

CIRCULAR OF INFORMATION, NO. 6.

University of the State of Missouri

COLLEGE OF AGRICULTURE AND MECHANIC ARTS.

AGRICULTURAL EXPERIMENT STATION.

COLUMBIA, MISSOURI, APRIL 10, 1898.

CLOVER AND COW-PEAS;

Their Value as Green Manure Crops and Methods
of Growing.



JEFFERSON CITY, MO.:

TRIBUNE PRINTING COMPANY, STATE PRINTERS AND BINDERS.

1898.

CLOVER AND COW-PEAS AS FERTILIZERS.

The greatest waste occurring on Missouri farmers to-day is the waste of soil fertility. This is brought about in several ways: First, by the continued selling off the farm of crops containing large quantities of plant-food—such as corn, wheat, oats, hay, etc. Oftentimes the plant-food, or soil fertility contained in these crops, is worth half what the crop brings on the market. Second, by allowing most of the manure produced from the stock on the farm to go to waste. The live-stock interests of Missouri are large, and much of the grain and forage produced is consumed on the farm where grown, but is handled in such a way as to return but a small proportion of the valuable elements of plant-food to the soil. Third, the fields are allowed to remain bare and subjected to washing by rains and loss through leaching, etc., during a considerable portion of the year. In many sections of the State the soil is beginning to show the effect of these wastes of fertility. To determine the best and cheapest means of saving the present fertility of the soil and of renovating those lands which have ceased to yield satisfactory returns, constitutes one of the most serious and at the same time one of the most important problems now engaging the attention of the State.

Many farmers are seeking relief through the purchase of commercial fertilizers, such as ground bone, tankage, etc. In many instances these commercial fertilizers are used profitably, but in general it may be safely asserted that it will not be profitable to grow our staple crops with commercial fertilizers, and allow fully three-fourths of all the farm manure to go to waste.

Every land-owner ought to be as much interested in keeping up the fertility of his soil as he is in maintaining the excellence of his cattle, horses and sheep, or in keeping his deposit in the bank undiminished. Strictly speaking, it is not the land that constitutes his capital, but it is the amount of plant-food contained in that land.

THE CHEAPEST WAY TO RENOVATE SOILS.

The first thing to be done in attempting to renew worn-out land or to stop the decline in productiveness of any land is to return to the soil in the form of manure as much as possible of the plant-food removed from it in the form of crops. This necessarily involves the careful saving and proper application of all animal manure produced on the farm. It further involves the use of good judgment in the kind of crops to sell off the farm. It involves the stopping of the practice of burning the corn-stalks, straw and such refuse matter; it involves the saving of wood-ashes produced on the farm; it involves the judicious and liberal use of such green manure crops as clover and cow-peas.

The heaviest loss of farm manures occurs from faulty methods of feeding. A large proportion of the live-stock of the State is fed in the open air. The feed lots are usually located on the most rolling ground on the farm and oftentimes either on stony land or along ravines. A large portion of the fertilizing material contained in the droppings is carried away by the rains and entirely lost to the farm, and what remains is scattered over so wide an area that it is not usually found profitable to collect and haul it to the fields. In many cases these feed lots are not susceptible of cultivation, either on account of the presence of stones, stumps, etc., or on account of their liability to wash into gullies. The grass in them is tramped to death by the stock or smothered by the manure and refuse coarse feed so that they produce nothing in summer when the stock are at pasture, or produce worse than nothing—a luxuriant growth of weeds, in which rabbits, mice and various injurious insects multiply and harbor to become a menace to the farm, garden and orchard crops.

A great improvement could be made by selecting some knoll or rolling spot convenient to the food supply and to the house, but removed from ravines or water courses, so that the surface drainage from the lot would spread over valuable land. It would also be an improvement to confine the stock to a smaller area so that the droppings and litter could be easily loaded into wagons or manure spreaders and hauled to the field. With dehorned cattle this plan is entirely practicable. The refuse straw and corn-stalks would soon accumulate in sufficient quantities to keep the lot comparatively dry and free from mud.

A better plan would be to build cheap sheds, open to the south, in which to feed the stock. The increased value of the manure would

in a few years pay for the shed, leaving the advantage of shelter to the stock as a profit.

Better than the sheds would be good barns in which the food, live-stock and manure may be sheltered.

Another common mistake which causes the loss of large quantities of manure is the leaving of shade trees along the ravines or on the rocky points in the pastures. The animals, in warm weather, spend considerable time under these trees, and at the end of the season a large quantity of manure has been deposited where it can not be conveniently hauled back to the pasture, and where the rains will most readily carry it away.

Locate the sheds already referred to so that they may be utilized for shelter against the summer heat as well as the winter storms. By making these sheds square and having the north wall built in sections so that it may be removed in summer, they will prove more satisfactory as summer shelter, and will more effectually protect the animals against flies than will shade trees. The droppings under the shed are safe against loss from leaching until it is convenient for the farmer to spread them on his fields. The manure that accumulates under these sheds in winter is packed so closely by the continued tramping of the animals that fermentation is to a large extent prevented, and it may be hauled out at the owner's convenience.

Manure made from animals at pasture is valuable, and should be as carefully conserved as that made in the barn. This difficulty can be remedied by leaving the shade trees on the level land away from the ravines and water-courses, or better, the sheds already referred to.

It is too often the case that a large waste of the fertilizing constituents of farm manures is allowed to occur even when suitable barns or sheds have been provided. The common methods of storing the manure under the eaves of the barn or shed for several months usually results in a loss of one-third or more of its value by leaching. Moreover, the materials thus leached out are the most soluble and, therefore, the most available portions of the manure. All three of the valuable elements, viz., nitrogen, phosphoric acid and potash, are affected by this leaching process.

Another way in which the value of stable manure, especially horse manure, is frequently diminished is by too rapid fermentation, or by fermentation without sufficient moisture. Only the nitrogen is lost in this way. A strong odor coming from the manure heap indicates that wasteful fermentation is taking place.

Both of these difficulties, losses from leaching and improper fermentation, may be easily remedied by hauling the manure direct from the barn to the field and spreading it. Nothing is added to manure by fermentation or rotting, and much is likely to be taken away by these processes. For the common farm crops, such as corn, wheat, oats, grass, etc., the unfermented manure, fresh from the barn, will, in the end, give better returns at less cost for handling, etc., than will manure that is allowed to stand for some time in small piles in the barnyard and afterward composted or rotted in the open air. It is true that the nitrogen, phosphoric acid and potash in fermented or rotted manure are more easily and readily available to the plants to which it is applied, but these constituents in fresh manure will be made available in a short time by the fermentive processes going on in the soil. This difference in availability is not sufficient to compensate for the losses that are likely to occur in composting or rotting, nor to pay for the extra labor involved.

The foregoing statements are not intended to apply to manure for garden crops, such as onions, cabbage, potatoes, etc. In case the manure contains seeds of injurious weeds, like dock, plantain, etc., it should always be thoroughly rotted before being applied.

Another important loss of fertility is occasioned by the waste of the urine or liquid manure. The urine in most cases contains much higher percentages of nitrogen and potash than does the dung. It should also be noted that these materials in the urine are soluble and immediately available. In barns and sheds this liquid manure may be saved by the liberal use of straw or other bedding and the use of a small quantity of land plaster.

CROPS TO BE SOLD FROM THE FARM.

Under no circumstances should either clover or cow-pea hay be sold off the farm. They contain too high fertilizing and feeding values and should be fed to the farm animals, and all the manure produced most carefully returned to the land. As much as possible of the corn should be fed and the manure returned, although a ton of shelled corn does not contain as much fertilizing material as a ton of clover or cow-pea hay. If any hay is to be sold, let it be timothy, and among the grains which may be best spared are wheat, oats and corn; but the straw and fodder of these plants should be used for bedding and to absorb the liquid manure of the animals and returned to the land as manure. In the sale of potatoes comparatively little fertility is lost.

GREEN MANURING WITH CLOVER AND COW-PEAS.

The reason for recommending clover and cow-peas for green manure crops is because they possess a power peculiar to this class of plants of gathering nitrogen from the air. This nitrogen is one of the important elements of plant-food, is required by all domestic plants, and is the most expensive part of commercial fertilizers. The other staple farm crops, such as corn, wheat, timothy, blue-grass, rye, millet, etc., have not the power of gathering this nitrogen from the air, and must depend upon the available supply already in the soil. This in part explains why clover and cow-peas, although producing a hay crop rich in the elements of plant-food, will leave the soil upon which this product is grown more productive than before.

On land not too badly worn the careful saving of the farm manures, and the proper rotation of clover and cow-peas with the other farm crops, will, for a long time, keep up the fertility of the soil, and will avoid the necessity of the purchase of any commercial fertilizers. This has been abundantly demonstrated by the actual experience of farmers in this and other states, and by the different experiment stations.

What shall constitute a proper rotation of the farm crops it is impossible to say, because of the different conditions existing on different farms. It may not suit one farmer to grow oats, while another would insist upon having this crop in his rotation; another does not care to grow wheat, while another cannot use advantageously large quantities of timothy, and so on. In general, the well established system of rotation in use in Eastern states of corn, oats, wheat, and clover and timothy, grown in the order named, and requiring four years for completion, is a good one, but the religious adherence to this iron-clad rotation has become a menace rather than a benefit to eastern agriculture. Many of the farmers are disinclined to break away from the system of crop rotation followed by their forefathers, and as a result, they are growing crops that have long since ceased to be profitable, merely to retain the rotation. Rotation of crops is in itself a good thing, but not sufficiently valuable to warrant a man in continuing to grow one or more crops upon which he loses money for the sake of such rotation. It is sometimes found necessary, however, to introduce into a rotation a crop that is not particularly profitable in order to provide proper means for seeding clover.

Unfortunately there are many failures, often under the very best management, connected with attempting to grow clover. The best methods of seeding and caring for the crop are difficult to explain, on

account of the difference in seasons, and there is also much difference of opinion among the best clover growers as to the best method of procedure. A large number of inquiries come to the Experiment Station every year on these points. As a result of these inquiries, and considering the importance of the subject, the Station has undertaken a series of experiments to determine the proper season of the year to sow clover, and the best methods of growing this plant. On the Station grounds we have sown clover each spring during the past three years once each week, from the 1st of February to the 10th of April. The results of two years' seeding are already available, while it is too early to determine the effect in the present year, 1898. In the springs of 1896 and 1897 the earliest and the latest sowings did not furnish as good a stand nor as thrifty plants as the intermediate ones. In other words, as far as all observations of these two years can determine, from February 1st to the 15th is too early in this latitude to sow clover. We may find some seasons in which this early sowing will succeed admirably, but in both seasons in which we have tried it the results have been unsatisfactory. This is due to the fact that we are likely to have a week or more of very warm weather during the latter part of February or in March that will germinate the seed, and the sharp freezes following are likely to kill many of the plants. Further north, where it remains cold, and no opportunity is afforded for the seeds to germinate, this difficulty in all probability will not present itself. Hon. T. B. Terry, of Ohio, after a long experience and years of careful observation, concludes that the best time to sow is the latter part of January or the first of February, but his experience has been confined to a climate different from that of Missouri.

Seeding after the first of April, especially in Central and Southern Missouri, is very likely to give plants too weak and imperfectly rooted to stand the severe drouth and heat that is likely to come in the early or mid-summer. On the whole our best results have been obtained from seeding between the 7th and 20th of March. We have obtained the best stand and the most vigorous and productive plants from seeding within this period. Subsequent trials may change this date somewhat, but this is the best light now obtainable on this subject.

As to the crops with which to sow the clover, there is much difference of opinion. After considerable experience and experiment in this matter, I am certain that *no nurse crop is necessary*. Oftentimes it is not considered feasible to devote the land in the early spring to the clover alone when another crop can be grown on the land and removed in time to allow the clover plants to develop. This is a correct view; but if the clover is the prime consideration and oats or other

crop be sown merely to protect the clover, then the proposition is wrong, because the clover will do better without the nurse crop than it will with it. If sown early enough, the clover plants do not require shade to protect them from the sun of spring, and they will become sufficiently hardy and strong to stand the heat in the summer. The chief danger in sowing other crops with the clover is that they furnish so much shade that the clover is checked in growth, becomes spindling and weak, and when the other crop is removed and the young plants are exposed to the intense heat of the sun and a drouth follows, they are almost certain to die. These same clover plants, however, if grown alone and exposed to the sun and air throughout the entire season would have easily withstood the drouth without material injury.

It is clear from these statements that wheat is a better crop with which to sow clover than oats, for the reason that it does not as completely shade the ground, and comes off much earlier. The plants thus have an opportunity to gather strength by the time the excessive heat comes on. Oats, on the other hand, have a more dense foliage, shade the ground more completely, and come off later and expose the plants to more intense heat when they are less able to stand it. Barley makes a most excellent nurse crop, but unfortunately barley is not a profitable crop in Missouri. We are practically confined to the crops of rye, wheat and oats. They are named in the order of their excellence for this purpose.

In seeding clover, use plenty of seed, not less than ten pounds per acre, and with this, even though the crop is to be exclusively clover, about three pounds of timothy should be sown to sustain the clover plants when they are mature. No more serious mistake could be made than to assume—it is unfortunate that this mistake is almost universally made—that after the clover is sown, all the necessary work and care has been bestowed upon the crop, until it is ready to harvest. It is just as essential that this crop be properly cared for as it is that corn be properly cared for after it is planted. No good farmer would allow his corn to struggle with the weeds unassisted by his cultivator, and no more should he permit the clover to struggle with the weeds without his assistance with the mower. Immediately after the grain crop is cut, there is a likelihood of rag weeds springing up to cover the ground and choke out the clover. As soon as these weeds get high enough to be in the way of the clover, the mower should be run over the land with the cutter bar set about four inches high, and the soft green material allowed to lie on the ground, settle down around the plants to form a mulch and protect the young clover against drouth and keep the ground cool. If the weeds spring up again, mow again, and repeat

this operation as often as necessary to keep the weeds subdued. This is almost universally neglected, and in many instances accounts for the failure to obtain a stand. The young clover plants will not be hurt by this mowing, but will be rather benefited, in that they will become more stocky and strong and better rooted.

Another mistake that is often made is in attempting to harvest the clover crop too soon. As soon as it affords respectable grazing, there is an uncontrollable desire to pasture it. Nothing could be more unfortunate to the prospective clover crop, especially if it is pastured close and drouth ensues. Only last season three fields of clover on the college farm were completely killed by pasturing with cattle, while two others that were not pastured came through the winter in excellent shape, and now promise a splendid crop. The fields that were pastured are now practically bare and have lost their clover stand entirely. Rather than pasture this crop, allow it to mature, and cut it for seed or hay.

VARIETIES OF CLOVER.

All things considered, the common red clover will prove more satisfactory than the Mammoth or Sappling variety. There are several other species, such as Crimson, Alsike and Alfalfa. Crimson clover is a failure in Missouri, and it will not be profitable to even experiment with it. We have tried it carefully on the Station grounds during the past four or five years. Our rainfall is not distributed evenly enough to enable this plant to be grown successfully. Alsike is not sufficiently productive to be profitable. Alfalfa, on some soils in Missouri, will do fairly well, provided a good stand can be obtained. This seems to be the greatest difficulty in our latitude. After considerable experiment with it, we have abandoned spring sowing. In almost every case it has been attended with failure on account of the weeds choking out the young plants. They do not seem to be as resistent as common red clover plants, and while a good stand may be obtained early in the spring, it will be almost entirely lost before the end of the season. Our best success has been obtained from sowing it in the latter part of August or the first of September on well prepared land, alone, at the rate of fifteen or twenty pounds of seed to the acre. Alfalfa will not be suitable for a green manure crop, because it is too valuable a crop for hay if a good stand is once obtained. In the summer of 1897, as dry as it was, we made three good cuttings of Alfalfa on land that would produce about a ton and a half of timothy per acre; we got over three tons of good Alfalfa hay. Unless a good

stand is obtained at first, keep on seeding until a good stand is obtained. The plants will not spread to cover the ground, as in the case of common red clover or timothy; once a thin stand, always a thin stand unless it is reseeded. The Alfalfa will be frozen out or spewed up by the alternate freezing and thawing, just as will common red clover, although not quite as badly. The land best adapted to Alfalfa is a light, porous soil of good depth. The land should not be too sandy, otherwise the plants will suffer from drouth. It is a mistake to assume that this plant does not require moisture in abundance. A trial of it will convince anyone to the contrary.

THE COW-PEA.

This plant appears to have the ability to thrive on land too poor to grow either red or crimson clover. It is not affected so seriously by excessive heat or drouth, and is not easily smothered out by weeds.

On most soils in Central and Southern Missouri it yields a larger quantity of vegetable matter, containing a larger total quantity of nitrogen, than does red clover. In the sections of the State where the climate is well adapted to the growth of cow-peas, it is believed that they will prove more satisfactory as a green manure crop than either red or crimson clover, especially on poor soils, inasmuch as there is less risk in securing a stand, and there is no danger of the hot weather in mid-summer killing the young plants.

Compared with other green manure crops, the cow-pea seems to grow especially well on poor land. On a piece of naturally poor upland clay, which has for the past fifty years been grown in corn and wheat without fertilizer, the Station began last spring a number of experiments in methods of restoring this soil to productiveness. On six of these plots cow-peas were sown without manure. The average yield of vines and pods, exclusive of the stubble, was as follows:

Green substance, 2,650 pounds per acre; dry matter, 1,430 pounds, estimated to contain 28 pounds of nitrogen, 7.5 pounds of phosphoric acid and 21 pounds of potash. Rating these materials at their market price in the form of commercial fertilizers, they would have a value of \$5.90 per acre. Adjoining plots planted to corn gave an average yield of 8.1 bushels of corn and 860 pounds of field cured stover. Other plots in the same series sown to millet produced an average of 555 pounds of green substance. Common red clover sown on similar plots did not attain a height of five inches, and failed to mature.

Cow-peas should be sown at the rate of about one and one-half bushels per acre on a seed-bed prepared about as for corn, either

broadcast and covered with a corn cultivator to a depth of two or three inches, or drilled with an ordinary wheat drill, set deep.

Avoid sowing too early in the spring. On the Station grounds the best results have been obtained from sowing from the 1st to the 10th of June. If sown earlier the plants grow slowly during the cool weather, enabling the weeds and grass to gain a foothold.

If a crust forms on the surface before the peas come up, run a light harrow or drag over this surface to break the crust and kill the young weeds that have started. When sown after the season is more advanced and the soil is warmer, no trouble need be feared from this cause, as the cow-peas will grow rapidly enough to smother any weeds that may start. Last season a crop of one and one-half tons of field-cured hay per acre was grown from seeding on wheat stubble without plowing after the wheat had been harvested July 1. These peas were removed and the land again sown in wheat without being broken, by September 20. It is a common practice in Southern Missouri to sow cow-peas between the corn rows just before the last cultivation, and cover them at the time the corn is cultivated. In this way a fair yield is obtained, which is valuable both for pasture and manure. In the corn belt where the whole season is required to mature the corn plant, this practice has not been found to be profitable.

VARIETIES.

It is certain that the early varieties of cow-peas will mature during any season in any point in Missouri. The varieties best adapted for general use in this State are: For green manuring or for hay, the Clay; for hog pasture, the Whip-poor-will. The Whip-poor-will is the earliest variety, and if sown by the 10th of June will in most seasons mature in time to clear the ground for sowing wheat that fall. We have just started a rotation on the Station grounds that gives promise of excellent results. To sow rye early for winter pasture, cut the crop by the 10th or 15th of June either for hay or pasture it down; then disk the land thoroughly, without plowing, and drill in Whip-poor-will or clay cow-peas, depending on how early the rye is removed, and remove the cow-peas as hay by the middle of August or first of September, and drill rye on the same ground again without breaking the land. The pea loosens the land sufficiently for rye, and there should be no necessity for breaking it in the fall. In this way we are now getting two fair crops a year with less labor than is usually required to get one. This rye field is convenient to the barn and is used as a sheep and calf pasture.

The cured vines and pods of cow-peas make a most excellent hay. All classes of stock prefer it, and will thrive better on it than the best clover hay. For curing purposes it should be cut when the first pods begin to turn yellow. When delayed beyond this stage a loss of leaves and peas by shattering will result. The hay is somewhat difficult to cure, and requires much more time and care than any other hay crop. The hottest, dryest time should be selected for mowing, and the peas should be allowed to lie in the swath as long as there is no danger of sun-burning, then should be raked into winrows and allowed to dry out as much as possible there, and if the weather should be unfavorable for curing they should then be thrown into shocks, and, if necessary, opened again when the weather is favorable. If the weather should continue cloudy and cool, allow the vines to heat in the shock until they reach a temperature that can scarcely be borne by the hand. Then select some bright day, throw the shocks open and allow the vines to cool out. This will usually be sufficient, and they may then be stacked just as any other hay and topped out with timothy or straw, as in the case of clover. If the vines are still too green to stack without danger of molding, alternate the peas with courses of dry wheat straw. The straw will absorb the moisture and enable the peas to keep without loss.

For pasture purposes, the cattle or hogs should not be turned on until the pods begin to turn yellow, or about the same time they would be cut for hay. In some localities it is the practice to pasture the peas down reasonably close earlier than this, about July, and allow them to spring up again and make a hay crop to be cut about the middle of September. In some seasons this is very successfully done, and with considerable profit.

One serious objection to growing the cow-pea is the cost of the seed. At the present time no satisfactory machine has been invented for threshing them. The ordinary thresher with all concaves removed and boards substituted in their stead, the pulley on the cylinder replaced by a larger one in order to reduce the speed of the cylinder and give it more power, and the very dry pea hay fed so as to keep the machine full all the time, with a slight adjustment of the sieves and fan, it will give a fairly well-cleaned seed with from one-fourth to one-half of the seed cracked and broken. Many of the cracked peas can be removed by running them through an ordinary wheat fan with the seives properly adjusted. We have thus succeeded in threshing cow-peas with about half the grains cracked with an ordinary thresher, and have secured a fair grade of seed by properly cleaning them. The seed on the market is in nearly all cases hand-picked, and, therefore,

costly. A machine has now been put on the market that is guaranteed by the manufacturers to successfully thresh the peas without breaking them, but it has not been sufficiently tested yet. The Station has purchased one of these machines and will give it a thorough trial during the summer of 1898.

THE TIME TO TURN UNDER GREEN MANURE.

The common impression among farmers is that these crops must be turned under when very green in order to produce valuable manure; that if allowed to mature or become dry, much of the valuable fertilizing material will be lost by evaporation. This is entirely incorrect. A larger yield will be obtained by allowing the plants designed for manure to become mature. Of course, an exception should be made in the case of weed crops whose seeds are likely to be troublesome afterward. Recent experiments show that red clover, when plowed under at the beginning of the blossom, contained little more than one-third as much nitrogen as when matured. In the case of crimson clover the amount of nitrogen yielded per acre by the entire plant, including the roots and stubble, was:

April 24, plants 5 to 7 inches high, 103 pounds of nitrogen; May 31, plants fully mature, 212 pounds nitrogen.

The fertilizing value of the crop at different stages of development was:

April 24, plants 5 to 7 inches high, value.....	\$21 94
May 12, plants 12 to 14 inches high, value.....	34 64
May 24, plants in bloom, value.....	37 06
May 31, plants fully matured, value.....	43 96*

In the case of cow-peas, except on poor land where a large supply of fertilizing matter and vegetable material is needed immediately, it will usually be found more profitable to pasture them with hogs or other stock, and turn the refuse vines under late in the fall or the following spring. Where a very rank growth of clover or cow-peas is secured, much of the difficulty usually experienced in turning it under may be obviated by first running a harrow over the field in the direction, in all cases, that the plow is to go, and so break and straighten the vines that with the aid of a rolling coulter they may be easily plowed under.

*Delaware Experiment Station.

Very respectfully yours,

H. J. WATERS, Director.