LEGUMINOUS FORAGE PLANTS.

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THE purpose of this bulletin is to supply the popular demand for information relative to the growing of leguminous forage plants.

The legumes are selected for two general reasons. First, on account of the value of this class of plants in furnishing protein compounds economically, and second, the beneficial influence exerted on the soil both chemically and physically as the result of their growth.

Owing to the fact that the State is divided into two grand physical divisions by the Cascade range of mountains, known as Eastern and Western Oregon, there is a very wide variation in the conditions under which forage plants are grown in this State. These districts possess a great diversity of soils, ranging from a volcanic ash to a heavy clay. The climatic conditions are equally as variable, ranging in annual precipitation from about seven inches to over one hundred inches, and from equable winter temperatures to those that are exceedingly rigorous.

Thus it will be readily seen that no general arbitrary rule can be successfully followed in the methods of seeding and the culture of forage plants under such variable conditions of climate and soil. The agriculturist will necessarily have to work out in a large measure for himself the details relative to the selection of varieties and cultural methods that are best suited to his particular soil and climate.

Each physical division supports in a measure forage plants peculiar to itself. For instance, conditions in Western Oregon are favorable for the growing of the clovers and vetch. While in the eastern section alfalfa is the principal domestic forage plant. Only restricted areas in this section will support clover without irrigation, while practically the whole of the western portion of the state is well adapted to this plant.
RED CLOVER (Trifolium pratense)

Red clover is easily the most valuable forage plant grown in Western Oregon. This section is the home of the clover judging from the large number of native varieties found here, of which there are at least seventeen.

The season of growth for clover throughout the larger portion of the Willamette valley extends from about the middle of March to the first of December, thus making it a valuable pasture as well as hay crop. Climatic conditions are not exactly suited to the operations of successful hay making when the plant is permitted to develop under normal conditions. The clover crop ordinarily is ready for hay from the first to the fifteenth of June, and quite frequently about this time refreshing showers are very prevalent. These showers are exceedingly helpful to other agricultural crops but are responsible oftentimes for a serious damage to clover hay. This damage consists of marked discoloration of the hay and occasionally an appreciable loss of protein substances. This may be obviated by pasturing clover off in the Spring, or by cutting the first crop for the silo when the blossoms appear. By the first method the hay crop is deferred to July and by the second to about August, thus improving the chances of good weather for the curing of the hay crop.

At this Station last season the first cutting for the silo was commenced June 11th and completed June 14th. The crop averaged 12.52 tons of green clover per acre. The second crop was cut July 25th, yielding 1.50 tons of cured hay per acre. There was also a good third growth which was pastured off with sheep. The latest period it would be safe to pasture clover for a deferred hay crop must be governed by the stand, the vigor of the plants, soil moisture and general conditions for growth. Ordinarily in Western Oregon it can be pastured as late as the first of May.

Continuous cropping with the cereals has materially changed the texture and hence reduced the productiveness of the valley soils. In their original state they were friable and rather easily worked, while at present, owing to a lessening of the per centum of vegetable matter present, these soils are heavy, lifeless and have a strong tendency to become cloddy, consequently are hard to work. The growing of clover, however, as a rotation crop will correct this evil. It is estimated that the roots of clover will about equal the weight of the
cured hay, so that from a crop of three or four tons of hay per acre we have an equal weight of roots left in the soil, which will not only very perceptibly improve the texture of the latter but also materially increase the amount of available plant food for succeeding crops.

Clover as a fertilizer is scarcely surpassed by any other plant, for as is generally well known, like all other legumes, it has the power to appropriate atmospheric nitrogen. Thus it takes direct from the air the most valuable element of plant food. However, we must not lose sight of the fact that clover also takes from the soil valuable elements of fertility in the form of potash and phosphates. Hence, if large crops of clover hay are taken from the land without adequate returns being made, these latter elements may in time be seriously diminished. To prevent this, the clover hay grown upon the farm should be consumed by domestic live stock maintained on the farm and the manure resulting therefrom returned to the land, thus preserving the productivity of the soil almost indefinitely.

Although Western Oregon is so well adapted to the growing of clover, numerous failures are annually recorded. This is very largely due to faulty methods of seeding. In fact these failures were so general in the past it was popularly believed that clover could not be successfully grown upon the ordinary prairie soils of the valley. The fallacy of this, however, has been completely proven within the past few years.

There is often some difficulty experienced in securing a satisfactory stand of clover on land that has been devoted to exclusive grain growing for a number of years. This difficulty is mainly due to the physical condition of the soil. This Station has been quite successful in securing a good stand of clover during the past four years by sowing the seed on winter wheat about the first of March. This method has given very satisfactory results with heavy clay soils.

For the average farmer a rotation system of cropping is recommended. The method followed by the Station in the main consists of wheat succeeding a cultivated crop, such as rape, potatoes, or corn. Following the wheat clover is grown for two seasons, after which the soil is broken up for some cereal crop. The following example will serve to illustrate the advantages of this system. In the Fall of 1899 a field, which gave a yield of 20.50 bushels of wheat per acre that season, was fertilized with about fifteen common wagonloads of barnyard manure to the acre, and then was plowed about eight
inches deep. The following Spring the land was plowed again, worked down fine and planted to corn, potatoes, and other cultivated crops. Immediately after harvesting these crops the land was disked and winter wheat drilled in at the rate of one and one-fourth bushels per acre. About the first of March eight pounds per acre of red clover seed were sown. The yield of wheat was 40.50 bushels per acre. The following year, as elsewhere noted, the first crop of clover, consisting of 12.52 tons per acre, was cut for the silo and the second crop for hay, yielding 1.50 tons per acre of the cured product. Ordinarily the clover will be a profitable crop the second year, but in this instance the clover root-borer destroyed such a large proportion of the plants that it was deemed advisable to break the sod for a cereal crop. Thus it will be noted that four good crops were secured from two plowings. This system not only reduces the labor expense in the operation of the farm, but it also makes the land more productive, and at the same time perceptibly improves the texture of the soil.

Another good method for seeding down to clover is to plow the land to a good depth in the Fall. Then in the Spring as soon as the land is in condition, work down very fine and leave fallow until about the middle of May or the first of June. Then harrow it thoroughly so as to destroy all weeds and seed to clover with about two pounds of rape seed per acre, covering with a light harrow. If the soil is thoroughly pulverized and compact, the clover and rape will develop rapidly, and within about six weeks or two months will furnish an excellent pasture for sheep, hogs, or young cattle. Either of the two methods mentioned, when properly executed, will almost invariably result in securing a satisfactory stand of clover.

There are other methods of seeding down to clover which are more or less successfully employed. Such as seeding in the Fall or sowing with Spring grain. The success of these two methods rests very largely upon the peculiarity of the soil and season. Frequently when clover is sown in the Fall an early freeze destroys it, and that which is sown with spring grain is often injured by the lack of sufficient moisture during a dry summer. Sowing grain with clover in the Spring as a nurse crop is a popular error; for instead of being a nurse crop in the true sense of the term it is more appropriately called a "curse crop." The grain deprives the clover of the necessary moisture to carry the latter through the last portion of the first summer, which is the most critical period of its existence. How-
ever, if clover has previously been grown on the land, the soil is
well supplied with plant food and has a good texture, then seeding
with spring grain will result favorably. For in this case the soil
will possess a physical condition which is conducive to the conserv-
ation of moisture, thus furnishing sufficient for both the grain and
young clover plants.

There is a wide variation in the opinion of farmers as to the
proper quantity of clover seed to be sown, ranging all the way from
two pounds to fifteen pounds per acre. We find that the proper
amount of seed to be sown is governed by several conditions. The
two principal factors perhaps are the germinating qualities of the
seed and the degree of suitability of the soil for the plant. While
two pounds of good seed per acre may be sufficient for some soils
this amount will be totally inadequate for others. At this Station
we have had excellent results with eight to ten pounds of seed per
acre, usually putting on from six to eight pounds of red clover and
two pounds of alsike. The alsike clover is a very desirable supple-
ment of the red. The proportion of alsike sown should be governed
by the character of the soil. On a heavy clay soil with poor drain-
age a larger proportion of alsike can be profitably used. A good
proportion for this class of soil is four pounds each of red clover
and alsike per acre.

Recognizing that clover is destined to be regarded as one of the
most valuable forage crops grown in Western Oregon, we desire that
this bulletin shall contain as much practical information relative
to the production of this crop as may possibly be obtained. Hence
the following letters, written at the solicitation of the Director, by
two gentlemen who are generally recognized as being among our
most successful farmers in the western portion of this State, are sub-
mitted with the full assurance that they will be appreciated.

"As to our method of getting a stand of clover will say that on
our soil we have found only one way that we can depend on with
certainty—about as follows: sow 10 or 12 pounds of common red
clover, or better 6 to 8 lbs. of red clover with about 2 to 4 lbs. of
alsike—sow alone or with 1 to 2 lbs. of rape seed to be pastured first
season. Rape can easily be killed out if you want to cut crop for
hay. The ground should be plowed early, and, after heavy rains
are over it should be rolled and harrowed till you have a fine, solid
seed-bed. No danger of getting too fine or too solid. On ground
prepared in this way sow seed in the latter part of May or 1st of
June. Cover lightly and you are almost sure to get an even stand. Have not been successful with any other way. This is the sure way. Wet summers will doubtless bring a good stand when sown on fall wheat or with spring grain, but we seldom have wet summers. There are no crops like rape, clover and vetch—indeed they are the salvation of the Willamette Valley.

Monmouth, Oregon. Jno. B. Stump.

"Red clover can be grown successfully on any land that will grow wheat. Time for spring seeding, April 1st to May 15th. A very important thing is to work the soil when it is in proper condition. Plow the ground thoroughly and harrow well. If oats are to be sown drill in one and one half bushels, and one bushel per acre of wheat. Follow the drill with the harrow, and if this puts the ground in good condition, sow the clover seed and follow with another harrowing. After this use a roller if the condition of the land will permit. If the ground should not be in good condition after the drilling and harrowing put a roller after the harrow that follows the drill, then sow the clover and cover with the harrow. If the clover is sown in May the ground can be rolled immediately after the harrowing that covers the seed, but if sown earlier in the season defer the rolling until the grain and clover are up. Follow this by putting 50 lbs. of land plaster per acre carefully spreading the same evenly on the land. When the time arrives to cut the grain, cut as close to the ground as may be possible with a binder. Do no threshing in the field, so as to leave field clean for clover crop the following year. Neither allow any stock to run on the young clover the first year if the crop is intended for hay or seed. Would cut the crop the first year as soon as in full bloom, not allowing any blossoms to turn, for this is where many fail to get a good hay crop and lose on the seed crop by letting it stand too long for first cutting. The first crop should yield 2 to 3 tons of hay per acre. The crop for seed is usually cut in September when the blossoms are good and brown and the seed just past the dough. Cut the crop with a self rake machine and when well cured gather in close racks. It should be hulled when only in good condition i.e. when it is good and dry. The crop should yield 175 to 250 lbs. of seed per acre. The second year a hay and pasture crop can be secured after which the land should be plowed and seeded to oats or any other crop desired. The clover will leave the land mellow and good for other crops for several years."
When seeding clover on Fall grain, prefer to seed in February or up to the 15th of March on a snow or freeze, followed by 50 lbs. of land plaster per acre the last of April or 1st of May. Never had as good success in this way of seeding as in Spring. It is neither so clean nor even a crop and will usually take it one year longer to mature. Should a timothy meadow be desired, sow clover in the Spring as has been suggested, and in September after the grain has been harvested sow 3 or 4 pounds of timothy per acre on the stubble. The first year you cut pure clover hay and in September take off a seed crop. The second year the hay crop will be half timothy and clover which makes splendid feed—no seed crop this year. The third year you will have a clear crop of timothy hay, and should yield 2 to 3 tons per acre. Would suggest that about the 1st of May on the second year that 30 to 40 pounds of land plaster be put on per acre.

I will refer you to a piece of land containing 115 acres which was sown to clover and oats. Seeding was finished May 15th. The following September sowed 4 pounds of timothy seed per acre. Harvested 4,000 bushels of oats. These were sold at 35 cents per bushel, bringing $1,400. The following year cut 275 tons of hay, some of this hay was sold for $14.00 per ton on the farm, but say we estimate it at $5.00 per ton, which would net $1,375. The same year in September cut the second crop for seed which yielded 211-275 pounds of seed which brought 9 cents per pound or $1,944.75. The second year there were cut from the field 250 tons of timothy and clover hay, for which we will allow $5.00 per ton (which is a low figure), $1,250. In September cut patches in the field for seed, getting 1,500 pounds at 10 cents per pound making $150. Third year cut 300 tons of timothy hay. Sold this for $9.00 per ton, or $2,700. This would make the total gross receipts for the 115 acres for three years of $8,789.75.

Now we will allow our neighbor who summerfallowed at that time 115 acres. Summerfallowed the first year and second year harvested his wheat. Allowing the wheat yield 30 bushels per acre and was sold for one dollar per bushel or $3,450. A good many farmers would reseed this field in the Fall to wheat and we will allow them 25 bushels per acre or $2,875 for this crop, thus making a total of $6,325 in the three years as against $8,789.75 for the 115 acres of clover, making a difference in favor of the clover of $2,464.75, and a greater difference would be in the farming of the land, that had been in clover for the next 5 or 6 years.
During these three years no stock was allowed to run on the 115 acres sown to clover and timothy.

I would suggest that when clover is sown straight it should not be permitted to stand longer than two years, and if the land is sown to both clover and timothy not over three years at the longest. For by this time they have both passed their period of usefulness. Seed some other land to clover that needs a rest. Rotate in this way and follow the clover with other crops. Clover is king of all fertilizers for the Oregon soils.


The above letters certainly contain much valuable information for those contemplating seeding down their land to clover. We suggest, however, that the system of consuming the hay and grain with domestic live stock on the farm itself is much more profitable in the end than selling these products at their market value. To sell these products is simply burning the candle at both ends. While it is true that clover is a great fertilizer, nevertheless without this is consumed on the farm or an equivalent is returned to the soil the land will ultimately suffer for the lack of potash, phosphoric acid and lime. The better plan and the one that will be unquestionably the more satisfactory in the end is to feed the crude product of the farm to well bred live stock, thus not only insuring maximum returns from the farm but also conserving the fertility of the soil.

VETCH (Vicia sativa).

On the point of value as a forage crop for Western Oregon the vetch is a very close rival of clover. The vetch is indigenous to Western Oregon, hence all the domestic varieties do remarkably well in this section. In some respects the vetch is superior to clover. It is richer in protein, more palatable and possesses a wider range of adaptability than the latter. The principal objections to vetch are the annual seeding, difficulty of harvesting and its tendency to volunteer in the wheat crop, thus lessening the commercial value of the wheat. With reasonable care the two last objections may be obviated. The difficulty of harvesting may be overcome by sowing grain with the vetch to hold it up, or in case in early Spring the crop gives indications of a rank growth it may be pastured back as late as the first of May and then yield an excellent crop of hay or seed. The pasturing will shorten the length of the vine and cause it to stand up better, thus facilitating harvesting. Vetch can be
kept out of wheat, if care is exercised not to sow winter wheat on land that has produced a crop of vetch seed that season, or the preceding season.

While the vetch gathers nitrogen it does not develop a large root system, hence is inferior to clover as a soil renovator. However, the growing of vetch is highly beneficial to the soil, for it not only increases its nitrogen content and lightens the texture of a heavy clay soil, but also, owing to the density of its growth, it smothered a great many weeds.

Vetch is very hardy, hence the land requires but little preparation to secure a good stand. A common practice is to disk it in on stubble ground in the Fall, putting on about one bushel each of vetch and winter wheat, or winter oats per acre. If the crop is intended for seed, it is better to seed with winter oats as the vetch can be easily separated from the oats, thus insuring clean seed for the market.

Vetch makes an excellent winter cover crop for an orchard or garden. For this purpose the vetch should be sown alone, putting on at the rate of about one and one-fourth to one and one-half bushels per acre. Upon rather heavy clay soils that have been given thorough cultivation during the summer, a winter cover crop of vetch will render an invaluable service in maintaining a desirable texture of the soil as well as possibly retaining the nitrates that might otherwise leach away.

While vetch has to be sown each year this may be done, however, with the minimum amount of labor. Where the land is in fairly good physical condition and the seeding is done in the Fall a good harrowing is all that is necessary. Ordinarily, however, diskig the ground before seeding is preferable. Vetch is also a good "catch" crop. For instance, in case the Spring seeding of clover should result in a light stand, vetch can be sown in the Fall and harrowed in without injury to the clover. The vetch and clover combined will yield a heavy crop of valuable hay, while the clover alone would perhaps have given an unprofitable yield.

There are two varieties of vetch generally grown in this section; the common vetch, *vicia sativa*, ordinarily called the Scotch tare, and the hairy vetch, *vicia villosa*. (The former is preferred owing to its character of growth and palatability). These are sometimes designated as Spring and Winter vetch, but this is an error, for they are both winter varieties, although either will pro-
duce a good crop of hay if sown moderately early in the Spring on good soil. They do better, however, if sown in the fall.

The hairy vetch, sand vetch, or Russian vetch, as it is sometimes called, is a vigorous grower and a very hardy variety. Its principal field of usefulness is perhaps for rather poor dry soil. There is also a possible field of usefulness for this variety on the unimproved lands of the Coast Range, especially in the heavy fern districts. From what we know of the habit of this plant we have confidence that if it is given a good start on these fern lands it will ultimately scatter all over the fern ridges of this section and furnish an immense amount of fairly good feed. The plan suggested for this work is to plant a few seeds ten feet apart each way and keep stock off for the first year. After this with judicious pasturing the plant will perpetuate itself and spread in every direction.

The seed of the vicia villosa is much smaller than that of the vicia sativa, hence a considerable less quantity per acre is sufficient for seeding. From a peck to a half bushel per acre is the usual quantity sown.

Spring Vetch. While there are several varieties of the genuine spring vetch, they are really subvarieties of the vicia sativa. The one more commonly grown is almost identical with the common vetch except that it matures much more quickly. There is another spring variety that produces a white seed, although otherwise the plant is almost identical with the common vicia sativa.

The spring varieties of vetch are very useful under the soiling system for furnishing succulent and highly nutritious feed late in the season.

At the solicitation of the Director of this Station, the following letter was written by the pioneer vetch grower of this state:

"I herewith inclose you in brief detail my experience in raising and curing vetch. The crop has been one of the most successful with me on account of its sureness of growth, as well as being a palatable and nutritious stock food.

I have seeded vetch in the Fall and early Winter in every way imaginable. Have sometimes had it volunteer and bring a valuable crop. A successful way of seeding it, is to sow in the stubble early in the Fall, using a good sharp cultivator to cover; (the crop being easier cured than a heavier one with more cultivation.) I increase the amount of grain in the mixture according to the calculated weight of the vetch crop, which depends upon the capacity of the
soil to raise it. The successful curing of vetch hay in damp weather is attended with a great deal of difficulty, as the straw is juicy and of soft fibre; especially heavy crops, grown in rich soil, or that which has been forced with land plaster. Of the latter I have never used more than 50 pounds to the acre, in many cases a less amount is better. Lighter crops are proportionately easier cured.

Where the crop grows to a height of eight or ten feet and is flattened to the ground by previous rains, there is often difficulty in mowing. I have found very little trouble with a mower that cuts clean and is furnished with a divider that will ride smoothly over on the side of the sickle-bar; next to the gearing a wheel is preferable. I prefer to turn over heavy crops after cutting which can be done with very little labor using a light pole or pitch fork handle. One active man can turn the swaths behind the mower about as fast as it will cut them, provided they are cut clean. This prevents mold and further decay which takes place very soon where the lower stalk becomes damp and during warm, close weather, and the condition aggravated by the mower wheel pressing it close to the ground. Shocking can be done better without raking; this is where I have found the most difficulty as the vetch hay does not stand exposure without bleaching and loses its feeding value very rapidly. It needs a great deal of curing before putting into a large mow. I have found it well worth the labor to recock in a week or so, putting three or more into one. Better turn over the first one. The only sure way to cure a heavy crop of vetch is to put it in a silo, and when one has this choice the weather may govern the operation.

Centerville, Oregon.

A. CHALMERS.

When a seed crop of vetch is desired it is a good plan to sow on moderately rich land and dispense with the land plaster. If, however, the growth gives indication of luxuriance in the Spring it would be well to pasture the vetch heavily up to about the first of May. This method will materially shorten the straw and greatly facilitate the development of seed. No arbitrary rule can be strictly followed in handling the crop for seed. Ordinarily the seed crop should be cut when fully three-fourths of the pods are turning yellow and the seed is commencing to assume a dark color. If the crop is permitted to become too ripe before cutting, much seed will be lost, for the plant has a pronounced tendency to the undomesticated habit of scattering its seed for self perpetuation. If the crop
stands up well it may be cut with the binder and handled similarly to sheaf grain. This, however, can rarely be done successfully and the mower has to be brought into requisition. After the crop is cut it should be exposed to the sun for but a brief period. If the crop is light it can be raked and shocked, but in case it be heavy a better plan is to shock it without the use of the rake. Whenever practicable the crop should be hauled directly from the shock to the thresher as the more often it is handled after it becomes dry the greater the waste of seed from shattering.

ALFALFA (*Medicago sativa*).

Alfalfa and aridity are usually closely associated for wherever irrigation is indispensable to successful agriculture alfalfa becomes the dominant crop. In these sections where water for irrigating purposes is available methods of production are well understood. Then again in the dryer sections of the state on subirrigated lands, or those supplied with a water table much below the reach of ordinary farm crops, alfalfa, owing to its ability to penetrate deeply into the underlying soil strata solves the problem of forage production. There is, however, a wider range of usefulness for this plant than is generally supposed. For instance in the great wheat belt of the Columbia River basin where the contour of the land precludes successful irrigation, alfalfa will yet prove to be a valuable crop. Before this condition is realized, methods of culture must be developed that are in harmony with the environment. In the great wheat growing areas of this section, alfalfa can scarcely be expected to give satisfactory results if sown broadcast. The plan adopted should, to the greatest possible extent, conserve soil moisture. This perhaps may be best secured by means of cultivation. Hence, the alfalfa should be sown in drills and cultivated similar to corn. This is not such a formidable task as would first appear. The work can be done very rapidly with a double cultivator, and the harrow can be frequently used to great advantage. The purpose of the cultivation is to reduce the evaporation of soil moisture to the minimum by destroying the continuity of the soil capillaries. The drills may be thirty to thirty-six inches apart. Just as soon as the plants are up, if sown in the Spring, a light cultivation should be given. This ought to be repeated every week or ten days during the first growing season. If weeds are troublesome in the rows, or the plants make a good growth the field may be mowed occasionally. The
ridging of the land through cultivation, or the development of large crowns by the plants may interfere with the convenience of harvesting. This can be obviated by cross harrowing early in the Spring, late Fall, or immediately after the cutting of the first crop. In fact after the plants are well developed, cross cultivation at the proper season either with a cultivator or disk harrow will work no injury to the plants; but on the other hand will materially improve the surface of the ground and thus expedite the harvesting of the crop. It has been pretty conclusively demonstrated that old alfalfa fields are reinvigorated by the occasional liberal use of the disk harrow.

**ALFALFA IN WESTERN OREGON.**

As yet alfalfa growing in Western Oregon is purely in the experimental stage. This forage plant in the estimation of the farmers of this section occupies the same position as did clover twenty years ago. Then it was popularly believed that clover would not flourish on the wheat lands of the Valley.

There are undoubtedly large areas of land in this section that will produce profitable crops of alfalfa. Perhaps the two chief obstacles to success are, the close proximity of the water-table to the surface of the soil during a large portion of the winter, and the rather pronounced tendency of weeds and grasses to crowd out the alfalfa. The former difficulty may be overcome by tile drainage, and the latter can be kept largely in subjection by suitable cultural methods. Alfalfa possesses no especial advantages over red clover other than greater permanency of the crop. In fact, clover is the better crop for the purpose of a short rotation, or for rejuvenating the soil. Another possible serious hindrance is the danger of "bloat" in stock pastured on it in the early Spring, when, in addition to the extreme succulency of the plant, much moisture from rain and dew is present.

The heavy clay soils of this section are certainly not ideal for alfalfa; but it has been reasonably well demonstrated at this Station that such soils will support profitable crops of alfalfa. At the present, June the first, we are cutting a crop of second year alfalfa from a heavy clay undrained soil, that is yielding 9.66 tons of green forage per acre. The seed for this field came from an arid region and perhaps even better results would be secured with home grown seed. However, it is rather remarkable how quickly the root system of al-
alfalfa will change to meet conditions of soil and moisture. Plate I represents two typical six months old alfalfa plants grown at this Station in heavy clay soil.

Plate II represents two Turkestan alfalfa plants which were kindly furnished by Mr. F. M. Chrisman, Silver Lake, Oregon. The longer root of the two measured twenty-one and one half inches. This plant was taken up 99 days from the date of planting the seed and was grown without irrigation. The section from where these plants came is very arid and the soil is largely volcanic ash with a hard-pan of cemented sand and gravel about 18 inches below the surface. It is a good illustration of the capabilities of the plant to adapt itself to its environments. This marked difference in the root system of practically the same variety of plants grown under widely different conditions indicate the strong cosmopolitan character of alfalfa.

Plate III illustrates rather a peculiar development of alfalfa tap roots. These plants are taken from a plat 8 years old. A trench six feet deep was dug alongside the plat to permit an investigation of the development of the tap roots. The soil was heavy clay and tiled two and one-half feet deep. It was found that the tap roots of approximately 50 per cent of the plants either stopped or rotted off at the level of the tile, while about 50 per cent of the plants had tap roots extending to and even below the bottom of the trench. This is a good example of the survival of the fittest. It appears that the tap roots of about one-half of the plants could not withstand the effects of the water present at the above level, while the other half were uninjured. This also indicates that, by judicious selection, a type of alfalfa can ultimately be developed which will be better adapted to the soil and climatic conditions of this section than one suited to arid soils and grown under irrigation.

Method of Seeding.—This must be governed largely by local conditions. Land naturally well drained or which is tiled at least three feet deep, should be selected for this crop. If barnyard manure is available, put on from fifteen to twenty tons per acre in the Fall and plow under eight to ten inches deep. In the Spring, when the land is in condition to work, cut it up thoroughly with a disk harrow and work down very fine. Let it lie for a week or ten days, then give a good harrowing so as to destroy all weeds. Sow about fifteen pounds of clean seed per acre and cover with a harrow. If the soil is inclined to be dry finish with a roller. About the time the seed is sown, put on seventy-five to one hundred pounds of land plaster to the acre.

Soil Inoculation.—In case the land has not grown a crop of alfalfa before, it is advisable to inoculate it with soil taken from a field that has produced alfalfa with root nodules. Many failures with alfalfa are due to the want of the proper bacteria in the soil. Hence to guard against this possible chance of trouble, it is a good policy
to inoculate the soil before seeding down to alfalfa for the first time. The method employed is to secure soil from an old alfalfa field, and scatter evenly about one hundred pounds to the acre. It is better to make this application before seeding, and the impregnated soil should be thoroughly incorporated with the field soil by harrowing.

The care of the crop the first summer consists simply of running the mower over the ground occasionally to subdue weeds. If the weeds are not too numerous they may be permitted to lie on the ground as a mulch; but in case they are so heavy as to menace the crop by smothering it, they should be raked up and removed. Allow no stock to pasture on the alfalfa the first year. After the first season the crop will require little or no care. However, if after a few years grass and weeds become troublesome and the vigor of the alfalfa seems to be waning, a thorough diskig of the land is beneficial. This should be done late in the Fall when the plants are in a dormant condition. Then the disk and harrow may be applied vigorously. In case the stand is growing thinner, reseeding may be practiced either in the Fall or early Spring. This may be accomplished by sowing the seed immediately preceding the last harrowing in the Fall, or by sowing and harrowing in early in the Spring.

From some cause the leaves of alfalfa at times will become yellow and the plant assumes an unthrifty appearance. When this condition manifests itself the crop should be cut at the earliest opportunity. The cutting seems to invigorate the plant when in this condition, and the succeeding crop rarely shows signs of unthriftiness.

**CRIMSON CLOVER (Trifolium incarnatum).**

This is an annual clover grown usually for two special purposes, either as a winter cover crop, or for soiling. The plant possesses considerable economic value as a forage crop for dairymen, and when its habits of growth are better understood, it will be more highly esteemed as an early soiling crop.

Crimson clover will flourish on a variety of soils but seems to prefer a sandy loam. It is a vigorous grower and, owing to its strong root development, is capable of securing nourishment from soils which will scarcely support red clover.

The principal cause of failure with this crop is perhaps late seeding in the Fall. The seed should be sown in August, if practicable, on land that has been cultivated during the summer. A very good plan is to sow on corn land immediately before the last cultivation, which of course should not be too deep. In some agricultural sections it is sown on grain stubble after a thorough diskig, but this method is rarely successful without timely fall rains. When sown on ground that has produced a cultivated crop, there is usually sufficient moisture to germinate the seed promptly. This gives the plant an opportunity to attain a considerable growth before winter. The success of the crop depends largely upon proper development of
the plants in the Fall. Fifteen to twenty pounds of seed should be sown to the acre.

When crimson clover is sown early, it is usually ready to cut for soiling at this Station, from the first to the tenth of May. It not only furnishes an early supply of green feed, but is also exceedingly palatable. The plant under favorable conditions stools freely, and the stems while large are not woody. Stock will consume every vestige of the plant with relish.

Crimson clover is rich in protein; hence is valuable for draft horses as well as for dairy stock. It is better fed green than in the form of hay, although it makes good hay when cut at the proper stage of development. For the purpose of hay it should be cut just as soon as it is in full bloom. If cutting is deferred later the hay becomes dangerous, owing to the hardness of the hairs upon the seed hull. Animals fed on over-ripe hay made from this clover have been troubled with "hair balls" in the digestive track, sometimes producing death.

In addition to its value for soiling it also makes good ensilage. For this purpose it should be put into the silo when in full bloom.

While crimson clover makes a phenomenal growth at times, it is a little unreliable. In the Spring of 1902 the clover at this Station yielded 23.67 tons of green forage per acre, while this Spring it only yielded 6.67 tons. This variation, however, was almost wholly due to the difference in the time of germination of the seed. In the Fall of 1901 the seed germinated about the first of September, while in 1902, it did not germinate before about the first of November. Last Fall was unusually dry, hence the crop this season does not represent what the plant is capable of doing under more favorable conditions.

FIELD PEA (Pisum arvense).

The field pea does well in practically every agricultural section of the State. This wide range of growth renders it one of the most valuable field plants we have, both for its forage and grain. There are numerous varieties of the field pea, but the one most generally grown is the white Canadian. The crop can be utilized either for grain, hay, soiling, or the silo.

Pea hay is very nutritious and is relished both by cattle and sheep. It is not so palatable in the green state. In fact cows that have been accustomed to green clover and vetch do not take kindly to the pea. Hence at first it is difficult to get them to consume a sufficient amount to prevent a serious shrinkage in the milk flow. This trouble is not experienced with the hay and silage, for these are consumed with an apparent relish. The pea has a very high nutritive value. It is especially rich in albuminoids, containing approximately 17 per cent of digestible protein, thus making it one of the richest concentrated feeds produced on the farm.

Peas are usually sown with grain, although when grown with the
intention of permitting the hogs to harvest them, they may be sown alone. Ordinarily from 2 to 3 bushels of peas to one to two bushels of grain are sown to the acre; the amount being governed by the class and condition of the soil. On good land the maximum amount of seed may be sown. The pea yields well on such land, often producing from 20 to 30 bushels per acre. Like all other leguminous plants, the pea is a nitrogen gatherer, hence it is an excellent crop to rotate with the cereals.

Its principal pest is the weevil. The ravages of this insect may be averted somewhat by early sowing. The plant is hardy and will grow under low temperature, hence peas can be sown as early in the Spring as the condition of the ground will permit. Early sown peas do not suffer from the weevil to the extent that the later sown do. Unfortunately some of the seed drills have not sufficient capacity to handle peas, hence it is often necessary to sow them by hand. In this case the peas should be sown first and either covered with a disk, or cultivator, after which the grain can be drilled in. Some recommend plowing them under with a very shallow furrow, but this method has not been satisfactory at this Station. The better plan is to sow them with a grain drill whenever practicable.

**FLAT PEA (Lathyrus sylvestris).**

This variety of pea has been highly recommended for its drought-resisting qualities. It is a perennial, resembling the ornamental flowering pea very closely. The hay made from this pea is rich in protein. An analysis, made at the Michigan Station, showed 27 per cent crude protein.

The seed should be planted in a bed and the plants transplanted in their place when about two years old. It prefers an arid soil to that of a heavy clay in a humid climate. A plot at this Station has produced a fair quantity of forage each year for a number of years, but we do not regard the plant to be of much value for this section.

**SANFOIN (Esparcette, Onobrychis sativa).**

This plant undoubtedly will prove an economic one for the rather dry hill lands in the southern portion of the state. It is a perennial legume, very durable, lasting under favorable conditions for quite a number of years. The plant flourishes in a rather dry, calcareous soil. It roots deeply and hence is capable of withstanding severe drought. Sanfoin will grow on land that is too poor to support either clover or alfalfa. It is more successful as a hay crop than for furnishing pasture. The plant does not possess the powers of recuperation of many other forage plants, such as the clovers, consequently it cannot stand close pasturing. It should be sown in the Spring at the rate of about 50 to 75 pounds of seed per acre. The seed must be covered with a good depth of soil to insure germination. This, however, should be governed by the character of the
soil and the amount of moisture it contains. On rather heavy moist soils a shallow covering of earth will suffice, while on a light, dry soil a deeper covering is required. On soils that are poor and dry, it is best to sow in drills about 20 inches apart and cultivate the first season. When sown in drills 20 to 30 pounds of seed per acre will be sufficient. With this system, land that is too poor and dry to support any other forage crop may be made to produce from one to two tons of sanfoin hay per acre, for many years.

**SOY BEAN** (*Glycine hispida*)

This plant is not readily adaptable to the climatic and soil conditions of Western Oregon. A few varieties have matured at this Station, but the yield of both seed and forage was not satisfactory. There may possibly be a field of usefulness for the soy bean as a supplementary crop with corn for ensilage. The soy beans mature about the season that corn does and being very rich in protein make an excellent combination with the latter. For this purpose the bean should be planted about the first of June in drills 2 to 3 feet apart. The seed may be sown with the ordinary hand drill, but the ideal soy bean planter will drop single beans three or four inches apart. If the bean is grown for the purpose of mixing with corn in the silo, it should be planted about the middle of June on rich ground that has been thoroughly pulverized. The soy bean seems to be a subtropical plant, hence it is not advisable to plant it before the soil becomes warm.

There are perhaps localities in Eastern and Southern Oregon where this bean can be grown for the seed. The soy bean may be worthy of a trial in these sections. If they can be grown economically the crop may be profitably utilized as a supplementary feed for dairying. The bean is very rich in albuminoids, containing about 30 per cent of digestible protein.

It seems useless to attempt the growing of the soy bean in Western Oregon on a commercial scale, as the climatic conditions are decidedly unfavorable to its production.

**COW PEA** (*Vigna catjang*).

This pea is frequently confounded with the common northern field variety. It is strictly a southern forage plant, but by gradual acclimation its growth has extended into northern latitudes. Failure to mature seed has followed every attempt to grow the plant at this Station. Hence, we do not deem the cow pea of any practical value for Western Oregon.

Plate No. IV is presented to illustrate the early development of the plants for soiling. These samples were taken from the field May 15th, 1903. The crimson clover and sanfoin were in bloom on that date.
PLATE IV.

In the preparation of the matter for this bulletin, the forage plants in the opinion of the author, were arranged in the order of their economic value in Western Oregon.

**Red Clover.**—Is clearly entitled to first place as an economical producer of forage, as well as being the most expeditious improver of the physical condition and fertility of the soil.

**Alsike Clover.**—Has not been treated separately. The same methods suggested for the seeding down to red clover will apply to this variety. Alsike does not produce a satisfactory growth after the first cutting. It is not predisposed to attacks of the root-borer, hence is more permanent than red clover. It will thrive on land too wet for the latter. The hay from this plant is nutritious and palatable. Without a seed crop is desired it should always be sown in connection with red clover.

**Vicia Sativa.**—Is the ideal vetch for Western Oregon. Fall sowing generally gives best results, although on a good soil, spring sowing is very satisfactory.

**Alfalfa.**—Should be sown on a fertile soil that is either naturally or artificially drained. Stock must not be permitted to forage on the plant the first season. Keep weeds subdued by frequent mowing. Sow in the Spring on a thoroughly pulverized soil. Subsoiling the land the previous season is helpful.

**Crimson Clover.**—While a valuable soil ing crop, yields a hay of doubtful value—a danger obviated by cutting when in early bloom. Success with this plant rests largely in the matter of early Fall sowing.

**Land Plaster.**—Is beneficial to all leguminous plants on most of the soils of Western Oregon. Hence it is recommended to be used at the rate of 50 to 100 pounds per acre each Spring, not later than the first of April. If the land is rich and the crop luxuriant, the plaster should not be sown.