and the red clover, 84,995 calories, showing that alfalfa is slightly more nutritious than red clover.

I believe that where the soil is well adapted to the growing of alfalfa, more than twice as much hay can be made from an acre as is possible to gather of red clover, but excepting in a few favored localities the red clover will prove the more profitable.

When used green, as a summer feed, whether fed in the stables or pastured, alfalfa should not be fed without first wilting, nor pastured while wet, otherwise bloating is quite likely to follow. I have not had any personal experience in pasturing alfalfa, but from what I have been able to gather it seems to be regarded as more dangerous, in this respect, than any of the clovers. Few writers recommend pasturing alfalfa, claiming that trampling or pasturing close will destroy it.

After cutting or feeding off, the young alfalfa shoot starts out much sooner and grows very much more rapidly than in the common clovers, and is correspondingly more tender, therefore much easier broken off and destroyed. A small patch of alfalfa, grown at this Station last year, was cut in June and produced at the rate of 1,400 pounds per acre; a second cutting was taken off September 2, which made nearly 1,500 pounds, a total for the season of a little less than a ton and a half per acre. The common red clover on a little better land made nearly one ton to the acre with one cutting.

As to the palatability of alfalfa, it is only just to say that any animal that will eat clover hay will eat alfalfa, either green or in the form of hay.

As to the value of this plant for green manuring we have not had any experience, but from its character and analysis it is fair to assume that it is equally as good to plow under as other clovers.

#### THE COWPEA.

The cowpea is one of the most recently introduced plants in Ohio. It belongs to the same family as the clovers, and is regarded as a plant especially adapted for plowing under as a soil renovator. It has an advantage over clover and alfalfa, in that it can be grown and turned under within the same season. For the southern and some of the western states it has doubtless proven a valuable soiling crop, but north of the Ohio river it has not been brought into general use sufficiently to determine definitely its value. There are a number of varieties, but our experience indicates but a single one that is likely to do well so far north. Below are given the names of several varieties and their characteristics.

*The Unknown Pea:* This is a greenish pea with blue eye; of good size; long pod and considerable vine, but remains green too long for this climate.

*Clay Pea:* Vines and growth only medium; berry cream colored, with a distinctly white eye, and rather small in size. Does not mature.

*Lady Pea:* Grows a lengthy vine, but comparatively small leaves; bears a small white pea, with white eye, but like the others, fails to reach maturity.

*Large White Pea:* This variety makes a vigorous growth at first, but does not carry it through the season. The berry is white, but it failed to mature on the Station grounds.

*Black Pea:* Medium in size, black, long pod and well filled with peas; the only variety that has matured out of the five given, and it has given a larger yield of vine than the others.

The cowpea is a tender annual; it may be sown as early as the first of May, but will do comparatively well if sown as late as the first of July, unless the weather should be more than ordinarily dry. It may be sown broadcast, in which case it is best to use from seven to eight pecks of seed per acre; or if put in with an ordinary grain drill, six pecks will make a fair stand. If sown the middle or last of May it will, as a rule, withstand a severe drouth, and will go through it as well as any crop we have grown on the farm.

For making into hay it is not desirable, for the reason that it is entirely too hard to cure; for ensilage it is quite as undesirable, making, when thus put up, a slimy, unpalatable mass that the stock simply refused to

eat. The third and last use we have attempted to make of it is perhaps the only one to which it will be profitably put on Ohio soils, namely, as a crop to plow under.

In June, 1894, we sowed three acres of the black peas, on a very thin clay soil; the weather following was very dry; a part of the crop was mowed, gathered, and put into the silo about the middle of September, the other part was left on the ground. The part harvested made only 2,700 pounds of green forage per acre.

In May, 1895, a much better piece of ground was drilled to the same variety of cowpeas, and when cut early in September gave a yield of 5,100 pounds per acre, or a little over two and one-half tons of green crop; some of these vines were four feet long and covered the ground completely, making it difficult to walk through the patch. A part of this patch was plowed down and the land drilled to wheat. From this will come our first well defined results as to the benefits of cowpeas for plowing down. They have not thus far produced one-third as much material for turning under as red clover will grow. We have cut a little more than eight tons of green clover from an average acre for putting into the silo.

The cowpeas have, however, I believe, one special redeeming quality, namely: that they will grow on land that seems too poor to grow anything else. They are therefore recommended for soils that are worn out, as a crop to start vegetation. Our experience, up to date, justifies the conclusion that cowpeas are not a success on our clay soils, except where nothing else of a renovating nature will grow. They are, however, worthy of further trial.

#### THE SOJA BEAN. (*Glycine hispida*.)

This is known in its native country (Japan) as the Japanese or Mongolian pea, in the United States as the "Soja" or "Soy" bean. It is an annual, leguminous plant, resembling the bean. It grows tree-like, eighteen inches to four feet high, bearing a dense crop of short pods, well filled with small berries. In Japan the soja bean is regarded, when properly cooked, as an edible and palatable dish, being so highly esteemed that it is rarely fed to stock. The berries, when broken and boiled in water, make a fair substitute for coffee.

In May, 1893, two varieties were planted in rows three feet apart and in hills twelve inches apart in the row; these were cultivated, much as we would cultivate potatoes, during the season. They made a very fine growth, but were planted too far apart to make a good yield per acre. In 1894 the same varieties were planted in rows about two feet apart; by this method we got at the rate of 3 tons 1,120 pounds of forage per acre

from the green variety and 4 tons 800 pounds per acre from the black variety.

In 1895 we planted a small patch (one-tenth acre), in rows, and another tenth acre was put in with the grain drill at the rate of one bushel per acre on the 17th of May. Those planted in rows had the same cultivation as was given corn, while those put in with the grain drill were undisturbed. The latter made a growth averaging nearly forty inches high, bearing a dense foliage of dark green, making a handsome appearance and attracting general attention.

Plate I is a picture of this patch, taken when the plants were about six weeks old. To the right of the soja beans is a patch of rape, which is shown more distinctly in Plate II.

These beans were harvested the last week in August and fed to the cows in the barn; they had matured too much to be in the best condition for this purpose, as the stem had become quite woody and dry, and the beans almost mature; but even in this condition the cows ate nearly eighty-seven percent. of the crop, as determined by actual weight of amount fed and amount refused. In this advanced stage of growth the plot gave a yield at the rate of 7 tons and 1,700 pounds per acre, on land which was slightly above the average of the Station farm in natural fertility.

This plant, like alfalfa and cowpeas, may be used in at least three ways: as a forage crop, for hay, and as a green manure, for plowing under.

As a forage crop, for feeding in a green condition, it is seemingly a success, though not as palatable, and therefore not as readily eaten as fodder-corn and some other succulent foods. While our cows ate almost eighty-seven percent. of it, as stated above, they did not seem to relish it as they did some of the more watery foods.

If cut just as it comes into blossom it makes a very fair hay; if allowed to pass this stage of growth it becomes very hard and unfit for preserving. In any case it can hardly be regarded as a good substitute for any of our native hay making plants, for the reason that it is more difficult to cure and is likely to mould or spoil if put into stacks or large bulk in the barn. The black variety, on account of losing its leaves more easily than the green, is not as desirable for hay-making purposes, but as a green manure or for forage the black variety is more suitable, giving larger yields and earlier maturity.

This plant has not been tested at this Station as a green manure, but, belonging as it does to the Leguminous family, and making such a large, strong growth within a single season, it would seem to have the advantage over the clovers, which take a full year to develop enough to turn under.



From my present knowledge of this plant I regard it as one of the most promising new plants, either as a forage crop or for plowing down.

In Plate II is shown, on the right of the rape patch, the soja beans grown in rows, and on the left the same grown from drilling. The former made at the rate of nearly five tons per acre, as against 7 tons 1,700 pounds from an acre drilled. The latter, however, bore comparatively little seed, and would not have matured what it did bear, while the former bore an average of about sixty-two pods to each plant, each pod containing two or three beans, showing that the thick seeding is justifiable to secure a large yield of forage, but planting in rows and cultivating is essential to secure a crop of mature beans.

#### THE CANADA PEA.

Considerable theorizing has been indulged in with reference to sowing oats and peas together. For lack of space it was impossible to duplicate the experiment on this work, and but three plots were used, one for oats, one for Canada peas and a third for Canada peas and oats. The oats alone were drilled at the rate of two bushels per acre, the peas alone at the same rate, and the peas and oats one bushel of each. All were drilled early in May. All were cut the first week in August, the first peas being nearly ripe and the oats just beginning to turn. The peas produced 4,250 pounds of green forage per acre, the oats 4,950 pounds and the oats and peas mixed 7,400 pounds.

The several lots were fed to the cows in the stable. Of the peas they ate eighty-nine per cent.; of the oats, eighty-six per cent. and of the oats and peas, almost eighty-eight per cent. It is possible that if these had all been free from sand and dirt they would have been cleaned up without any waste.

Judging from appearances, the peas drilled with the oats did not stand up any better than where they were drilled alone.

To have carried this experiment to a more decisive point, the percentage of dry matter should have been carefully determined, for I am confident that the oats alone contained a larger percentage of moisture than the peas, and that the peas and oats together contained a larger percentage of water than either of the others. Both peas and oats were especially relished by the cattle, and if there was any difference the mixture of oats and peas was more palatable than either alone.

Neither peas nor oats have given sufficient yields when grown alone to warrant their use as a forage crop, but where grown together they have given relatively a much higher yield, enough higher to justify further experiment. It should not be overlooked that in peas we are dealing

with a leguminous crop, and like others of their class they act as a nitrogen trap.

#### THE VETCHES.

*Hairy Vetch. (Vicia villosa):* Of this genus of legumes there are a number of species, but few if any of them have succeeded in this country. The particular one under discussion is a native of Russia and was introduced into this country by the Department of Agriculture in 1886. It is a very hardy annual, having remained green during the entire Winter at this Station, where mulched by its own top of last Summer's growth.

To those not familiar with vetches it may be said that they are very similar to peas, bearing slender leaflets, small stalks, small blue flowers and a small seed about the size of a number two shot and almost as round.

A small patch was drilled in the first of June, 1895, seeding at the rate of thirty pounds per acre; the plants were cultivated three times during the two succeeding months. The plants grew slowly, but even in the very dry weather which followed made some growth, and kept a healthful green color for a month after freezing weather set in, or until about the first of January, and as stated above they are at this date (March 20) quite green under the mulch formed from their own growth, showing that the vetch is capable of withstanding the winter of this climate. The greatest objection to this plant is that, when sown alone, it spreads close to the ground, so low that it would be impossible to mow it with a machine.

If corn or oats were planted with it I am of the opinion that this objection would be overcome. It is relished by sheep, horses and cattle, but is regarded as especially adapted to sheep. Like other leguminous plants, it is especially rich in albuminoids. It may be pastured, but I believe will be found more useful as a soiling crop; for this purpose it may be sown with oats, which will hold it up sufficiently to permit cutting with the mowing machine. Its should be cut while in blossom. A given weight of this crop per acre will probably go farther in feeding than the same weight of any other forage crop treated of in this bulletin, for the reason that at the period of growth named it made, during the past season, about 35 per cent. of dry matter. Like other plants of its kind, it is regarded as an excellent crop for green manuring, and from its manner of growth, on account of covering the ground so completely, there is good reason to believe that it is one of the best of the pulse family for this purpose.

This vetch is usually considered a winter variety, but it may be sown in the Autumn or Spring. If in the Spring, the last of April or first

of May. If in the Fall it should be sown early, certainly not after the middle of September.

*Spring Vetch. (Vicia sativa):* This variety is very closely related to the Winter vetch, the habits of growth, color of flowers and general structure are almost identical, but in our experiments, covering a single year, the Spring variety is a failure, while the Winter variety promises well, and is worthy of a more extended trial.

THE FLAT PEA. (*Lathyrus sylvestris.*)

After repeated trials, covering three years, I have about concluded that the flat pea is a flat failure. Upon thin sandy soil where vegetation is sparse and difficult to start, the flat pea may afford a solution to the problem as to how such soil shall be reclaimed and fitted for cultivation. Being perennial in nature, hardy in endurance, and last, but not least, a nitrogen gatherer, fits it especially for thin, sandy soils, where time and patience go hand in hand. But on the relatively fertile soils of Ohio, I doubt if it ever finds a husbandman with sufficient patience to develop such a slow growing legume, while others, equally efficient, can be grown in from one-half to one-fourth as much time.

We have planted the seed the last two years early in May; the first season it was forty days before it could be seen pushing its way through the soil, and last year it required forty-three days to make the same progress. This slow growth seemed excusable, because the seed had an extremely hard outer covering, but in three months of relatively good growing weather during the early summer of 1894, this plant did not make a growth exceeding seven inches, and this, too, on land that made the same season at least forty bushels of corn to the acre.

There are, possibly, within our State, a very few localities where the flat pea might be a valuable plant to grow; but on account of its slow germination and delicate growth the first season, the average farmer cannot afford to spend time and effort with it, so long as he can grow any of the other legumes treated of on the preceding pages. It is possible to have, at the end of three years after planting the seed, a patch of flat pea, but any one expecting to get a stand in a shorter time will be disappointed.

SWEET CLOVER (*Melilotus alba.*)

This is a biennial plant belonging to the clover family; it does not produce any flowers until the second year, after which it matures its seed and dies. It occupies a special place in this great family of plants, growing most luxuriantly on thin and hard-beaten ground. It is easily grown upon the stiffest of clays, is very common on road-sides and other waste

places, where the soil is especially poor and thin, and is ordinarily regarded as a weed; but if sown upon the fields and due care given, it need not be any more harmful or hard to get rid of than an equal area of wheat. If cut down before it ripens its seed, it will not spread, though it will re-seed the ground from year to year if it is not cut in due time. As a forage crop for feeding or for hay, we have not found it of any special value, our cows and horses having refused to eat it either green or dried. But as a green manure and a soil renovator, it has special qualifications, as noted in the following experiment, originally reported in our bulletin No. 42, page 85:

#### WHEAT GROWN AFTER MELILOTUS.

In July, 1888, a piece of very poor clay land was plowed, harrowed and thoroughly prepared, then sown to white Bokhara clover, *Melilotus alba*, using about five pounds of seed on two-fifths of an acre. The melilotus was allowed to grow up and fall down, re-seeding the ground, until the fall of 1891, when one-fourth of an acre of the original patch was plowed up, and at the same time one-fourth of an acre of the same kind of land adjoining was plowed and given the same preparation, after which both pieces were drilled to Poole wheat. The one-fourth acre adjoining had been in corn two years and in oats and wheat one year each, during the four seasons that the other land had been continued in melilotus.

The claim is made that the roots of the melilotus extend down to a depth of several feet, and as they decay rapidly they furnish an outlet for the surplus water, or in other words they act as temporary drains.

The results of this test were as follows: The one-fourth acre in the rotation gave a yield of 18.6 bushels of wheat per acre and 1,524 pounds of straw, while the one-fourth acre following the melilotus gave a yield of 26.9 bushels of grain per acre and 2,606 pounds of straw. The appearance of the two pieces of wheat in April gave evidence of better drainage following the melilotus, and the yield in bushels per acre may have resulted from a better stand in the spring or from the better stand caused by the better condition of the soil.

This experiment alone is not conclusive. Probably the wheat crop would have been increased as much at the end of one year as by four years' growth of melilotus, but it was desired to study the habit of the plant in other respects, especially that of self seeding and continuous growth on the same land, therefore it was left undisturbed until it had demonstrated its ability to maintain itself.

The melilotus should be sown between the first of June and the middle of July, and if the seed is good no difficulty will be experienced in getting a good stand.

#### CRIMSON CLOVER. (*Trifolium incarnatum*.)

This species of clover is known under different names as Crimson, Scarlet, German and Italian clover. It is, perhaps, best known in Ohio as Crimson clover, a name most applicable, because it describes exactly the color of the blossom it bears. It is an annual, growing but one year, or if sown in the spring, lasting less than a year. It has been grown with marked success in Delaware, New Jersey, Maryland and Virginia, and in

some of the southern states. Farther north and west there is yet considerable doubt about its adaptation to soil and climate. Great claims have been made for it, especially by seedsmen and dealers. Like patent medicines, it has been recommended for almost every conceivable purpose possible for any one plant to serve. These claims have doubtless been practically correct within certain limits, but both claims and seed have just as certainly been pushed enthusiastically beyond their latitude. I think it a conservative statement to say that more money has been expended within the last two years in Ohio for crimson clover seed that did the purchaser no good, than for seed which returned him value received. It has been claimed that foreign grown seed was largely responsible for the numerous failures to get a catch; and that many would have had different results had they secured American grown seed. This statement has not been proved, but is a suggestion which the buyer would do well to consider.

It is claimed for crimson clover that it is good for soiling, good as a green manure, good for hay, good for poor land, good for pasture etc. There is certainly no question but these claims are all correct; from the very nature of the plant it must be true, but of what value are these good qualities, unless we can grow the crop.

In July of 1892, about four pounds of seed was sown among the corn on a half acre of ground that had just received its last working. After sowing broadcast the seed was lightly covered by running over it with a brush harrow. The following May a few straggling plants grew and matured seed.

In August, 1893, a second attempt was made with similar results. In August, 1894, one bushel of seed (60 pounds) was sown among our corn as follows: August 1st, 20 rows, 120 rods long, were sown with this clover seed at the rate of 12 pounds per acre. In ten of these rows or spaces the seed was not covered; the other ten were run over with a small harrow. On the 15th of August a like number of rows were treated the same as the above, leaving half without covering and giving the other half a light harrowing. Thirty days later about one fourth of the seed on the two pieces left without covering had germinated. On the two pieces that had received the light covering about two-thirds of the seed had made a nice start, but it grew very slowly, and after the first freeze it began to disappear, and a few days later, when the mercury fell to 16 degrees above zero (Fahrenheit) almost all the crimson clover plants were killed; and although we had considerable snow I could not find on the five acres a single living plant the April following.

In the spring of 1895 two bushels of the seed were secured. On the 17th of May one-tenth acre of soja beans was drilled in, and crimson clover

was sown broadcast and harrowed in on the same plot. On another tenth acre oats were drilled, and crimson clover put in as with the soja beans. The crimson clover grew very nicely on both pieces, but by the first of July the foliage of the soja bean had become so dense that the crimson clover was smothered out, except as a border on the outer edge. A few of these plants, perhaps one hundred or more, are living yet (March 20) and bid fair to get through the winter.

On the oats plot a good stand of the clover was secured, but it was disappointing in that it headed out at an average height of seven inches, this too by the 15th of September, at which time it was plowed down and wheat sown on the plot to test effect of the crimson clover as a green manure. During the first week in September nearly three acres in a young apple orchard were drilled to rye, and crimson clover was sown broadcast and lightly harrowed. An adjoining tomato patch was sown at the same time, each receiving the crimson clover at the rate of 12 pounds per acre. A very severe wind and rain storm followed in a few days, leaving the ground in such condition that neither rye nor clover did much good. There is, however, at this time a light stand of rye, but not a single clover plant to be found. A little later a quarter acre of land was plowed and prepared in a very thorough manner, finishing with a top dressing of yard manure. Crimson clover was sown and the ground lightly harrowed; the seed germinated, but rather late in the fall, so that it did not get a fair start until winter overtook it and froze it out.

In addition to our experience, I have received letters from nine other counties of the state, from which I quote as follows:

S. F. Leyde, Carrollton, Carroll County.—“I sowed alfalfa and crimson clover, both on the farm I sold, and on the one on which I am now living, neither did any good.”

Geo. E. Scott, Mt. Pleasant, Jefferson County, Ohio:—“I sowed the crimson clover last August on potato soil, but it all winter killed, and some sown the year before did the same. Many here have tried in vain to get it to do any good when sown on the last working of corn, and will have to give it up. I don't think I will waste any more time with crimson clover, as it is not adapted to our soil and climate.”

Alva Agee, Cheshire, Gallia County, writes as follows:—“Last May I had two acres of beautiful crimson clover, headed out in the first week of May, about 15 to 18 inches high—rather under than over. It is a great plant to stool. It yields about two-thirds as much hay as red clover, maybe less. I regard it hardy. The trouble is to get it started in time to get rooted well before winter. Too dry Augusts have caused loss of hundreds of dollars worth of seed in southern Ohio. It sprouted and died, or

else did not germinate till late in September, and was not decently rooted for winter.

August is a bad time to get a seeding of anything. If a good fall growth is obtained I regard the plant safe. At Ohio institutes I heard little of success with the plant—too dry in August and fall. I will say in conclusion that the plant is still on trial and not proven a failure.”

M. M. Meisse, Lancaster, Fairfield county, says: “I sowed two bushels of crimson clover last year (1894) about the 1st of August on tomato land; using a Planet Jr. cultivator with scuff shovels to work it in. I sowed too thin, putting only two bushels on twelve acres. The weather following was so dry that it got a very poor stand. It came up well on the low, damp places and stood the winter well. I think that every stalk that sprouted came through the severe winter. I shall sow every inch of ground that I have in cultivation now, that I do not put to winter wheat. I will sow one-fourth bushel to the acre.”

W. P. Wolf, Superintendent of Children's Home, Wilmington, Clinton county, gives his experience as follows: “In August, 1893, I sowed a few bushels of crimson clover seed in corn, but the fall was so very dry that it did not come up well; yet there was enough to do some good as a fertilizer by the time the land was plowed up the next spring. About the first of August, last year (1894), I sowed one and a half acres among mangel wurzels. The seed did not get evenly distributed, owing to the foliage of the beets, yet I had a nice piece of clover, notwithstanding the dry summer. I also sowed a few acres among corn; part of this yielded abundantly and some was about a half crop. I cut a little of it for hay, to see the quality and note how it would be relished by stock. The hay is fine and the stock like it. I plowed under most of what I raised for fertilizer, planting the ground in corn and potatoes. What I sow among corn this year I will go over with a small-tooth cultivator (14 teeth), as I am sure the seed should be in some way covered.”

C. W. Horr, Wellington, Lorain county, sowed crimson clover on black land in June, 1895; in reporting upon it, Mr. Horr says: “Crimson clover did not amount to anything, it was too dry for it.”

Hiram E. Batterson, Pulaski, Williams county: ‘In my opinion crimson clover needs a warmer climate and one less subject to drouth.’”

Dr. W. W. Crane, Tippecanoe City, Miami county: “The first week in July, 1894. I sowed fifteen acres in corn. On the 16th we had a very good rain, and by the 21st there was a good showing of plants; after that, expected and needed rains did not follow, and the plants gradually perished, so that by winter only a few remained, and they were weaklings which perished before May. On July 16, 1895, I sowed again in corn, but drouth continuing we never had a good stand and now we have none.

"My belief is that if the plants go into winter in plentiful supply and of good size they will come through about as safely as spring sowed clover. Some evidence of this was shown in the field I sowed in 1894. The canal runs along one side of the field, and for several rods near it the ground was somewhat damper than elsewhere; for a few rods out the clover did fairly well, and on this small part there was a stand the following April that would have been satisfactory, if the whole field had done as well.

"About twenty years ago I sowed a field in common red clover, just after we laid our corn by, which came up promptly, grew well in the fall and came through the winter in splendid shape; by the middle of May every corn stub was hidden and in June we cut a good crop of clover. I then thought the clover problem for us was solved. We repeated the sowing the following July. The first of May following we found one clover stalk standing and no more.

"My conclusions are that if the conditions are all favorable, summer sowing of clover will prove satisfactory, but the further conclusion is that the conditions are too uncertain in our valley for great encouragement in this line of seeding. In fact, the almost certainty of a drouth in August and early September, foretells failure in a majority of years."

A. E. Wildman, Selma, Clark county: "In August, 1894, I carefully prepared three acres of potato land and sowed to crimson clover, at the rate of one peck per acre. I sowed the seed broadcast and covered with a smoothing harrow. The land sown was partly loose black land and partly heavy clay.

"Notwithstanding the dry weather, the seed germinated and came up nicely, making a good growth before winter. At the beginning of winter the plants had roots from four to six inches long and foliage that almost covered the ground.

"From early winter until about the middle of February the plants were well protected by snow. During the next six weeks there were several hard freezes while the ground was bare, and by April 1st two-thirds of the plants were killed. The damage from freezing was greatest in black land and least on the slope where black and clay were blended. In September, 1895, I sowed one-half bushel of seed on two acres of land, from which potatoes had been harvested. On account of extreme drouth not more than one-third came up; this made a very poor, indifferent growth, and at this writing, March 23, practically all has disappeared."

*Season for seeding, habits of growth etc.*:—From the results of our experiments I have reason to believe that seeding in May or June is most likely to result in an early, rapid growth, followed by premature blossoming, and an early decay of plant life. Seeding in July will possibly give the



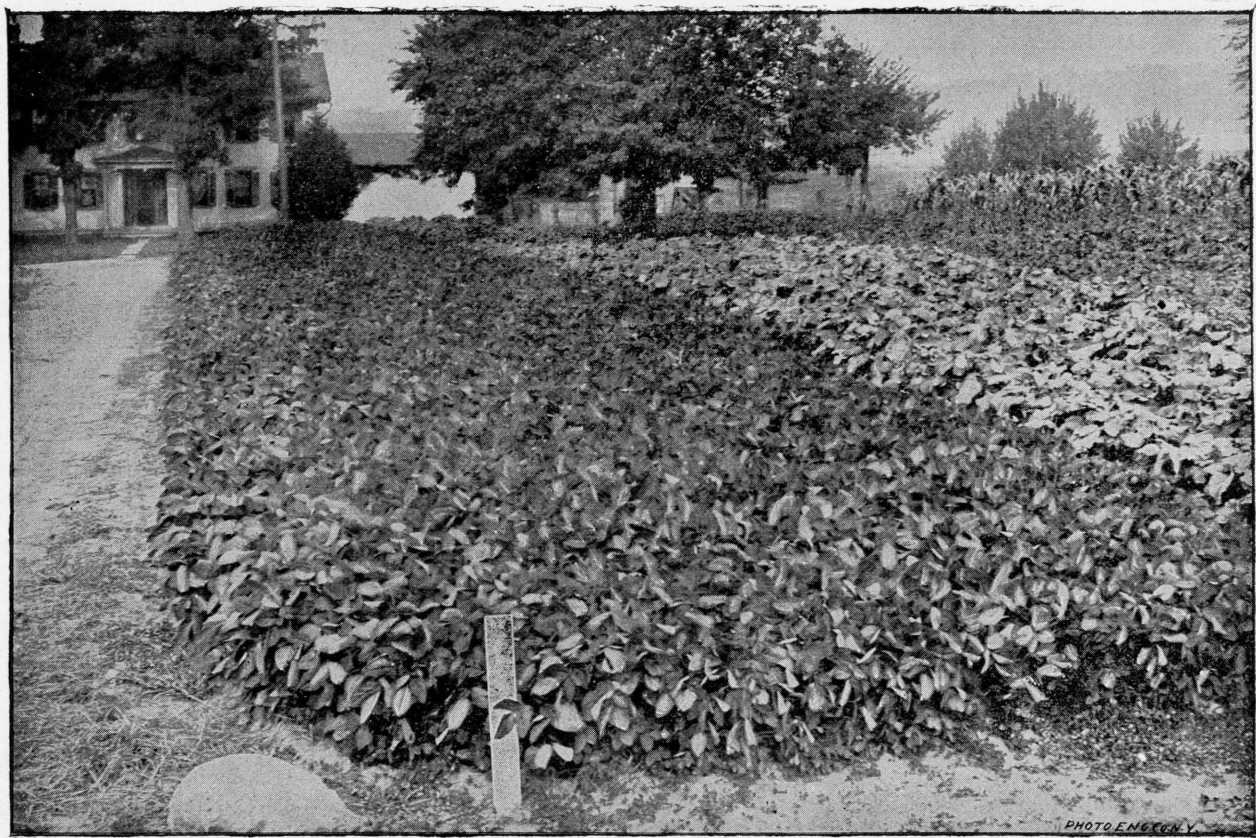


PLATE I.—THE LOJA BEAN.

This page intentionally blank.



PLATE II.—RAPE,

This page intentionally blank.



PLATE III.—OHIO'S GREATEST FORAGE CROP.

This page intentionally blank.



PLATE IV.—CORN, FOLLOWING RAPE.

This page intentionally blank.



plants sufficient strength to pass through our winters, but later seeding is almost certain to fail in this latitude, except under the most favorable circumstances. As the seed is larger than ordinary, or red clover seed, it is best to sow not less than twelve pounds per acre.

It is a rapid grower, but has a very weak stalk, nearly always assuming, when in blossom, a decumbent position. It is remarkable for its "stooling" habit, and prolific flowering capacity, which is not so marked in early or spring seeding as in the midsummer or early fall seeding, and not so marked when sown with another crop, like oats or Soja beans, as when sown with corn or alone. I have found a number of plants bearing from thirty to thirty-seven stems, and none less than seven, and I find that the plants average fully one-third more blossoms than stems, the surplus blossoms coming from branches of main stems. This fact indicates the possibility of securing a fair stand, even when only a very small percentage of the seeds grow, or a relatively small proportion of the plants survive the winter.

Since crimson clover is a catch crop, and has done best here when sown in the spring, it may be of special service to sow on bare or weedy spots in meadows, on which, if it should succeed in even shading the ground during the summer and attracting nitrogen, it would be adding fertility to our soils, whereas weeds would be abstracting it.

#### THE RELATION OF LEGUMINOUS PLANTS TO SOIL FERTILITY.

The family of forage crops which have been considered in the foregoing pages constitute a class that should have special consideration. For, in addition to their use as feed, they may also be used advantageously as green manure, in which case the condition of the soil is better after growing the crop than before. There is, of course, a wide variation, even in this class of plants, as to their value for green manure, but the growing of any one of them upon a piece of land leaves it in improved condition. Examination of the roots of many species of this family has revealed the presence of nodular or gall like appendages, known in modern agriculture as root tubercules. Much time and study has been expended on these peculiar formations, until it is now generally agreed that they are not products of these plants, but that they are formed under the influence of micro-organisms. It has been clearly shown that leguminous plants have access to stores of nitrogen beyond the reach of other cultivated plants, and there is no longer doubt that there is a connection between these micro-organisms, the root galls, and the accumulation of nitrogen by the leguminous plants. These discoveries are of untold value to the cause of agriculture, and show how it is possible to add nitrogen to

our soils in the most simple and least expensive way. Certainly the liberal use of leguminous crops cannot be too strongly urged.

#### GRAMINEOUS FORAGE CROPS.

Under this general head several species of the grass family, ordinarily used for fodder, will be treated in the following order: Corn, Brazilian Flour Corn, Kaffir Corn, Millo Maize, Jerusalem Corn, Teosinte and different varieties of Millet.

*Corn. (Zea mays.)* This is so well and widely known that it is not necessary to say anything regarding its cultivation in this connection. It is so common however, and so easily grown in this climate, that we are apt to underestimate its true value. Without going into details I venture to say that Ohio today could better afford to dispense with all other forage crops named in this bulletin than to do without corn, the greatest of all.

No one crop will produce more forage in this State today than corn, and none can be raised with less trouble or less expense. No crop planted in the spring will bring any earlier or better forage. It can be planted so as to furnish a green crop continuously, from the first of July until frost kills it, and from that time until the next July it can be preserved in the silo, furnishing a forage crop continuously from season to season and from year to year. It has furnished the only source of rough feed (in the form of silage and dry fodder) for the stock of this Station since the first of January, including twelve horses and more than forty cattle. Neither cattle nor horses, except those under one year old, have had any hay since the first of January, and for about seventy-five sheep silage has been more than half the rough forage. These sheep are today eating on an average nearly four pounds apiece of silage per day, silage too, that was put into the silo two years and a half ago, but is coming out just as green and fresh as that taken from the same silo two years ago, with no more waste than if it had been taken out then.

Few if any of the forage crops will produce more per acre on all kinds of soil than corn. Plate III represents a field of ensilage corn on this farm, as it appeared the first week in September, 1895, and which gave an average yield of twelve and three-fourths tons per acre, on only moderately good land that had had two cultivated crops taken off just before being planted to corn. Other forage crops may be grown to give variety and to balance up a one sided ration, but the indications are that corn after all will continue to stand at the head of the forage crops grown in this State.

*Brazilian flour corn:* This is simply a variety of maize which is very prolific in suckers, and yields a large proportion of leaves. The grain is white and makes a good meal for house use. Its yield at this

Station, while at Columbus in 1891, was 22.6 bushels per acre, while the standard varieties gave the following yields per acre: Clarage 55.1 bushels; Leaming 65.1, and Hess' White 64.2 bushels. By some the Brazilian flour corn has been thought to be well adapted for ensilage purposes on account of the numerous suckers and abundant leaf growth, but like many other fodder plants it is at its best further south, and is not sufficiently hardy for Ohio soil and climate; in short, it does not mature.

*Kaffir corn*: At least two varieties, the white and red, are pretty well known. They are in general appearance quite similar, and belong to a class of non-saccharine sorghums. The red variety, on the Station farm, has grown taller and more slender than the white. Both varieties produce a large number of leaves in proportion to the height of the stalks.

These are branching, each bearing a number of heads having much the same appearance as sorghum. The heads bear grains very similar to sorghum seed; the red variety bearing red and the white variety white seeds. It is recommended very highly and is exciting considerable inquiry this year. Our experience with it at the Station does not justify the conclusions reached by growers farther west and south.

Several efforts have been made to grow it in a small way in different seasons. We have had a very fair stand of both the red and white varieties, but have not in one year out of five had it to mature. Last fall, the white variety gave a yield of eight tons 1160 pounds of forage per acre and the red variety eight tons 620 pounds per acre; neither of these has afforded a second cutting, in this climate.

Where the soil and climate are adapted to these plants they are expected to furnish from two to four cuttings each summer, or mature from thirty to fifty bushels of seed per acre. The seed, when ground, makes a meal very similar to corn meal in feeding value.

Our dairy cows ate the stalks, leaves and immature seed with considerable relish, though they were certainly no more fond of it than they were of ordinary corn.

*Millo maize*: Very much like Kaffir corn, but has made a less vigorous growth, and does not seem as hardy; about half way up the stalk and on the top branches or shoots start out and bear numerous leaves and heads like the main stalks. We have grown single stalks bearing eleven heads, varying in weight from one-fourth to three-fourths of a pound each. Our crop last year made at the rate of eight tons 320 pounds per acre of green forage, but, like the Kaffir corn, it failed to mature. There are a number of varieties, but we have not experimented with any except the yellow Millo maize.

*Jerusalem corn*, like Kaffir corn and Millo maize, belongs to the class of non saccharine sorghums. It does not grow to exceed three feet high,

and produces from a single stalk from two to four branches, which start out from the main stalk within a foot of the base; these all bear heads of grain, which stand more or less erect, while the head on the parent stalk turns completely over and matures with its top pointing to the ground. The grain or berry is almost pure white and nearly flat.

*Teosinte:* This is a South American plant, and like our Indian corn bears pistillate and staminate flowers on the same stalk. It bears its grain in a husk; the ears grow from the top joint, bearing grains almost triangular in shape and diminishing in size from the base of the ear upwards. I know of no plant grown that suckers so abundantly. In a climate to which it is adapted it is expected to stand two to four cuttings each season, and doubtless produces large yields of green forage. It grows from three to seven feet high.

The five plants, Brazilian flour corn, Kaffir corn, Millo maize, Jerusalem corn and Teosinte are very closely related, and require very similar treatment. All should be planted in rows from three to four feet apart, with from one to two grains in hills eighteen inches apart in the rows. If every seed would grow one stalk in each hill twelve inches apart would be ample, but in our experience we have found the young plants much more easily disturbed than our common corn, and the process of thinning not an advisable one to undertake, especially if the ground is a little dry. In general appearance and condition, these plants are somewhat like the plants of sorghum, being smaller and more delicate during the first few weeks of their growth than corn plants of equal age; for this reason they require more skill and care to bring them through the first six weeks' growth. Like sorghum plants they are likely to need some hand work to keep them free from weeds.

When once started they require about as much care as Indian corn.

To seed an acre it will take about as much Brazilian flour corn as to seed an acre of Indian corn. Of the other four plants named from three to five pounds of good seed will be ample for an acre. I emphasize especially the matter of good seed for the reason that in the last three years less than fifty per cent. of the seed we have planted grew. Drawing the conclusion from personal experience I am clearly of the opinion that Ohio farmers will be better off to leave all of this class alone except our Indian corn.

*Millets:* Under this general head will be taken up the several varieties of grass known as millet, including Hungarian grass, common millet, German millet, Japanese and Russian millet

The first of these is as much a millet as any of the others, but is more commonly known as Hungarian grass. It starts out several stems from each root; these are slender and inclined to branch, the leaves are narrow,

grow erect and are of a dark green color. The seed is oval and mixed in color, some being yellow, others dark or almost purple. This variation in color of seed is one of the most marked characteristics of the Hungarian millet and by this peculiarity it can be told from other varieties. An occasional dark seed will be found in other varieties, but up to date I have not found as much as two per cent. in any variety except the Hungarian, and the varieties of *Panicum miliaceum* in which all the seeds are dark; the common name under which these are known is broom-corn millet.

*Hungarian grass* requires a shorter period for its growth than any others tried at this Station, maturing at least two weeks earlier than either the common or German millets. The head of the Hungarian usually stands erect until the seed is ripe, after which it will turn down, very much as a head of wheat does when not cut until dead ripe.

*Common millet* differs from Hungarian in having yellow tinged, brown, oval seeds, and does not incline to branch; the heads turn over soon after they are formed and are from two to three times as large as the heads of Hungarian grass; it does not mature until a week or ten days later than the Hungarian.

*German millet* generally carries but a single stem from each root; these are large but not branching, the leaves are broader than in either of the above varieties, the heads are an inch or more in diameter and five to six inches long, made up of clustered branches bearing purplish awns; the seeds are more round than oval and are yellow or golden, while the common millet seed is yellowish brown.

*Japanese millet*: This variety was originally imported by the Massachusetts Agricultural College from Japan. The seed used at this Station was secured from the Massachusetts Station. The first year's experience did not seem to commend it, as it made a very feeble start and seemed more delicate than our other varieties; the young plants were of a peculiar purple color and remained so until nearly mature. The leaves were upright growers, but less abundant than on some of the other varieties. It did not mature as early as the German millet, nor produce as much foliage.

*Russian millet, hog millet and broom-corn millet* are synonymous; all three were grown together and it would have been impossible for an expert to distinguish one from the other.

It has an advantage in maturing earlier than any other varieties herein treated. It has not grown more than two feet high in any of our tests at this Station, and the stem is literally covered with hairy projections, standing at right angles to the main stalk. I do not regard it as

at all promising for Ohio soil, but believe it is much better adapted to a more northerly climate, where the seasons are short.

*Soil and preparation for the millets:* Millet will grow on a moderately fertile soil but does best on a warm, gravelly, strong land. This should be well plowed, thoroughly harrowed and free from clods. The seed should not be sown earlier than the first of June, or until after the ground is well warmed. These grasses are natives of warm countries, and require a warm soil to insure best development. For forage or hay at least three pecks of seed should be sown to the acre; for seed one-half bushel to the acre is plenty. If sown thick it grows a finer stalk which makes better hay than when grown more sparsely. After sowing the seed, which may be done by spreading it broadcast, the ground should be lightly harrowed or run over with a drag to cover the seed.

The crop will not need further attention until cutting time. Should it be wanted for soiling purposes it will probably do to cut in about sixty days from time of sowing.

*Time to cut and method of making hay:* If it is intended for hay it should be cut before the seed matures. I believe it is better to cut as soon as the blossom goes off; the stalks will be less woody, and therefore more palatable. Hungarian and other millets are ordinarily regarded as hard to cure into hay. This I think is more due to the season than to the plant. At the time of cutting and curing millet, the days are shorter, the sun has less force, and the ground is usually more dewy than in mid-summer when other hay is made. In addition to these, millet is cut when greener than other crops intended for hay, and if good produces more tons per acre, and for this reason lies thicker on the ground, which only adds to the complication of causes for its being harder to cure than other grasses.

After cutting, if the weather is fair, it should be allowed to wilt for a few hours, then use the tedder two or three times, after which the partly cured hay should be thrown into cock and allowed to stand two or three days, then opened out and well aired, after which it may be hauled in and stored in the mow. Should the millet be allowed to dry on the ground the leaves become hard and more brittle than when it is sweat cured. When well cured and housed, millet makes a most excellent substitute for hay, especially for cattle. Our cattle when fed on it for two months continuously, with no other rough feed except silage, did as well apparently as if they had been eating timothy hay or corn fodder. For horses it makes a good feed and they are fond of it, but if it is allowed to ripen its seed, or even mature it sufficiently so that it would grow, horses as a rule will not do so well on it as they will on timothy hay.

The indications are that the matured millet contains a diuretic principle that causes a too free action of the kidneys. It does not act as quickly upon some horses as others; in fact, we have horses that could seemingly subsist on millet from month to month without being in the least affected, but others in the same stable, after eating millet two weeks continuously, are frequently seen standing in position attempting to urinate for five or ten minutes at a time.

*General remarks:* Millet is a surface feeder and is undoubtedly hard on the land. It is a good crop to clean land, as few weeds can grow with it. It is a good catch crop, because it can be put in after it is too late to grow a crop of corn and cure it. Millet may be sown after a crop of early potatoes or after taking off a crop of clover, and a fair crop be realized. When the grass crop is likely to be short there is nothing that can be grown in this latitude which is likely to give better satisfaction or a more certain return than millet. In seasons when other crops promise to be short it is recommended as the best and most reliable substitute to aid in tiding over after a short hay crop. The Hungarian millet may be sown with reasonable safety as late as the 10th to 15th of July, but German millet should not be sown in this latitude after the first of July. In Southern Ohio about one week to ten days may be safely added to the above dates. These are given as the extreme dates. Early June sowing is advised when at all possible for the reason that the grower is apt to have better weather to cure the hay than if sown later.

Early in June, 1895, finding that our hay crop would inevitably be a light one, we plowed up and sowed about twenty-five acres to millet. On most of this we sowed the German millet, because from former work, we had found it a superior variety, because it gave higher yields than other varieties tested. By way of experiment, one piece was sown to different varieties on the 20th of June, and gave returns when cut as shown in the table below:

MILLET—YIELDS IN 1888 AND 1895.

| Variety.                      | Tons per acre. |       |
|-------------------------------|----------------|-------|
|                               | 1895.          | 1888. |
| Common millet.....            | .....          | 3.70  |
| German millet.....            | 2.70           | 7.00  |
| Hungarian (grass) millet..... | .85            | ..... |
| Broom corn millet.....        | .61            | ..... |
| Japanese millet.....          | 1.25           | ..... |

The second column is included to show the difference between the amount of millet grown in a normal season on a good soil and the same variety grown in an abnormally dry season and on a rather thin soil, (The crop of 1888 was grown on second bottom land at Columbus and the crop of 1895 on a thin soil of only moderate fertility.)

#### MISCELLANEOUS FORAGE PLANTS.

Under each of the two preceding heads have been grouped a series of forage crops, having some general characteristics in common. Under this, the third and last section, we have a few plants that have claimed more or less attention as forage crops. These are Rape, Sacaline and Spurrey.

*Rape*: The first of these, rape, belongs to the same family of plants as cabbage, mustard, turnips and rutabagas. In the early stages of its growth it resembles the turnip very much. It has only been within the last few years that this plant has been grown in this country. It has been grown in Canada as a feed for sheep for a number of years, and only within recent years has been introduced into the States for the same purpose. It is therefore only in an experimental stage in this country. Like some of the other forage plants, it may be termed a catch crop. It may be planted almost any time after the first of May, on until the first of August.

Sown any time within the three months above noted, rape will give a fair yield. The earlier seeding, it may be noted, will grow much more slowly the first few weeks than if planted after the first of July, but owing to the wide range of time in which the seed may be started it is possible to have green rape, as a pasture or as a soiling crop, from the first of July until the first of December, or nearly so, for the reason that unlike other forage plants, thus far considered, moderate frost does not injure it, and it will bear pasturing or cutting until the thermometer gets down several degrees below the freezing point. It may be sown broadcast and lightly harrowed in, but it will give as large, if not larger yields, when planted or drilled in rows about thirty inches apart and cultivated, giving only surface cultivation. This last method is recommended for the earlier planting; that planted after the first of July will, in ordinary seasons, do quite as well sown broadcast.

On the 17th of May, 1895, a patch of the Dwarf Essex Rape was planted in drills on the Station farm. It came up very nicely in about ten days, but grew rather slowly until the last two weeks in June, after which it grew much more rapidly, reaching an average height of about four feet by the middle of August. At this stage we began cutting and feeding it to some of our sheep in the barn. They ate it with a relish,



leaving no part of stem nor leaf. This patch netted a yield of twelve tons and 1,700 pounds per acre. After this was cut off, it immediately started up a second growth, and in about thirty days the second growth has reached an average height of eighteen inches. This was cut down and fed. A third crop started and grew nicely until the mercury reached about twenty degrees above zero, which seemed to kill all the vitality in it. This rape patch is pictured in Plate II.

About the 1st of July we cleaned off a small patch which had been sown to cowpeas, sowed it to rape and harrowed it lightly to cover the seed; in three weeks from date of planting, it had almost hidden the ground, showing a very much more rapid growth than when planted earlier. Our sheep were very fond of it and did well while feeding on it.

If pastured upon the rape patch, sheep, when first turned in, or rather after they get to eating nicely, should not be turned in when very hungry or when the rape is wet, as they may over-eat and suffer from indigestion, or they may die from bloating. There is also some danger of them purging at first. If they have access to an old pasture when first turned on the rape, it will be very effective in preventing scours, as well as other disorders likely to arise from impaired digestion. If the first few days are passed without trouble, it will not be necessary to remove the sheep from the patch, but it will always be judicious to look after them frequently. A serious objection to the rape plant is that it is liable to be attacked with the cabbage aphid. This little pest is capable of destroying a whole field within a very short time.

A greater objection to the crop is the rapidity with which it depletes the soil. Plate IV represents this more clearly than words can tell. The four or five rows of corn, shown in the middle foreground, are of the same varieties as the corn on the left and right; plowing, harrowing, cultivation, time of seeding, etc., were the same for all the corn shown on the plate, the only difference being that the light rows of corn are growing after a rape crop of the year before and the corn of normal size after corn. This test will be followed up this season by growing oats where the corn was and another patch of corn after a patch of rape, similar to the experiment of 1895. Should future experiments give results similar to those already obtained, it will make the growing of rape a very doubtful quantity.\*

Were it not for the two objections, which are only tentative, rape might well be regarded as a new forage crop of more than passing value.

---

\* The later months of 1894 and the earlier part of 1895 was a period of abnormal drouth, and it is possible that the effect shown was due simply to exhaustion of the water supply in the soil. Whether this is the true explanation, or whether it was due to actual depletion of soil fertility, remains for further investigation to decide. It is true, however, that plants of the rape family draw enormously on the mineral constituents of soil fertility.

*Sacaline*: This plant belongs to the buckwheat family. It is one of the most recently introduced forage plants, and has been most extravagantly praised in the catalogues of several seedsmen during the last two years. An effort was made to grow it in the spring and summer of 1894, and on account of the great claims made for it special pains were taken to get it started, that the record for it might be confirmed; but like the flat pea spoken of on a preceding page, I found it a very slow and discouraging grower. It was carried far enough and studied over sufficient time to find that it would require more time, pains and means to secure a crop, than the average farmer would give. From the experience gained I believe it could not be started on a ten acre field short of two years time, and then only after spending a great amount of money and labor for a return which, to say the least, would be of doubtful utility.

*Spurrey*: Several letters have been received, asking about spurrey and its adaptability to Ohio soils. Two years ago it was given a trial. It was found that the seeds germinate very quickly and that it made a very slow growth after starting. It failed to make any appreciable growth during the first summer. In the spring of 1894 it was tried again, but the results were very much the same as those of the year previous. It is certainly not adapted to clay soils. Indeed this could hardly be expected, since it is known as the "clover of sandy soils," but it is not a clover, belonging to the pink family.

#### SUMMARY.

1. (a) *Alfalfa* is well adapted to soils having an open or porous sub-soil. Upon such, after it is once established, it furnishes a large supply of forage.

(b) The most discouraging feature of this plant is the difficulty of getting it started.

(c) It will not give sufficient growth the first year to warrant pasturing or cutting for forage, or for soiling purposes.

(d) It is not adapted to any system of rotation, but should be sown on land where it may remain for a series of years, which it will do, if properly cared for.

(e) For soiling purposes, or for hay, it should be cut when it begins to blossom; if left much longer it becomes woody and less digestible.

(f) It should not be pastured while wet, nor fed in the stable without wilting, otherwise there is danger of the animals bloating.

(g) *Alfalfa* is not recommended indiscriminately for Ohio soils, though it will doubtless do well in some sections and on some soils. It is likely to give the best results on lands having open or porous sub-soils.

It is certainly well worth experimenting with in a small way, as it is a most excellent forage crop where it can be successfully grown.

2. (a) *Cowpeas*, according to experiments thus far made, are not regarded as a success so far north, at least for forage crop purposes.

(b) They are recommended for impoverished land as a means of getting vegetable matter into the soil, and there is a possibility that in this capacity they may prove a superior crop.

(c) There are a number of varieties, but only one tested thus far that will mature seed in this latitude, namely: the Black pea.

3. (a) *The soja bean* is one of the most promising new forage crops grown at this Station. It makes a very good yield per acre, is a hardy, rapid grower, makes a relatively good soiling crop, and promises well as a green manure.

(b) Of the two varieties (black and green) the former is considered the more prolific yielder and the only one maturing seed in this latitude; but for hay, the green is perhaps the better, on account of not shedding its leaves so easily.

(c) For forage purposes they give best results when put in with the grain drill, but to grow seed and mature it they should be put in in rows and cultivated the same as corn or potatoes.

4. (a) *Canada peas* and oats, in the single experiment conducted last year, did better when drilled together than when either peas or oats were drilled alone, and apparently were preferred by the cattle when mixed.

5. (a) *Hairy vetch* has made a good growth during the past year, and has shown itself sufficiently hardy to withstand the past winter.

(b) On account of its growing so close to the ground it is recommended to sow oats or plant corn with it.

(c) The hairy vetch is a promising plant, though not sufficiently tested to recommend for general use. The spring vetch (*Vicia sativa*) has been a failure so far as tried.

6. (a) *The flat pea (Lathyrus sylvestris)* requires at least two years to get started, with many chances of failure intervening. In this age of progress Ohio farmers cannot afford to spend time nor means in attempting to grow it.

7. (a) *Sweet clover* is especially adapted to heavy clay lands or to waste places, where many other plants would refuse to grow.

(b) It is not relished by cattle or horses, and is not recommended as a soiling crop, but as a green manure and as possibly furnishing temporary drainage.

8. (a) *Crimson clover* on Ohio soils has been proven to be more

tender than the little red clover, as the reports from ten counties of the State go to show.

(b) Midsummer sowing is recommended, for the reason that early or spring seeding is followed by an extremely short growth. Sowing after the first of August, north of the fortieth parallel, does not give the plant sufficient start to enable it to endure the winter.

(c) There is considerable doubt about the vitality of foreign seed or its adaptability to our soils. Purchasers are recommended to secure American grown seed if possible, even at a greater cost.

(d) It is at best a doubtful crop, reasonably so from the very fact that few plants of any kind will grow and make a crop from seed sown in midsummer.

(e) All tests so far reported north of the fortieth parallel have been failures or nearly so, while many south of that line have indicated like results.

*Brazilian flour corn, Kaffir corn, Millo maize, Jerusalem corn and Teosinte* have thus far, from their manner of growth and crops produced, shown that they are not adapted to the climate and soils of Ohio.

*Indian corn*: The ease with which it is grown, the season or time in which it can be produced ready for soiling, the various forms and conditions in which it can be used, and its general adaptability to Ohio soils and climate, and as a feed for various kinds of live stock, commend it as the first and foremost of all forage crops grown in Ohio up to date.

*Millets*: On account of the short season required for their growth and their general fitness as a substitute for hay, are recommended as a catch crop in seasons when other hay promises to be a failure.

Of the several varieties grown in our experiments thus far, but two have sufficient merit to commend them for general use. These are Hungarian (grass) millet and the German millet. The former is preferable when sowing after the season is far advanced, the German millet has proven to be decidedly superior to all others when it can be sown previous to the middle of June.

*Japanese millet* has been an indifferent grower, seeming to lack in hardiness and on our soil has required a longer season than our climate insures.

*Hog millet, Russian millet and Broom-corn millet* are synonymous and the variety is too coarse and woody to make a popular feed. Furthermore it has not been a productive sort.

*Rape*, so far as tested, has proven to be a good forage crop. It is not especially hard to grow and produces a large yield of succulent forage, adapted to sheep feeding. Sheep are very fond of it, and do well when fed on it.

The Dwarf Essex rape is the only variety recommended for use in this State.

It may be sown on well prepared ground, any time between the first of May and the first of August. Early sowing may be expected to give a slow growth and later sowing a more rapid growth.

It bears pasturing or repeated cutting until cold freezing weather destroys it.

It is very liable to be attacked and destroyed by the cabbage aphid.

It appears to deplete soils very rapidly. This, however, is a tentative opinion and may be confirmed or disproved by further experiment.

*Sacaline* is extremely hard to grow and requires at least two years to get a fair start. It is not recommended.

*Spurrey* is a recognized forage plant for sandy soils, but does not seem adapted to our clay soils. It makes a slow and uncertain growth.

---

This page intentionally blank.

This page intentionally blank.

This page intentionally blank.