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[Westgate, John Minton]

Alfalfa; growing for seed and
hay... 1910.



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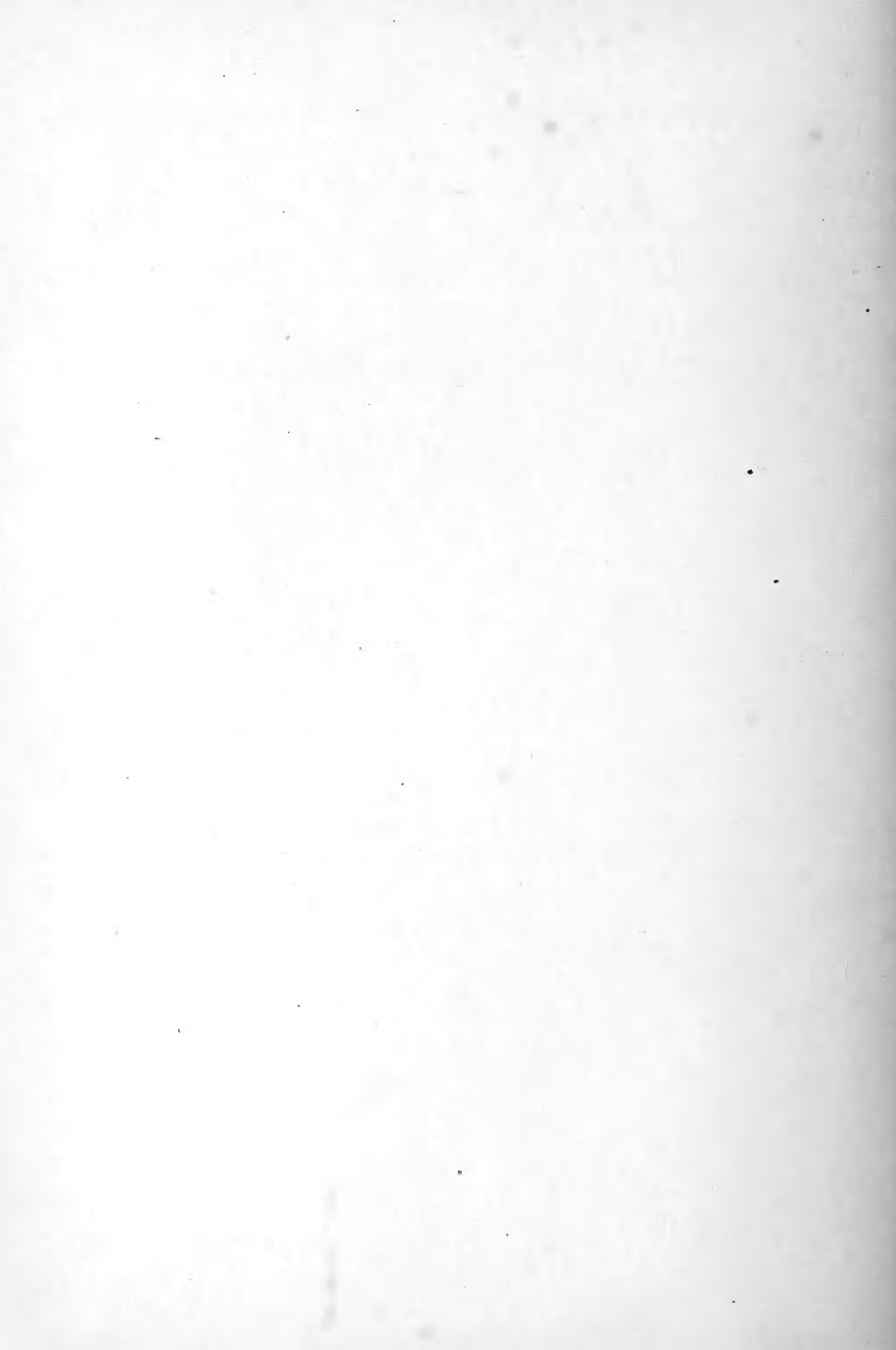
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ALFALFA

GROWING *for* SEED AND HAY



Westgate, John Minton.

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BIRSELL MANUFACTURING CO.

South Bend, Ind.

**Manufacturers of Alfalfa and Clover Hullers, Automatic Feeders,
Wind Stackers, Farm and Freight Wagons.**

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SB 205

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ALFALFA

By J. M. WESTGATE, *U. S. Dept. of Agriculture*

Alfalfa has been cultivated for many years in the irrigated sections of the United States, where it is by far the most important forage crop grown. Although it is one of the staple forage crops of every continent on the Globe, it is only within comparatively recent years that its culture has been taken up in many portions of the United States that are now proving adapted to its growth.

The history of the spread of alfalfa is interesting. The Persian armies carried it with them when they invaded Greece in about 490 B. C. The Arabs also raised it extensively and in fact the name "alfalfa" is the old Arabic term meaning "the best fodder". From Greece it spread successively to Italy and Spain, and finally to Mexico at the time of the Spanish conquest. From Mexico it was soon carried to the South American countries. It was taken from Chile to San Francisco in 1851. From there it has spread rapidly to all the irrigated portions of the West. Within the past 20 years it has proved successful in the Great Plains region, where irrigation is not possible, and where the reduced rainfall is insufficient for the production of the ordinary tame grasses which thrive in the Eastern States. By the adoption of suitable methods of dry farming successful crops of alfalfa are also being produced in some of the non-irrigated sections of the mountainous region of the West.

The value of leguminous crops both as feed and soil improvers has been recognized throughout historic times, but so far is practice behind theory that much remains to be accomplished in the way

of the extension before every farmer makes the best use of such leguminous crops.

The early attempts at its introduction dating back as far as 1750 show the East to have been the pioneer in its introduction in the United States. It has been grown scatteringly for more than a century in the limestone sections from New York southward to Texas. The varied attempts with alfalfa were made under many difficulties and most of them met with failure. It is especially in sections of light rainfall that it shows its superiority over red clover and timothy. The interest of the East in Alfalfa is of concern to the Western farmer in that it annually calls for large amounts of alfalfa seed, which can be produced only in the Western States. So great is the importance of alfalfa throughout the West that the whole farming system is built up in reference to the harvesting and curing of this crop. As the yield of each cutting runs from one to two tons per acre it is obvious that a large field of alfalfa requires the major part of the farmer's time to care for the three or four cuttings of hay usually obtained.

DISTRIBUTION OF ALFALFA IN THE UNITED STATES

According to the accompanying map, which was compiled from data secured from the census of 1899, the general distribution of the large alfalfa growing sections is indicated. Each dot represents one thousand acres in the county where the dot is located. For this reason, only the large alfalfa producing sections are dotted, as counties having less than one thousand acres are not marked.

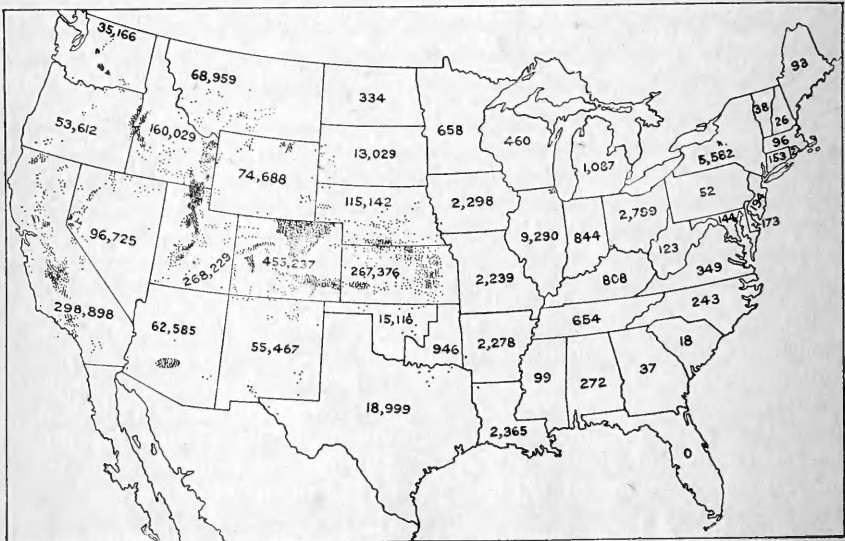


Fig. 1.—Map of the United States, showing the distribution of alfalfa in 1899. (Westgate—Farmers' Bul. 339. U. S. Dept. Agriculture.)

In the irrigated sections of the West, the production of alfalfa has greatly increased, especially where new areas have been thrown open to irrigation. The extension of alfalfa in the eastern half of the country has been so great that there is probably three times as much alfalfa being grown as there was ten years ago. Its rapid extension in the Great Plains region is indicated by the fact that in Kansas the assessors' reports in 1891, when alfalfa was first listed separately, showed 34,384 acres, while in 1907 there were 743,050 acres reported. Advance reports for the Fall of 1909 indicate approximately 1,000,000 acres in Kansas for the year 1909.

In the arid regions of the western half of the country, on the areas which have been brought under cultivation in the last ten years, alfalfa has been extensively planted. In the eastern half of the country the limestone sections offer the best prospects for the successful production of alfalfa. The limestone regions around Lake Champlain, and in Central New York are producing successful results. The limestone valleys of Maryland and Virginia, and the black prairie soils of Alabama and Mississippi are also proving adapted to alfalfa and offer good possibilities for farmers who are acquainted with the production of alfalfa in the West. The Eastern States call for a large amount of alfalfa seed from the West, and the chances of success with alfalfa in the East increase greatly as the special requirements for its production are understood and provided for.

DESCRIPTION OF ALFALFA.

The Western farmer needs no description of this well-known plant. The accompanying illustration, however, indicates its general appearance.

Alfalfa may briefly be described as being a deep-rooted, long-lived, herbaceous forage plant belonging to the same family as do the peas and beans. Its clover-shaped flowers are purple or violet in color and are borne in clusters from an inch to an inch and a half long. The pods are small and are quite tightly coiled in two or three spirals. The seeds are kidney-shaped and about one-twelfth of an inch long, and each pod contains several seeds.

One important characteristic of alfalfa is its long tap root. A specimen was on exhibition at the Chicago exposition which had a root thirty-three feet long. This had been produced in Colorado. The long tap-root enables the plant to reach the deep-lying plant food in the soil which is not available to the ordinary shallow-rooted crops. The long root system is also of importance in sections of limited rainfall, as by this means the plant is able to withstand severe droughts, which might otherwise be injurious. The extensive root system also enables the plant to respond quickly after cutting and produce several successive crops during the course of the season.



Fig. 2.—Alfalfa Plant in Early Bloom.
(Westgate—Farmers' Bul. 339. U. S. Dept. Agriculture.)

The wide distribution of alfalfa throughout the world indicates its remarkable adaptability to different climates and conditions. So far as climate is concerned, alfalfa can be grown in every State in the Union. It is, however, very exacting in the humid sections in the Eastern part of the United States as to soil conditions and treatment. It is grown below the sea level in southern California, and also at an altitude exceeding eight thousand feet in the Rocky Mountains. Under proper irrigation it yields abundant crops in the deserts of Arizona, where the climate is practically as hot as anywhere in the world. The hardier strains are also able to withstand the severe winters of the north central states, where the thermometer may fall as low as fifty degrees below zero, Fahrenheit. It succeeds without irrigation where the rainfall is only fourteen inches a year, and also in the portions of the Gulf States where the annual rainfall may reach as high as sixty-five inches. A rainfall of thirty-six inches a year is ample for this crop, and an amount in excess of this is usually a detriment. About twenty-four inches a year is best for seed producing purposes.

The young plants are not especially adapted to withstand alkali, although old plants will stand as much as any of the ordinary cultivated crops.

The natural conditions in the West are much more favorable to the production of alfalfa than are the conditions in the eastern part of the country.

SOIL REQUIREMENTS OF ALFALFA.

It is necessary in the East to exercise great care in the selection of soil for the prospective alfalfa field, but in the Western half of the United States most of the ordinary fields are well suited to its growth. In the East a deep, fertile, well drained soil, rich in lime and reasonably free from weeds is necessary. The lack of any one of these essentials is very apt to be the cause of failure. In the West, however, it is necessary only to ascertain that soil is fertile enough to grow the ordinary farm crops, and is deep enough to provide for the necessary deep-growing alfalfa roots. It is also essential that the soil be not too alkaline, as the young plants will not stand a large excess of alkali in the soil. If the soil lacks depth, the alfalfa plant is unable to utilize its deep-feeding root system, and is also less able to withstand the severe droughts which occur in parts of the West. Alfalfa will not withstand wet feet or sour soil. Fortunately, however, these conditions are very rarely to be met with in the Western half of the country. Some care, however, must be taken to avoid land that is subject to prolonged overflows from streams. During the growing period it will not generally withstand more than twenty-four hours of complete submersion, nor more than forty-eight hours of partial overflow. During the winter, however, fields have been known to remain under flowing water for over two weeks without serious injury. Stagnant water is always fatal to the alfalfa plants.

PREPARATION OF THE SEED BED.

The tender nature of the young alfalfa plant makes it desirable that the soil be in good tilt at planting time. The seed bed should be fine on top, but firm and thoroughly settled. In the Great Plains area, harrowing and packing should immediately follow the plowing. In addition, subsurface packing is to be advised when the seeding is to take place within six weeks of the plowing. If the firming of the seed bed does not take place there will be, at the bottom of each furrow, a dry mass of clods which were turned down from the old top soil. If this condition is at hand, it is apt to result fatally to the young alfalfa plants, as their roots can not usually puncture this mass of dry clods and air spaces. When the plowing is done in the fall it is usually desirable to leave the ground comparatively rough to catch the snow, and to prevent the loss of any rains or melting snow. This conservation of moisture is of special importance in the non-irrigated sections of the West, but also merits attention, even where there is water for irrigation. It is important that the preparation of the soil be uniformly good, as the poorly prepared spots are apt to fail and these bare places form the center from which weeds may spread and eventually destroy the stand. Summer-fallowing is often practiced in the semi-arid sections to

conserve sufficient moisture for the germination of the seed at planting time. This method is also effective in any section for ridding the ground of weeds. It may be practiced with good results in humid sections where late summer seeding is desirable, but where droughts are apt to occur at this time.

PREPARATION OF SANDY GROUND FOR ALFALFA.

It is quite difficult to establish alfalfa on soils that are so sandy as to drift when bare. On such soils the young unprotected alfalfa plants are very apt to be cut off by the drifting sand unless special precautions are taken. This danger may be avoided by applying a light top dressing of straw or horse manure just after seeding. This may be disked in with a disk set straight to imbed the straw so that there will not be any shifting of the covering. The disk should be run at right angles to the direction of the prevailing wind. Another method is to drill the alfalfa into the high-cut stubble of cane, kafir corn or millet. Still another method is to seed the alfalfa in a thin young stand of small grain, such as oats, which makes a rapid, early growth, and thus protects the alfalfa plants. Fortunately, these areas are usually quite limited in extent, but where they do occur, the problem of starting alfalfa is a serious one, and merits most careful attention, as when once established the stand is usually a permanent success.

SELECTION OF SEED.

Other things being equal, Northern grown seed should be used as the seed produced in the Northern alfalfa districts is very successful, but the Southern grown seed is apt to lack in hardiness, should it be seeded in the North. It is usually desirable to secure samples from several sources, and test them as to germination and purity before purchasing. The germination test may be made quite easily by counting out one or two hundred seeds and placing them in the home-made tester, consisting of two plates or saucers and two damp cloths or pieces of blotting paper.

Since the demand for alfalfa seed in this country has for some time exceeded the supply, there is, as a consequence, very little old seed on the market.

The securing of particularly fresh seed is not of as vital importance as the securing of seed free from bad weeds, as alfalfa seed usually retains a satisfactory germination for from five to seven years. (The loss of vitality due to age is usually indicated by the seed turning a reddish brown.) The greatest care should be taken to get the seed free from dangerous weeds. The weed seeds

most apt to be present in alfalfa seed are shown in the accompanying drawing.



Fig. 3.—Seeds of alfalfa and common impurities. (Enlarged; natural size at the right.) A, alfalfa; B, yellow trefoil; C, sweet clover; D, buckhorn; E, wild carrot; F, wild chicory; G, curled dock; H, large-seeded dodder; I, small-seeded dodder. (Westgate—Farmer's Bul. 339, U. S. Dept. Agriculture.)

It is generally advisable if possible to order the samples the winter before seeding, as it is often impossible in the rush season just before seeding to purchase seed from the same lot from which the samples were ordered. Some seed firms will book orders for seeds subject to satisfactory germination and purity tests. This practice should be more common, however, than it is at present, and would doubtless become more general if there was a sufficient demand for it on the part of the American farmer. In the great alfalfa producing sections of the West, the seed such as produced in Kansas, Colorado, Nebraska, Montana and Utah has been found to give excellent results in comparative tests including alfalfas from all parts of the world. The Turkestan alfalfa is quite cold resistant and will sometimes do better than the ordinary alfalfa in the semi-arid sections. The sand lucerne, which has to be imported from Germany and Bohemia, is both drouth and cold resistant, and is a more vigorous grower than is the Turkestan alfalfa. The Grimm alfalfa, of Minnesota, is also very hardy and cold resistant. These special strains of alfalfa, however, are usually to be recommended only in sections where the ordinary alfalfa fails, by reason of drouth or cold, and it must be borne in mind that even the most drouth resistant alfalfas are relatively slightly superior to the ordinary strains. There is yet to be discovered the

alfalfa that will grow without irrigation in desert sections. The dry land alfalfa, of Utah, is also to be included in the list of alfalfas that are slightly more drouth resistant than the ordinary alfalfa of the irrigated sections.

TIME OF SEEDING ALFALFA.

Alfalfa may usually be seeded any time that the ground is not frozen, and successful germination will be obtained. The extreme variation in climate and other conditions, however, usually make one or at most two months of the year the best for any particular locality. In the extreme North, late spring seeding is necessary, owing to the danger of winter killing of the small seedlings if the seeding is done in the late summer or fall. The Central and Southern districts usually call for spring seeding, as the alfalfa plants are usually able to withstand the weeds of midsummer, which prove so destructive to the newly-seeded alfalfa fields in the East, where late summer seeding is necessary. South of latitude 40 and west from the Mississippi River as far as central Kansas, seeding from the middle of August to the first week in September is usually successful. The general principle which should underlie the selection of the time of seeding is that the seedlings should be the largest possible size at the time when the most dangerous or critical period of their first year is anticipated. In the North, winter killing is the worst danger and hence spring seeding is to be recommended. In sections where winter weeds are bad, it is also desirable to seed in very early spring, in order to produce a good growth of plants by the time the weeds begin to trouble in the late fall. Where the weeds of midsummer constitute the worst enemy or danger, it is best to seed just after midsummer upon thoroughly prepared, weed freed ground. This makes the plants nearly a year old by the following midsummer when the weeds would be apt to cause trouble. Spring seeding with oats is good in such irrigated areas as Colorado, where alfalfa succeeds exceedingly well and is not subject to any great dangers. The accompanying illustration indicates the relative size of different seedings of alfalfa at the approach of winter. Spring seeded alfalfa would have been much larger and is to be recommended where there is no danger from midsummer weeds.

METHODS OF SEEDING.

The manner of seeding varies considerably in different parts of the country. The various methods agree in that it is necessary for the seed to be covered and not left exposed on the surface of the ground, as is often done with grasses and clovers. Alfalfa may be drilled or seeded broadcast either by hand or with a hand seeder or wheelbarrow seeder. It is an excellent plan to sow half the seed

one way across the field and the other half at right angles to the line of the first sowing. This insures a more even stand. The depth of planting varies to some extent with the soil and climatic conditions. Covering from three-fourths to one inch deep is usually sufficient on clay soil, but one and one-half inches are necessary for sandy soils or in the semi-arid sections, where deep covering is required to insure sufficient moisture for the germination of the seed. If the seed is sown broadcast, a light harrow weeder or brush may be used to cover the seed to the required depth. It is not usually advisable to roll the soil unless it be exceptionally light, as the soil is more apt to become dried out before the plants have become well set. A smaller quantity of seed can be used when it is drilled than if it is seeded broadcast. If the grain drill is used the amount seeded may be regulated by the use of leather thongs to reduce the feed.

Corn chop may be mixed with the alfalfa to secure a more even seeding. If a drill is used it is an excellent idea to first test it on hard ground, with the shoes not touching the ground. By this method it is possible to observe the rate at which the seed is being dropped, and by this method a proper regulation of the seeding can be secured.

RATE OF SEEDING.

The quantity of seed required per acre is much greater in the humid and irrigated sections of the country than in the semi-arid regions. In the West, fair stands have been secured with as little as from one to five pounds per acre, but this has been under particularly ideal conditions. Good stands are frequently secured from five pounds of seed to the acre in the drier portions of the West, where irrigation is not possible. A pound of ordinary alfalfa contains about 220,000 seeds. As there are 43,560 square feet in an acre each pound of alfalfa seeded per acre would give about five seeds to the square foot. Ten pounds of seed would provide fifty plants per square foot. Many of the seeds, however, fail to grow and a great portion of the young plants meet with fatal accidents. Old alfalfa fields have shown from one to six plants per square foot, and the field with but one plant per square foot producing as good yields as where there were six plants per square foot.

The following recommendations as to the rate of seeding are made as to the different sections of the country. Atlantic and Southern states 24 and 28 pounds per acre. States west of the Appalachian Mountains and East of the Ninety-eighth meridian, 20 to 24 pounds. Semi-arid sections, 5 to 15 pounds, depending on the average rainfall. In the irrigated sections, experienced growers usually seed about 15 pounds per acre. In all the above cases, where seed production is desired, it is necessary to use considerable less seed than when hay only is desired. A thick stand of alfalfa very



Fig. 4.—Alfalfa seedlings at the beginning of winter. 1, seeded August 15, 13 inches high; 2, seeded September 1, 5½ inches high; 3, seeded September 15, 2¼ inches high. The larger, early-seeded plants are much better able to withstand the winter than are the small, late-seeded ones. (Westgate—Farmer's Bul., 339. U. S. Dept. of Agricul.)

seldom produces a good seed crop. The idea should be to get about one plant per square foot over the field, if good yields of both hay and seed are desired. It is usually safest to seed a little thicker than desired, and then thin the plant to the desired stand by disking.

USE OF A NURSE CROP.

In the Eastern and Southern States, and in the semi-arid sections of the West, a nurse crop usually proves disastrous to alfalfa, even resulting in the ruining of the stand. In the irrigated sections of the West, however, alfalfa can usually be seeded safely with a nurse crop such as oats. In this case, however, the alfalfa succeeds in spite of the nurse crop, rather than by reason of it. In the extreme Southwest, barley is sometimes seeded with alfalfa in the fall. In the States bordering on Lake Michigan, a spring seeding of barley is often a success as a nurse crop for alfalfa. In this section, however, it is generally recommended that alfalfa be seeded alone in mid or late summer. In sandy soils a very light seeding of small grain as a nurse crop is sometimes used to prevent the sand from blowing and injuring the young plants. In all cases, the nurse crop when used should be cut as soon as it shows signs of injury to young alfalfa plants.

INOCULATION FOR ALFALFA.

The legumes or pod-bearing plants are different from other farm crops in that they normally possess a species of bacteria upon their roots. These bacteria, or minute organisms, are able to utilize the nitrogen of the air and convert it into a substance that can be used by not only the leguminous plant itself, but also by succeeding crops grown upon the same soil. Alfalfa is no exception and in fact it usually fails to succeed unless the roots are supplied with these bacteria which produce the nodules on the roots. Fortunately most of the soils of the western half of the United States appear to possess these now or are so well adapted to their growth that what comes in the dust storms or by floods or with the seed itself, is enough to give the plants a start. After this, the bacteria can spread rapidly. In the humid sections, where the soils lack lime, and have a tendency to be poorly drained, artificial inoculation is necessary. For this purpose, soil from a successful alfalfa field or soil from around the roots of sweet clover may be used. The artificial cultures are more convenient, but are not so sure as the soil inoculation. The latter method is open to some danger of carrying harmful weed seeds or plant diseases.

TREATMENT OF A STAND OF ALFALFA.

As a usual thing a successful alfalfa field requires little treatment after seeding, other than the prompt removal of the different cuttings. Any delay in cutting after the next growth starts results unfavorably to the succeeding crops. Disking a field of mature alfalfa plants usually rejuvenates the stands if the disks are set properly so as to split the crowns rather than to cut them off. If the stand be too thick as it is apt to be if seed production is desired, the disk harrow with the disks set to cut off a portion of the crowns, is effective in thinning the stand. The cultivation of the ground seems to have a very beneficial effect upon the growth of the plants. If insect enemies threaten the stand it is usually best to immediately cut and rake off the young growth. The insects thus deprived of their food supply either die or move on to other quarters.

It is also important to remove the windrows or cocks from the field as promptly as possible in event of rain, as the plants underneath are soon smothered out and these bare places form the centers from which weeds may spread. Some large growers of alfalfa make it a practice to disk their neids lightly at least once a season. An implement known as an alfalfa renovator is sometimes employed where the ground is free from stones or gravel. This is a disk harrow with the disks armed with teeth as shown in the accompanying illustration.

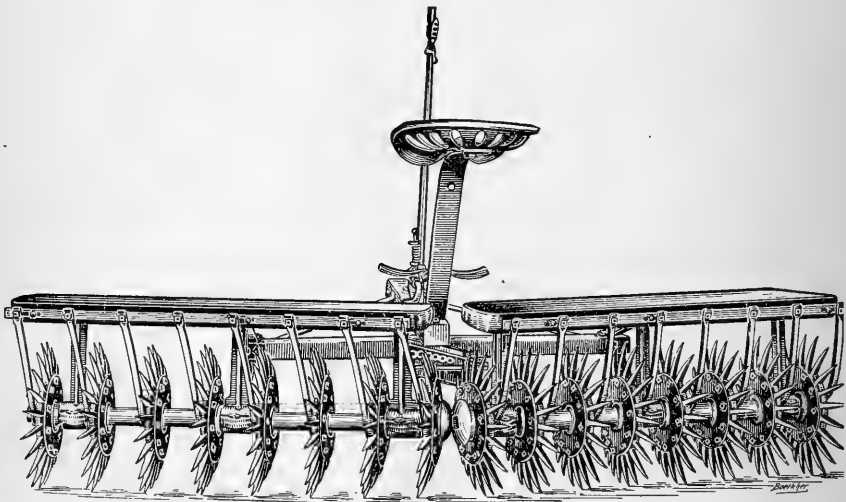


Fig. 5.—An alfalfa harrow. (Farmers' Bul. 342. U. S. Dept. Agriculture.)

ALFALFA SEED PRODUCTION.

Practically all of the alfalfa seed raised in the United States is produced west of the one hundredth meridian. Even in the West the seed production industry is apparently only in its infancy. The results in any particular section are usually somewhat uncertain, since the yield may be enough one year to pay for the land upon which the crop is grown and the next year it may not pay the expenses of harvesting the seed. A study of the general principles underlying the production of alfalfa seed indicates that when all the factors are better understood the production of a paying crop of seed each season will be much more uniform than at present. The strong demand for alfalfa seed at high prices makes this branch of farming operations offer one of the most promising lines of endeavor for all farmers situated in sections where seed production is a possibility. The alfalfa plant, while naturally adapted to a very wide range of conditions is decidedly particular as to what conditions must be present in order to make it produce satisfactory crops of seed. A great many fields of alfalfa are left for seed each season under conditions where seed crops are out of the question. These experiences are unfortunate as they tend to deter others from producing seed under conditions where success would be reasonably certain. For this reason it is important to have in mind the conditions which bring about failure or success with the alfalfa seed crop.

REQUIREMENTS FOR ALFALFA SEED CROP.

A thin stand is essential and the lack of this perhaps more than anything else has been the cause of many of the failures to produce satisfactory crops of seed. It is perhaps most essential to have the plants far enough apart on the ground so that each plant may develop without contact with its neighbors. In this way each plant will present a semispherical mass of blossoms to the sunlight, whereas, if the plant were crowded there would be room for only relatively few blossoms at the top of the plant. The undulating surface of a thin alfalfa field in bloom has about twice the area of blossoms as does a thick stand where the blossoms can exist only on the tops of the plants. The accompanying illustration shows a plant grown isolated from its neighbors and bearing its pods over the entire plant rather than merely at the top.

Importance of a Relative Shortage of Water at Seed Setting time:—If there is an abundance of water present in the soil by irrigation or from rains at the time the seed is supposed to be setting, failure will be almost certain. In other words, it is necessary to have a period of relative drought at this time, as otherwise the succeeding crop of stems will come on and develop at the expense of the seed crop. With the soil relatively dry, however,

the basal shoots to form the next crop will be unable to start up and as the result the small amount of water which is available will be used by the seed crop instead. It has often been a matter of common observation that in such sections as eastern Kansas, where as a rule there is too much rain for a successful seed crop, that in years so dry that the corn crop fails there will be a very large seed crop on the alfalfa fields that are left to stand for seed. Experiences such as these give us a hint as to what conditions must be provided for the best possible crops of seed. In other words, sections of the country where there is a hot summer drought, or in irrigated



Fig. 6.—Heavily seeded alfalfa plant grown near Washington, D. C., where the climatic conditions are much more unfavorable to the production of alfalfa seed than in the semi-arid regions. (Brand and Westgate—B. P. I. Circ., 24, U. S. Dept. Agriculture.)

sections where there is apt to be a shortage of water at the second crop, offer special advantages for alfalfa seed production.

Hot Weather Necessary for Seed Production.—For some cause alfalfa will not set seed in cool weather and for this reason the sections which are relatively warm during July and August afford the best possibilities as regards the temperature for alfalfa seed setting.

Which Crop to Leave for Seed.—In deciding which crop to leave for seed the conditions required for setting a good crop should be carefully considered and that crop left stand which will most nearly receive these ideal conditions. As a rule the first crop does not produce a good seed crop. This is partly because the plants are uneven in ripening and partly because there is apt to be too much moisture in the soil and too little warm weather for the best results. In the north and in the higher altitudes the second crop may be matured so late that the cold nights of August will injure the seed prospects, and on the other hand the disadvantages of the saving of the first crop may be great. This will necessitate the clipping of the first crop quite early to even up the stand and bring on the second crop at the time the hottest weather of summer may be expected. A very good rule is to figure on the number of cuttings of hay normally to be secured in the section, and then let the next to the last cutting stand for seed. That is, if three crops are usually secured, it is best to let the second crop stand for seed.

Whether to Cut for Hay or Seed.—As a general rule it can be determined when the plants are in full bloom whether or not it will pay to allow the crop to stand for seed or not. If the blossoms blight and fall without setting more than four or five pods per cluster, or if heavy rains come at blooming time, it is usually useless to expect a seed crop, and more profit will be obtained by cutting promptly for hay. When the basal shoots for the next crop are observed to be starting, this generally means that the seed pods will blight and fall and the seed crop be a failure.

The points brought out in the above pages indicate the fact that in the humid sections or where the rainfall is more than thirty inches a year but little can be expected of alfalfa seed production. This is extremely fortunate for the drier sections of the country, as it gives such sections a veritable monopoly of the seed-producing business and furnishes a very valuable crop, which can usually be turned promptly into cash. Since the methods of producing alfalfa seed vary in the irrigated and non-irrigated sections, these two types of localities will be considered separately.

PRODUCING ALFALFA SEED UNDER IRRIGATION.

One of the advantages which irrigated sections offer to the alfalfa seed producer is the fact that the moisture supply is under

control. This is a most important consideration owing to the special requirements of the alfalfa seed field for just the right amount of water at the time the seed is setting. The only drawback from the standpoint of the alfalfa seed producer is the fact that the relatively small areas of land that can be irrigated make the land extremely valuable for other purposes, which while not always netting more than would a good seed crop, yet are somewhat more certain as to their yields.

Irrigated sections not possessing good transportation facilities by reason of great distance from railroads, offer especially good possibilities for alfalfa seed production, since the produce of an entire field may be transported at a comparatively small cost.

There also exist numerous localities where there is sufficient water for irrigating purposes up to early or middle summer. These sections are exceedingly well adapted to the production of alfalfa seed as the relative shortage of water after July first is just what the seed-producing alfalfa plants need for the best development of seed. In this way the alfalfa fields bring in good revenues in spite of the shortage of water, whereas, if hay alone or other crops were to be produced, the yield of the same would be materially reduced.

In supplying water to an irrigated alfalfa field which is to be allowed to stand for seed, the idea is to give it just enough water to enable it to make good, but not too rapid growth up to the blooming period. After this blooming stage is reached, there should not be sufficient water in the soil to enable the basal shoots to start to make the next crop, as this would ruin the seed crop. It will usually be sufficient to give one irrigation shortly after cutting and this should last until the seed is harvested. However, in soils not retentive of moisture, it may be necessary to give a second irrigation when the plants are about a foot high or twenty days after cutting. An irrigation at blooming time is practically certain to ruin the prospects for seed.

METHODS OF IRRIGATION.

In irrigating an alfalfa seed producing field, care should be taken not to give certain parts of the field overly heavy applications of water, as this will be apt to materially reduce the prospects for seed on these parts of the field. For this reason the flooding system from ditches, which is in rather common use throughout most of the alfalfa sections of the West, and the check system much used in California are not ideal in this respect, as the portion of the field at the intake is apt to be flooded too much if the further stretches of the field or check be allowed to receive a sufficient supply. To overcome this objection the method of irrigating by shallow furrows

across the field is often to be recommended, as this allows of a rapid and light irrigation and permits the water to be controlled to a much greater degree of certainty than by either of the flooding systems just mentioned.

HARVESTING THE ALFALFA SEED CROP.

If the alfalfa plant ripened all its seed at once as do wheat and corn, it would not be difficult to determine just when the seed crops should be harvested. Unfortunately the pods never ripen with absolute uniformity and the cutting must be done during a time when the greatest number of pods are in the proper condition. This will mean that a small percentage of the pods are so ripe as to shatter badly, while a corresponding percentage are too green to have matured seeds. A good rule is to cut when about two-thirds of the seed pods are brown in color.

There are numerous devices for cutting the seed crop, but the underlying principle is to get it into bunches and thrashed with as little handling and consequent shattering as possible. The most primitive method is to cut the plants with a mowing machine and rake in windrows and load on the wagons the same as though the crop were being cut for hay. This is not to be recommended, as much of the seed is lost in this way. It is a much better plan to have some sort of dropping attachment on a mowing machine or to use a self-rake reaper. One attachment on the ordinary mowing machine is shown in the accompanying illustration.

This consists of a slat-box at the rear of which a board can be lifted, allowing the accumulated plants to slide off the slat teeth at the bottom. It is usually advisable to mow the alfalfa while the dew is still on in the morning, and get it into shape to leave on the field as soon as possible to avoid shattering. When the seed crop is ripe most of the leaves have fallen and the stems are comparatively dry and on this account it is possible to put the alfalfa into cocks very soon after cutting. This prevents bleaching of the seed and unless heavy rains occur the inside of the cock is not apt to be damaged. In sections where it is desirable to leave the cocks standing for any length of time in the field, heavy muslin shock covers may be recommended. These should be forty inches square, with a stone, one-half of a horse-shoe or a ball of cement attached to each corner. A great deal of shattering can be avoided if the cocks are made large enough so that two good pitchers can place the entire cock on the rack at once. It is very desirable to have a rack bottom made of matched flooring with an extra board placed around the outside to hold in the seed. A large canvas can also be utilized to catch the fallen seeds at the bottom of the rack.

If a self rake reaper is used the bunches can be nicely placed out of way of the horses and machine. Three or four of the bunches should be placed together to prevent bleaching and reduce the

danger from rain. In very dry sections where there is no danger from rain, alfalfa may, if necessary, be cut with a header, leaving



Fig. 7.—Mowing machine with dropper attachment in operation in a field of alfalfa in cultivated rows in western Nebraska. The rows in this case are one-half mile long. (Brand and Westgate—B. P. I. Circ. 24—U. S. Department Agriculture.

the alfalfa in windrows across the field, to be removed within a week or two after harvest. An ordinary grain binder can be used either with or without the binder attachment. If the bundles are bound they may be readily shocked and can also be stacked the same as are wheat bundles.

INJURY TO THE ALFALFA SEED CROP BY RAIN.

Attention has already been called to the injury of the seed of the alfalfa crop if a rain comes at the blooming period. The rain may do almost as much damage to the seed crop if it comes when the newly-cut crop is fully exposed to the elements. For this reason it is important to so handle the crop as to reduce the danger from rain to a minimum. A single rain is not especially injurious to the alfalfa if it is in cocks, but a long period of wet weather will cause the seeds to sprout and will greatly injure the appearance of the seeds which are not actually destroyed. The alternate wetting and drying of the seed pods even from ordinary dew will sometimes

cause the pods to burst and lose a considerable portion of their seed. Considerable care must be taken in stacking to prevent heating. The stems pack very closely and will be apt to heat even when apparently nearly dry when stacked. With some farmers it is a practice to mix grain straw with alfalfa hay to permit it to be stacked a little greener than would otherwise be possible. As a usual thing alfalfa may be stacked in from four to six days after cutting if it has been allowed to cure in the windrows or in small cocks. If cured in large cocks more than a week may be necessary. Alfalfa is ready for stacking several days before it will do for threshing or hulling from the field. If alfalfa is stacked it must be borne in mind that the relative absence of leaves on the stems make the stack less able to shed water than where alfalfa hay has been stacked. For this reason it is desirable to provide some sort of a cover for the stack. Long hay, straw, millet or even a load of freshly cut alfalfa hay may be used to top off the stack if it is not possible to provide a tarpaulin. If seed is desired for fall sowing it is usually necessary to hull or thrash either from the field or very shortly after stacking, as otherwise the alfalfa in the stack will go into a sweat which will make the pods so tough that the seed can be removed from the hulls only with great difficulty. If the seed is not desired for immediate use or sale the stack should be given good protection from the rain and thrashed or hulled late in the fall when work is slack. The methods described are those practiced in the alfalfa seed producing sections of the West. Much more primitive methods are to be observed in parts of Asia where alfalfa has been grown for untold centuries. Much of the Turkestan alfalfa imported into this country is thrashed out on outside thrashing floors by oxen and horses. A layer of the heavily-seeded alfalfa plants are spread over the floor for a depth of about a foot and horses or oxen are then driven around the alfalfa covered enclosure until the greater part of the seed has been shattered. The straw is then pitched away and the seed freed from dust by throwing it into the air with shovels and allowing the winds to blow away the lighter particles. These conditions, however, will not last long, as the American method of using special machines is being adopted by them, as it is possible to save a much greater portion of the seed and the product is rendered of a much better grade.

IMPORTANCE OF PRODUCING PRIME ALFALFA SEED.

With proper precautions No. 1 alfalfa seed may be procured with but little more expense, than second quality seed and the price will be much better. It is also important that the light seeds and the weed seeds be removed. This can be accomplished with a good fanning mill before selling. It is often the practice of a number of local dealers to fit up an alfalfa cleaning room for the use of their farmer patrons. In other instances farmers may club together and obtain a fanning mill and the power for operating the same. In this way the seed of an entire locality may be uniformly graded and

will command a relatively higher price than if each lot had to be graded separately, or if the second quality seed were bulked with that of the first quality. Prime alfalfa seed is of a light yellow color, with a slightly greenish cast. The seed which is of a brown dead color is usually low in vitality and reduces the selling quality of the seed. In localities where it is the practice to bulk the seed of a number of farmers it is important that poor lots of seed should be sold separately and not bulked with the good lots, as the grade of the seed will be reduced considerably more than the value of the poor lots of seed. One advantage which the Western farmer has over his European competitors in the alfalfa seed producing business is the relative freedom from obnoxious weeds if he exercises reasonable care. Dodder is probably the worst weed with which he has to contend, as this is quite difficult to clean out from the seed entirely if it is present, and a very small percentage of the dodder seed in alfalfa is dangerous, owing to the rapidity with which a single dodder plant spreads from plant to plant. The illustration on page 8, (Fig. 3) shows a number of weed seeds which are usually found in imported alfalfa seed. The dodder and dock are sometimes present in the American grown seed. Foxtail and lamb's quarter are also apt to be present in seed produced in the western part of this country. In the Great Plains area, Russian thistle is often present, and this seed may be found in some of the alfalfa seed secured from these regions. It is quite difficult to entirely remove it from the alfalfa seed.

YIELD OF ALFALFA SEED.

The yield of alfalfa seed secured in this country ranges from nothing up to twenty bushels per acre. A yield of two bushels per acre is usually considered necessary to pay expenses, while from three to four bushels per acre may be considered a fair average over considerable sections. In certain sections under very favorable conditions yields have been known to run as high as twenty bushels per acre. The conditions, however, for such yields must be ideal and it is a study of the conditions present when such yields are secured that serve to indicate the best possible conditions for the production of an alfalfa seed crop. At Chinook, Montana, little attention had been paid to the production of seed until one year when there was a great shortage of water for irrigation. The ground was so dry that the hay production was apparently hardly worth cutting and many farmers let the crop stand for seed. The result in many instances was enough seed to more than pay for the ground upon which the alfalfa was growing. This clearly shows the necessity of a relative lack of water at the time of seed setting and offers a hint to parties located in irrigated sections even where there is no shortage of water at this period.

ALFALFA SEED PRODUCTION IN SEMI-ARID REGIONS.

Certain parts of the semi-arid regions offer special facilities for the production of alfalfa seed. These sections comprise part of the Great Plains extending from Texas to South Dakota, where the rainfall averages from 14 to 25 inches annually. Where the rainfall is less it is insufficient for the proper development of the plants to enable them to set seed and where the rainfall is greater than 25 inches the seed setting is apt to be greatly reduced by rain. Other semi-arid regions which offer promise in alfalfa seed production are parts of New Mexico, Utah, Eastern Oregon and Washington. Alfalfa seed production is always more or less of a gamble where the moisture conditions are not under perfect control and it must be borne in mind that seasons unfavorable to the production of seed may occur at any time. If, however, the alfalfa is planted so that it can be given surface cultivation in order to conserve moisture if the drought be too severe, failure is much less apt to result in the unfavorable years.

ALFALFA IN CULTIVATED ROWS FOR SEED IN SEMI-ARID REGIONS.

Almost every grower of alfalfa seed has noted that the isolated alfalfa plants are usually loaded with seed. Instances have been noted where single plants produced enough seed to make fifteen bushels per acre if the plants were grown singly in hills 30 inches apart each way. This indicates the possibilities of the method, although in actual practice no such yields can be expected. The method of growing alfalfa in wide cultivated rows so that the plants may be cultivated the same as corn, is comparatively new in this country, although it was advocated more than a hundred years ago in England, where hay alone was desired. Since this phase of the industry is so new rather detailed instructions will be given, as, if the results obtained by the few pioneers who have gone into this, can be repeated by everyone, the semi-arid sections of the country will come to be the principal source of alfalfa seed in this country and give in addition a probable surplus for export to less favorably situated portions of the world.

PREPARING THE SEED BED FOR CULTIVATED ALFALFA ROWS.

The preparation of the ground should be such as to rid it as far as possible of weeds and weed seeds, as the young alfalfa plants in the dry regions are very slow in growth at first and no intertillage is possible until they are large enough to prevent them from being covered up by the cultivation. It is also necessary to provide a seed bed very well firmed either by settling or rolling and in the drier sections of the semi-arid regions summer fallowing for the entire preceding season may be necessary to insure sufficient moisture in the ground to provide for the quick germination of the seed. This summer fallowed land must not be allowed to grow up to weeds and should be harrowed frequently enough to keep the weeds down, and in any event should be harrowed after each rain in order to break the crust which would otherwise allow the soil to dry out. The soil mulch thus secured will reduce the loss of water by evaporation and in the following year will place at the disposal of the young plants a considerable proportion of the two years' rainfall.

In the northern sections, where spring planting is advisable on account of winter-killing of fall planted seedlings, surface tillage must be continued until seeding time. If the ground has been planted to corn or cane and given good cultivation the preceding year it may be unnecessary to summer fallow.

In the Great Plains country, where spring seeding is also advisable, the ground should be harrowed and rolled immediately after plowing, especially if the plowing is done in the spring. If fall plowing is practiced the natural settling of the land will do much toward bringing it into proper condition for the young alfalfa plants. In Utah and in the southern part of the Great Plains area the fall plowing may be left unharrowed until the following spring. Rough plowed land in the winter time usually holds a larger proportion of rain and snow than if it has been harrowed.

Dr. W. J. Workman, of Ashland, Kansas, has developed a method which is giving very good results on buffalo-grass sod. A 16-inch sod plow is used to cut a furrow 2½ inches deep through the sod, a stirring plow following immediately in the furrow left by the breaking plow and leaving a furrow 8 inches deep. On the next round the breaking plow puts the strip of sod in the bottom of the deep preceding furrow, where it is completely covered by the new soil turned up by the stirring plow. The harrow is kept at work to smooth and firm the ground as fast as it is turned, and the alfalfa is seeded with the grain drill while the soil is still moist. This method possesses the special advantage of allowing the alfalfa seed to be put into the ground practically free from weeds or weed seeds.

PREVENTING DRIFTING OF SOIL IN ALFALFA ROWS FOR SEED IN SEMI-ARID REGIONS.

If the ground is so sandy as to drift or blow during high winds it is a good practice to sow alternate rows of oats or barley and make these rows run at right angles to the direction of the worst winds. The first cultivation of the alfalfa plants will destroy the grain, which should not in any case be left long enough to injure the young alfalfa plants. Another method is to sow the alfalfa between rows of high cut thickly seeded sorghums or kafir corn. The disadvantage of this method is the danger of covering up the young alfalfa plants when the sorghum or kafir corn stubble is plowed up in cultivating. Still another method is to seed the alfalfa in shallow listed furrows running at right angles to the direction of the prevailing heavy winds. These furrows should be shallow or occasionally heavy rains would be apt to cover the young plants. If this method is used it will probably be necessary to seed the alfalfa either with a garden drill or with a grain drill by making the necessary changes in the plate holes. The ridges made by the lister will also prove efficient in catching the snow during the preceding winter and spring harrowing will lower the ridges if they are too high at planting time.

DISTANCE BETWEEN ALFALFA ROWS FOR SEED.

The best results have been obtained by sowing the seed in rows about three feet apart. In the drier sections 42 inches is none too narrow, but in any event the rows should never be less than 28 inches apart or there will be difficulty in cultivating them. If an ordinary grain drill with shoes 8 inches apart is used, four out of every five holes may be stopped up. This will make the rows 40 inches apart. On the other hand if three out of every four holes are stopped up the rows will be 32 inches apart.

RATE OF SEEDING ALFALFA IN CULTIVATED ROWS.

When the plants are grown they should average about a foot apart in the row. They must, however, be considerably closer than this at first, as many of the plants are apt to succumb to the unfavorable conditions. Satisfactory results have been secured in seeding the alfalfa with an ordinary grain drill so regulated that it would sow 12 pounds of seed per acre if all the holes were in operation. Since, however, four out of every five holes are to be stopped up, only about 2½ pounds of seed will be sown per acre, by this method. The stand in cultivated rows should be about as thick as rows in ordinary drilled alfalfa fields where the rows are usually about eight inches apart. It will usually be quite diffi-

cult to make the grain drill seed the alfalfa slowly enough. This difficulty may be overcome by mixing corn chop with the alfalfa seed or by reducing the feed in the grain drill with strips of leather. In any event the drill should be first tested on bare ground with the shoes not touching the ground. In this way it is possible to note the rate at which the seed is being dropped and to properly regulate it.

TREATMENT OF ALFALFA IN ROWS THE FIRST SEASON.

The well settled moist seed bed which is to be provided for the best growth of alfalfa unfortunately furnishes the same ideal conditions for the rapid development of the weeds. Several cultivations are necessary even the first season to hold the weeds in check. A two-row cultivator provided with narrow shovels or bull tongues is best for this work. A small box sled or good fenders should be attached to the cultivator so as not to cover up the young alfalfa plants. The rows should not be ridged up, as this will interfere with the mowing of the plants later on. The stand will be thicker the first season than in the subsequent seasons. Some of the plants are destroyed by cultivation and the less vigorous plants are killed by the droughts of summer or the cold of the first winter. Unless the plants are so thick as to crowd one another no thinning should be done by cross harrowing while the plants are still small. Experience indicates that the best growth may be expected if the plants are not clipped the first season, especially if they do not come into bloom and start to set seed. If the latter condition prevails it may be necessary to clip high with a mower.

TREATMENT OF ALFALFA IN ROWS AFTER THE FIRST SEASON.

During subsequent seasons the treatment will not differ much from that of the first season. At the beginning of the second season the plants should not average more than four to the foot. These, however, should be reduced by cross disking or otherwise until when the plants are fully grown they may be a foot or even more apart in the row. There should always be a noticeable space between each plant. If the thinning is done with a hoe or mattock it is often desirable to do this when the plants are beginning to set a crop of seed, as then the undesirable individuals can be eliminated and the heavy seeders kept. Cross disking will thin the plants very readily and is generally best where the work is done on a very large scale. The first clipping should be so timed as to bring the time of seed setting in mid summer or slightly later, when the most favorable conditions for seed production are present. Where the seasons are short, this first clipping must be made while

the plants are still very small. It will usually be well for persons with an experimental turn of mind to undertake some experiments along this line to obtain definite information. One row may be given an early clipping and then left for seed; another a later clipping and still another left for seed after the first crop has been cut for hay at the usual time. In this way the experience which would take a number of seasons will be obtained in one year. The methods of harvesting are not essentially different from those employed in the irrigated sections.

POSSIBILITIES OF SEED PRODUCTION IN CULTIVATED ROWS IN SEMI-ARID SECTIONS.

Since this method promises to be adapted to sections where thick broadcasted stands of alfalfa produce at best very light yields of hay too much must not be expected of such a field for alfalfa seed. That is, if three bushels of seed per acre can be secured on cheap short grass land the method will pay abundantly. The results thus far obtained show that this method gives promise in Utah, eastern Colorado, western Kansas, western Nebraska and also South Dakota. Yields of seed to the rate of five bushels per acre have been obtained. It is suggested that persons who are interested in this, try it out on a comparatively small scale until they see just what it will do under their conditions. Such an experiment should be surrounded by other alfalfa or be of sufficient size so that the grasshoppers will not ruin all the stand.

It is expected that machinery now in use in most communities can be adapted to the growing of alfalfa seed in rows. Those undertaking the work will be pioneers in every sense of the word and to them will fall the work of inventing new types of machines to suit the needs, and upon these will depend for a large extent the practical success of this method. The secret of the success of this method lies in the fact that the isolated alfalfa plants produce the heaviest crops of seed, coupled with the power of the farmers in the semi-arid regions to regulate the supply of moisture by surface tillage, thus bringing about just the conditions required for the best success in this line.

ALFALFA AS A HAY PLANT.

It is estimated that 80 per cent of the alfalfa of the country is utilized in the form of hay. The number of cuttings varies from eight in the extreme southwest to only two in the extreme northern and semi-arid sections. Three cuttings per season may be taken as a fair average the country over. In very dry sections, however, one cutting may be all that can be secured in dry seasons. In good

growing weather alfalfa will usually grow nearly an inch per day, and usually 30 or 40 days in good growing weather are all required for it to reach a growth for a good crop of hay.

TIME OF CUTTING ALFALFA FOR HAY.

The general rule as to the time of cutting alfalfa is to mow it just as it is coming into bloom, or when about one-tenth in bloom. Feeding experiments performed in several of the State experiment stations show that the feeding value is higher when the alfalfa is cut in early bloom. Experiments at the Kansas Experiment Station show that with hay cut when only one-tenth in bloom, the protein content, the muscle building part of the hay was 18.5 per cent, while with that cut when one-half in bloom, the protein content had become 17.2 per cent, and when cut in full bloom contained only 14.4 per cent of protein. At the Utah Experiment Station in an experiment extended over a period of five years it was found that hay cut when in full bloom produced 562 pounds of beef annually to the acre, while that cut in early bloom produced 706 pounds per acre and the hay that was not cut until one-half the blooms had fallen produced only 490 pounds of beef per acre per year. From this experiment it will be seen how important it is from the feeding standpoint to cut the alfalfa early enough. Another good indication as to the time of cutting is the appearance of the basal shoots at the base of the old stems. These are to form the next crop, and the cutting should not be delayed after they are more than an inch in length, as otherwise they will be clipped off and the next crop greatly retarded. In case of dry weather, however, these basal shoots do not form early and in no case should the cutting be delayed after the early bloom if the best cutting of hay is desired.

METHODS OF HARVESTING ALFALFA HAY.

Methods of harvesting vary a good deal in the different parts of the United States. The underlying motive in each section, however, is to get the hay to the feed lot, the barn, or the stack with the least possible amount of handling and exposure to the weather. In the Western States, where the rainfall is relatively light, the problem of obtaining a prime quality of hay is much less difficult than in the humid sections, where the rainy weather often makes first quality of hay an impossibility. In the great alfalfa sections it is usually the practice to start the mowers in the morning and rake the hay in the windrows the following day. The hay is then cocked or is stacked or baled direct from the windrows as soon as the hay is sufficiently cured. The stacking can usually take place in two days after the hay has been raked, but at least three days

must elapse before it is in condition to bale. The raking, however, begins as soon as the leaves are wilted, or while the stems are still green. It may be cocked as soon as the stems are what is known as "half dry". It may be stacked when the moisture can no longer be twisted out of the stems. It is not in condition for baling, however, until the stems will break under heavy twisting in the hand.

MACHINERY FOR MAKING ALFALFA HAY.

There has been an increasing tendency to introduce machinery which will enable the alfalfa to be put up on as large a scale as possible, and with the least amount of hand labor. Mowing machines cutting a swath six or eight feet in width are sometimes used on the large alfalfa fields. The rakes may be the usual dump rakes or they may be the side-delivery rakes, which leave the hay in a continuous windrow parallel with the swath. In this latter condition it is then in proper position to load on the rack with the hayloader or to be gathered with sweep rakes, buck rakes or "go-devils" as they are sometimes called. At the barn, hay forks or stackers do away with the necessity of much of the hand pitching. With them it is possible to lift 100 to 500 pounds of hay from the load and drop it in the desired place on the stack or in the mow. In this way with proper attention to curing in the field the loss of the valuable and nutritious leaves is reduced to a minimum.

IMPORTANCE OF LEAVES FOR HAY.

One of the worst dangers to be guarded against in the whole process of alfalfa hay making is the loss of the leaves due to shattering. Although but two-fifths of the total weight of the alfalfa plant is in the leaves, yet three-fifths of all the protein, or muscle-making part of the alfalfa plant is contained in them. To put it in another way, it requires 100 pounds of stems to contain as much protein as is found in 45 pounds of the leaves. Analyses have indicated that the leaves are even richer than bran for feeding purposes. Much of the loss of the leaves, mostly occurring during harvesting operations, might be saved by proper attention to the curing of the hay. If the hay be cocked or put into large windrows when the leaves are wilted but are not yet dry, the moisture in the stem passing into the leaves will cause the hay to sweat, and in this way the whole plant becomes gradually wilted and the leaves are rendered pliable on ultimately drying, instead of being brittle as when dried out completely in the sun. The author has harvested crops of alfalfa where by giving careful attention to the curing process the entire crop was removed without leaving any leaves behind on the ground. On the other hand he has observed fields where the loss from the shattering of the leaves was probably 25 per cent.

When one considers that the shattered leaves are really as valuable or even more valuable than good wheat bran, the importance of saving them must appeal to any interested observer.

ALFALFA HAY GREATLY INJURED BY RAIN.

Unfortunately a good deal of the protein or nutritious portion of the alfalfa hay can be dissolved by rain, just as is so much sugar. As much as 40 per cent of the protein content of hay has been lost by a two weeks' exposure, aggregating a total of less than two inches in experiments conducted by the Colorado Experiment Station. The protein content of the hay was reduced from 18.71 per cent to only 11.01 per cent. This shows clearly one of the handicaps to the success of raising alfalfa hay in sections where heavy rainfall is apt to be great during the alfalfa season. Even a slight rain destroys the green color of the hay which is so characteristic of the western-grown hay cured without having been wet. In this respect the States having a light rainfall have a great advantage over the States having an abundance of rain during the summer months.

STACKING ALFALFA HAY.

The use of hay forks and stackers in almost all of the alfalfa districts makes it possible to build very large stacks. The large size stacks indicated in the illustration have a decided advantage over the smaller stacks as a smaller percentage of the hay is exposed to the weather, which usually injures the outside of the stack to a depth of several inches.



Fig. 8.—Stacking alfalfa in the West. The new crop is stacked on the top of the preceding crop by the use of large hay forks. (Westgate—Farmers' Bul., 339—U. S. Dept. Agriculture.)

Alfalfa hay does not shed water readily and if barn protection or a shed roof cannot be provided it is commonly the practice to cover the stack with canvas or with grass hay or millet to shed the water. A load of green alfalfa placed upon top of the stack will, on drying, form a fair protection from the rain, since the leaves will lay folded one over the other somewhat after the fashion of shingles on a roof. The fact that alfalfa suffers so severely from being wet makes it highly important that care be taken to protect the alfalfa stacks from any rain which may fall before the hay is used. It is also desirable that the stack be built upon some sort of a foundation, especially if water is apt to run under the stack, as otherwise a considerable portion of the base of the stack may be rendered practically worthless.

BALING ALFALFA HAY.

When alfalfa is fed on the farm where it is raised, there is little need for baling, but where it has to be transported to any



Fig. 9.—Baling alfalfa hay. The sweep-rake, or “go-devil”, is used to bring in the hay from the windrow. (Westgate—Farmers’ Bul. 339. U. S. Dept. Agriculture).

considerable distance it is usually more economical to use the bales. While the baling is quite often done from the stack it may be done from the windrow, as shown in the accompanying illustration.

If baled from the windrow, great care must be taken to have the hay at just the right stage of curing, so that it will not be so damp as to heat and spoil or on the other hand be so dry as to shatter its leaves. The ordinary bale weighs about 90 pounds, although specially large bales are made for transportation to the mining regions. Where the alfalfa is shipped by ocean, it is sometimes doubly compressed, thus bringing them to about one-half the bulk of the ordinary bale. These bales on being released usually turn to powder, so great has been the pressure exerted upon them.

SPONTANEOUS COMBUSTION OF ALFALFA HAY.

When alfalfa hay is stacked or put away in the barn too green or wet it is apt to heat and may, in extreme cases become so heated as to take fire and burn. When alfalfa is observed to be heating, care should be taken to admit no air into the heating mass, which will then be unable to burn for lack of oxygen. If this heating process is not carried too far it results in what is known as brown hay. In this form it is well relished by stock, and apparently loses none of its feeding value. Some persons make brown hay by stacking alfalfa while it is still quite green. It is usually done at some risk of over-heating, especially at the hands of one unaccustomed to the process.

ALFALFA FOR ENSILAGE.

The readiness with which alfalfa hay may be cured and handled in the alfalfa sections makes its use as ensilage usually unnecessary. In the humid sections, however, the first crop is apt to be injured by rain unless it can be put up green in the form of ensilage. When the first crop is utilized in this way it is usually put up alone. The third cutting, however, is usually ready about the same time as is corn, and the two may be put in together. If put in the silo alone, it is usually too slimy to make an ideal stock feed. Considerable losses are liable to occur around the edges of the silo and for this no effective remedy has been found. It is usually necessary to use a deep silo for alfalfa, to make possible sufficient pressure to prevent spoiling. The Colorado Agricultural Experiment Station found that ensilage made from the whole alfalfa showed a loss of 10.7 per cent, while the chopped alfalfa was damaged to the extent of 7.3 per cent.

ALFALFA AS A SOILING CROP.

Alfalfa is an ideal plant for soiling purposes in that it may be cut and carried to the stock continuously during the growing season. The readiness with which it renews its growth after each cutting, as well as its value as a feed, makes it especially valuable for this purpose. Handled in this way, there is practically no danger from bloat, and in this respect it is superior to pasturing. The field or patch from which the daily cuttings of green feed are made, should be sufficiently large to be cut over every four or five weeks, as under such conditions the part of the field first cut will be ready for the second cutting by the time the last of the field or patch has been fed.

ALFALFA FOR PASTURE.

Alfalfa should not be pastured during the first or second season of the growth, and even an old field should be grazed rather sparingly, if a good stand is to be maintained continuously. The last crop of alfalfa is often pastured off instead of being cut, as at this season of the year the grazing pastures are apt to be very short. When pastured in the autumn, care should be taken not to pasture too closely, as otherwise the plants will go into the winter with little growth upon the crowns, and in this way they will be unable to stand the winter as well or be able to store up food material for a vigorous early growth the next spring. Where the trampling of the stock has been heavy, the packing of the ground can be overcome by disking.

All kinds of live stock may be pastured upon alfalfa. Horses and sheep graze more closely than do cattle and are consequently somewhat more destructive to the stand. If hogs are pastured on alfalfa they should have their noses ringed in order to prevent them from rooting up the entire plants. An average field of alfalfa will support continuously during the growing season about ten large hogs to the acre and will enable them to make good gains, especially if a small quantity of grain is fed in addition. It is usually the custom to allow one pound of grain a day for every 100 pounds live weight of the hogs.

The principal drawback of pasturing cattle and sheep on alfalfa is their tendency to bloat. This danger can be reduced to a minimum by not allowing the cattle to go on the alfalfa when hungry or when the alfalfa is wet. When the animals become bloated, several remedies are usually at hand for the trouble. A large wooden bit an inch in diameter may be tied in the mouth or a piece of rubber tubing may be passed through the mouth to the first stomach. Should neither of these remedies be at hand or prove

effective, or if the animal is too far gone to make them practical, the paunch may be punctured or tapped to allow the escape of the gas. For this purpose a trochar, such as is used by veterinarians, is the best, but if this is not at hand a small-bladed knife may be used to make the incision about six inches in front of and slightly below the left hip bone. A large straw or quill may be used to allow the escape of the gas. If a quill is used, it is best to cut off the bottom and cut a small hole at the upper portion of the quill where the feather begins. The feather end should be left attached, as it will prevent the quill from working into the hole and becoming lost. If the straw is used a string should be tied around it or some other protection taken to prevent its being worked down into the hole by the breathing of the animal.

ALFALFA MEAL.

There have been a great number of mills established during the past ten years for the grinding of alfalfa hay into meal. This meal is nearly as valuable as bran for feeding purposes and is convenient for city trade for feeding to poultry or to horses where it is not convenient to feed the hay for any reason. In the alfalfa sections where hay is readily procured, it is doubtless more economical to let the animals do the grinding of the hay for themselves, as the feeding value of the alfalfa is not greatly increased by the grinding. The animals will make practically as good gains on alfalfa hay as on the alfalfa meal.

The meal is often mixed with a cheap grade of molasses in order to make it more nearly a balanced ration, as when fed alone it is too rich in protein for the most economical results with most animals. The cost of transporting alfalfa meal is considerably less than that of the baled alfalfa, as the freight rates are less. Such grains as corn and oats are sometimes crushed and added to the alfalfa meal.

FEEDING VALUE OF ALFALFA.

Alfalfa is one of the most highly nutritious and most valuable of feeds for all classes of farm animals either in the form of green alfalfa or as hay or alfalfa meal. The following tables taken in part from a book called "Feeds and Feeding" by Professor W. A. Henry indicates the results of experiments to determine the relative value of the different kinds of feeds.

Average percentage composition of alfalfa and other forage crops.

Kind of forage.	Number of analyses.	Water	Ash.	Protein.	Crude fiber.	Nitrogen free extract.	Ether extract (fat).
		Per Cent	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent
Cowpea hay	23	71.8	2.7	4.8	7.4	12.3	1.0
Fresh alfalfa	43	70.8	2.1	4.4	8.1	13.5	1.1
Fresh clover	21	8.4	7.4	14.3	25.0	42.7	2.2
Alfalfa hay	38	15.3	6.2	12.3	24.8	38.1	3.3
Clover hay	68	13.2	4.4	5.9	29.0	45.0	2.5
Timothy hay	8	10.7	7.5	16.6	20.1	42.2	2.2

* In part from Henry's "Feeds and Feeding." Appendix.

Average percentage of digestibility of alfalfa and other forage crops.

(Experiments with ruminants.)

Kind of forage.	Number of experiments.	Protein.	Crude fiber.	Nitrogen free extract	Ether extract (fat).
		Per Cent	Per Cent	Per Cent	Per Cent
Fresh alfalfa	2	81	45	76	52
Fresh clover	2	67	53	78	65
Alfalfa hay	28	73	43	66	54
Clover hay	46	55	49	69	53
Timothy hay	26	48	52	63	57
Cowpea hay	2	65	43	71	50

Digestible nutrients in alfalfa and other forage crops.

Kind of forage.	Dry matter in 100 pounds.	Digestible nutrients in 100 pounds		
		Protein.	Carbohydrates.	Ether extract
		Pounds.	Pounds.	Pounds.
Fresh alfalfa	28.2	3.9	12.7	0.5
Fresh clover	29.2	2.9	14.8	0.7
Alfalfa hay	91.6	11.0	39.6	1.2
Clover hay	84.7	6.8	35.8	1.7
Timothy hay	86.8	2.8	43.4	1.4
Cowpea hay	89.3	10.8	38.6	1.1
Wheat bran	88.1	12.2	39.2	2.7
Shelled corn	89.1	7.9	66.7	4.3

In order to make the above figures appear more intelligible, the actual value in dollars and cents per ton has been figured out as given below. The price of protein, carbohydrates and fats vary considerably from season to season and in different localities. The values per hundred pounds assigned in the present calculation are: fats, \$1.12; starches, \$0.64; protein, \$6.74. It will be noted that the feeding value of alfalfa hay is slightly more than double that of timothy, although in many places timothy hay sells for more than does the alfalfa hay, since it is more of a favorite with livery stable proprietors.

Actual feeding value of different feeds based on amount of digestible nutrients

FEED	Value per ton	FEED	Value per ton
Fresh alfalfa	\$ 7.00	Timothy hay	\$ 9.80
Fresh clover	5.96	Cowpea hay	19.76
Alfalfa hay	20.16	Wheat bran	22.80
Clover hay	14.12	Shelled corn	20.16

ALFALFA FOR SHEEP.

Alfalfa is an ideal hay for sheep, as it is fine and the sheep can readily eat both the leaves and stems. There is some loss from bloat if the sheep are pastured on alfalfa fields. It is often the practice in the mountainous regions of the West to graze the sheep on the wild grasses in the mountains during the summer and then drive them to the protected valleys during the winters, where they are fed on alfalfa hay. The Wing Brothers, of Mechanicsburg, Ohio, demonstrated the worth of alfalfa hay for lambs when they showed that spring lambs cost them \$6 per hundred pounds when alfalfa was not used in the ration, as compared with \$2.50 per hundred pounds when alfalfa formed a large part of their feed. It is usually customary to cut alfalfa hay for sheep just as it commences to bloom instead of when one tenth in bloom, as is usual for dairy cattle, or when from one-half to one-third in bloom, as for horses.

ALFALFA FOR BEEF CATTLE.

Alfalfa forms the best of roughage for fattening cattle, as it is quite a concentrated feed and the animals are able to consume sufficient quantities to make large and rapid gains. Owing to its bone and muscle building power it is also valuable to feed young growing stock before the fattening period begins.

The Utah Experiment Station showed in an experiment covering five years that much more beef can be obtained per acre if the hay is cut in early bloom. They were able to average 490 pounds of beef per acre where the hay was not cut until one-half the blooms had fallen, and they made 562 pounds of beef annually per acre when the alfalfa was cut in full bloom. By cutting it in early bloom they were able to average 706 pounds of beef per acre each year. In other words there was an increase of 25 per cent in the beef produced per acre in favor of the alfalfa cut in early bloom, as compared with that cut in full bloom. At the Nebraska Experiment Station where cattle were fed a full ration of corn and alfalfa they made 2.41 pounds gain per day. When they fed on corn with prairie hay they made only 1.48. This difference is usually more than the difference between success and failure in feeding a yard of fattening cattle. One large feeder in Nebraska states that he is able to secure alfalfa hay at \$5 a ton for his steers and that at this price he could not afford to feed timothy or prairie hay even though it were delivered free to him.

ALFALFA FOR DAIRY CATTLE.

In order to produce the best flow of milk, dairy cows require feeds very high in protein. This can be supplied by feeding non-leguminous roughage as corn-fodder and a grain ration of such concentrates as bran and corn meal. These concentrated feeds, however, are expensive, and can usually be replaced by a feed like alfalfa, especially in the alfalfa growing districts. The Tennessee Experiment Station showed that it was possible to replace each pound of wheat bran in a cow's ration by feeding her 1½ pounds of alfalfa. The tests showed that with alfalfa at \$10 a ton and wheat bran at \$20 the saving effected by substituting the alfalfa for the wheat bran was \$2.80 for every 100 pounds of butter and nearly 20 cents for every 100 pounds of milk. The saving is often greater than this in sections where alfalfa hay can be easily raised and where concentrated feeds are more expensive.

ALFALFA FOR HOGS.

Alfalfa is fed to hogs usually in the green state, either as pasture or as a soiling crop. It has been found, however, that hogs can be brought through the winter when fed nothing but alfalfa hay, and will come through in good farrowing condition. Wherever possible brood sows should be fed alfalfa either as hay or in the green state during the latter portion of their period of gestation. There appears to be no other crop which will give such good results in making bone and muscle in both the sows and the pigs.

The Kansas Experiment Station showed in an experiment that an acre of alfalfa produced 776 pounds of pork during a season when the pigs were pastured on the same. These figures compare favorably with the 706 pounds of beef which the Utah Experiment Station secured by feeding hay cut in early bloom for fattening steers. Although the number of hogs fed alfalfa on any one farm is not usually large, yet the practice is so common in most of the alfalfa sections that the aggregate use of alfalfa for hogs is very large and should be much more universal than is even now the case.

ALFALFA FOR HORSES.

Alfalfa may be fed to horses either green or as hay. When necessary, horses have shown themselves able to do heavy work throughout the summer with nothing but green alfalfa. Liverymen are generally opposed to the use of alfalfa for their horses, owing to its laxative effect. It has often been stated that the kidneys are unduly stimulated by alfalfa, but experiments which have been tried, do not seem to bear out this statement. There are many cases on record where alfalfa hay and green alfalfa have formed a large part of the work horse's feed for years without there being a noticeable injurious effect. In addition to being a good feed for working animals it is very good for young growing stock, especially horses. Care must be taken, however, to avoid feeding too much hay to colts, as coarseness of bone may be developed. The accompanying illustration shows a portable feeding rack, which is convenient for feeding alfalfa either green or as hay to horses or cattle which are allowed to run loose in a yard.



Fig. 10.—A portable alfalfa feed rack which avoids the necessity of unloading the hay in the feed yard. This device is also applicable to other kinds of hay. (Westgate—Farmers' Bul., 339—U. S. Dept. Agriculture.)

ALFALFA FOR POULTRY.

Alfalfa is a good feed for all kinds of poultry. If the chickens and turkeys are given the range of an alfalfa field during the summer they will thrive by eating both the alfalfa and insect enemies found in the alfalfa field. The plants may also be cut and fed green. In the winter alfalfa may be fed as meal in a warm mash mixture, with an excellent effect in increasing the production of eggs.

ALFALFA FOR BEES.

The development of the honey-producing industry throughout the West has been made almost entirely in the sections where alfalfa culture has been extended. The heaviest yields of honey are secured in sections where there is an abundance of alfalfa. Honey produced from alfalfa fields is of very good quality. The fact that an alfalfa field will come in bloom several times during the season makes it possible for the bees to gather successive crops of honey during the year.

ALFALFA IN MIXTURES FOR PASTURE.

Although alfalfa is generally grown alone, there are exceptions to the general practice that indicate that its use in mixtures may be extended. Alfalfa fed or pastured alone is apt to be a richer feed that is necessary for a continuous diet for any kind of stock. For this reason it may well be used in connection with some of the tame grasses. The tendency of a pure stand of alfalfa to produce bloat when sheep or cattle are pastured upon it seems to be overcome if the stock are at the same time allowed access to the ordinary tame grasses, such as timothy, brome grass, red-top or orchard grass. An adjoining field of tame grass, upon which the cattle can feed upon being turned out at first, will answer this purpose, but it is usually best to have the alfalfa in a mixture with one or more of the staple tame grasses which are known to succeed in the section in question. A seeding of one-half alfalfa is to be recommended. While in the East, orchard grass and meadow fescue may be used, it is usually advisable to use brome grass in most of the alfalfa producing sections of the Great Plains. This grass spreads by underground rootstocks and thus has a tendency to crowd out the alfalfa, especially when pastured without being cut for hay.

WINTER GRAIN IN ALFALFA FIELDS.

In the Southwest the occurrence of much of the rainfall during the winter months, together with the mild winters, makes it quite possible to seed wheat or barley in a stand of alfalfa after the last cutting and harvest it at the proper stage for hay the next spring along with the first cutting of alfalfa. The grain crop has an additional advantage in that it prevents the growth of troublesome winter seeds, which would otherwise detract from the value of the mixed hay the following spring. As a usual thing it is more difficult to obtain the carbonaceous or starchy foods in the Southwest than it is to obtain the feed high in protein, for this reason grain hay will often sell higher than alfalfa hay. The seeding of the grain in the alfalfa field has the further advantage of giving a mixed crop of alfalfa and grain hay, which often sells for more than the pure alfalfa. The method is especially recommended when for any reason the stand of alfalfa has become thin. This condition may be brought about by field mice, gophers or other enemies. The question as to how much grain should be seeded and disked in, depends on the thickness of the stand of alfalfa. While this practice is not at all general, yet the marked success which it has met in the sections where tried, indicate that it might well be extended with profit to other sections where the conditions are similar.

EFFECT OF ALFALFA ON THE LAND.

Alfalfa is able to increase the fertility of the land in the same way as are the clovers and other leguminous crops. In this way they are able to increase the yields of the succeeding crops. The roots by means of the bacteria which live upon them add nitrogen directly to the soil and are also efficient because of their deep-feeding habit, which allows them to bring up other mineral fertilizers from the lower layers of the soil and thus render them available to the shallow-rooted crops which follow.

The Wyoming Experiment Station showed that on irrigated land the effect of alfalfa was to increase the value per acre of the succeeding crops as follows: Wheat, \$8 to \$12 per acre; oats, \$16 per acre, and potatoes, \$16 per acre. These increased gains were made without any additional cost in fertilizing the land, as the alfalfa had been cut regularly for hay for five years preceding. In Colorado and Nebraska the yields of corn are sometimes nearly doubled when immediately preceded by alfalfa. One 40-acre field just west of Alma, Nebraska, averaged 992.5 bushels per acre, while a measured acre in the field produced 114 bushels. This was immediately following alfalfa. The nearest field that had not been in alfalfa produced corn that season at the rate of 60 bushels per acre.

In Colorado the increase in the yield of wheat and truck crops is very marked when the land has been in alfalfa for a few years.

The value of a successful alfalfa field is so great that there is always the temptation to keep on mowing it as long as paying crops are produced. The difficulty of getting rid of a stand of alfalfa as well as the slight uncertainty of a satisfactory new stand works against the use of alfalfa in ordinary rotations of the farm. In the West the alfalfa field does not reach full maturity until the second or third year and except in certain regions, it is not customary to plow up the alfalfa until it has been in at least five years. In the humid sections, as in the East, the rotation period is shorter owing to the tendency of alfalfa to run out in from three to five years. With the gradual exhaustion of soil fertility in the West, however, alfalfa must come to be recognized as possessing great importance in the plan of rotations on the ordinary farm. Even at the present time a compound rotation is being recommended. This calls for allowing the alfalfa to remain in for from five to seven years and then producing successively a number of non-leguminous crops, repeating certain crops if desired, for a series of years, after which alfalfa is again seeded down.

ALFALFA IN SHORT ROTATIONS.

The cost of establishing an alfalfa field makes it usually of doubtful economy to plow under the alfalfa at the end of the first or second year unless with the object of increasing the productivity of the land for some very profitable crop. In eastern Colorado the soils are low in nitrates and phosphates and as a consequence it is usually impossible to grow more than two successive crops of sugar beets, potatoes or cantaloupes on the same land. At the end of the second year in truck crops the land is put in wheat, to be followed by alfalfa, seeded with oats. The alfalfa makes a moderate growth the first season and at the end of the second season is turned under in preparation of another series of truck crops. In this section alfalfa is sometimes, but not usually allowed to stand for more than two years.

GETTING RID OF A STAND OF ALFALFA.

To one unaccustomed to plowing under a stand of alfalfa, the problem of getting the land in shape for the succeeding crop is apt to present many difficulties. In irrigated sections the land can be flooded for two or three days during the growing period, and in this way the plants will be killed. The farmers of Eastern Colorado have practiced the growing of alfalfa in short rotations with their truck crops to such an extent that the difficulties of plowing

under an alfalfa field have been materially reduced. The usual method is to plow shallow in the fall, preferably with a riding plow, drawn by at least three steady horses. The plows are sometimes provided with a knife or cutting attachment on the land side of the plow to cut the roots near the outer edge of the next furrow. The fall plowing followed by harrowing, exposes the crowns and a small portion of the roots, to the weather. The following spring the land is plowed quite deep. The shallow plowing of the fall before prevents there being a great length of tap root in which reserve material can be stored and as a result the deep plowing covers them so deeply that they have not the strength to reach the surface. Deep plowing also prevents the cultivator teeth from catching on the alfalfa roots when cultivating the succeeding crop. In other sections throughout the west and elsewhere it is sometimes the practice to pasture very heavily the fall before plowing. This greatly reduces the vitality of the plants and exhausts the roots of their reserve material, so that it is comparatively easy to get rid of them by plowing. It is always essential to have the plow share very sharp and it is recommended that the share be so set as to be able to cut the roots without sliding off and away from them as is apt to be the case if the share is set sloping. Prof. P. K. Blinn, of the Colorado Experiment Station recommends certain modifications of the ordinary breaking or sod plow. The essential points to consider are: a long, strong beam to steady the plow; a long landside to resist the great cutting strain. It is often necessary to reinforce the beam with heavy iron to withstand the draft. The plow should be adjusted to cut a narrow furrow and the extra long share should lap a part of the last furrow to prevent the roots near the heel from slipping around. The next essential is a very sharp share, drawn thin and tempered so that it will not be brittle. A sharp share should be replaced each day and frequent filings during the day are necessary to maintain a keen cutting edge. The share should be long, heavy and well pointed, with a wide wing six or eight inches at the heel. The outside two inches of the share should be rolled so as to run flat and cut some distance ahead of the "lift" and thus avoid a dragging cut.

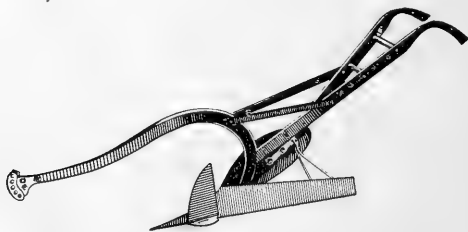


Fig. 11.—Plow with an attachment for cutting the alfalfa roots at the outer edge of the succeeding furrow. (Westgate—Farmers' Bul., 339, U. S. Dept. Agriculture.)

WEEDS IN ALFALFA FIELDS.

Alfalfa fields have been known to exist uninjured for thirty years or more where every condition was favorable; however, the appearance of enemies of one kind and another usually reduce the length of the life of an alfalfa field to seven years or less. Weeds present the most apparent drawback to the production of alfalfa, but these usually appear after some injury has been done to the stand. These are especially troublesome in those sections where there is considerable rainfall. The winter-growing weeds prove quite obnoxious in the southwest quarter of the United States, since they are able to make their growth while the alfalfa is dormant and unable to crowd them out as it is in the warm growing months of the summer. Foxtail grass, Russian thistle and tumble weeds are especially bad in the Great Plains area, while the wild barleys are perhaps the worst of all weeds in the southwestern quarter of the United States. These wild barleys make their growth during the winter and early spring and mature a short time previous to the first cutting of alfalfa. In this way the hardened beards frequently ruin the first crop of hay. This is sometimes remedied by burning the first crop to destroy the grass seed. Another method is to cut the first crop very early, while the wild barley is still unmaturing. This mixture of alfalfa and wild barley hay can be fed on the farm. Disking is usually the most effective remedy for weeds. Alfalfa is generally benefitted by the operation while the weeds are greatly injured owing to their branch root system, while the alfalfa possesses a vertical tap root, which is not usually injured by the disks. Dodder is one of the worst weeds so far as alfalfa is concerned. The dodder seeds germinate in the ground and the young plants soon attach themselves to the alfalfa stems. As soon as the thread-like stem is firmly attached to the plant its connection with the ground withers and dies away. After this the dodder plant lives entirely on the alfalfa stems, spreading from plant to plant by means of its long, yellow, tendril-like branches. The young plants are illustrated in the accompanying figure. Dodder is very difficult to destroy when once established and as a consequence great care should be taken to prevent the sowing of alfalfa seed with dodder in it or of thrashing seed from plots infested with this plant. Grazing close with sheep has sometimes proven effective in holding the dodder in check. If there are only a few patches of dodder in the field it is often practicable to cut the alfalfa plants very low as with a hoe and remove them from the field. Gasoline torches have also been used to burn out these patches, but this is quite an expensive method. If a stand of alfalfa is very badly infected with dodder it may be necessary to plow up the alfalfa before the dodder goes to seed. The land should then be kept in cultivated crops for two or three years. The seed of two of the different dodders is illustrated in the cut on page 7.



FIG. 12.—Young alfalfa plants attacked by dodder. As soon as the dodder thread fastens itself to the alfalfa the stalk attaching it to the ground withers and dies. (Westgate—Farmers' Bul. 339—U. S. Department of Agriculture.)

ANIMAL PESTS IN ALFALFA FIELDS.

The gophers, ground squirrels, prairie dogs and mice are the worst animal pests with which the alfalfa plants must contend. These are troublesome, particularly in the western half of the United States, where they injure both the alfalfa stems and roots by eating and gnawing. The mounds of the gophers are troublesome when the field is mowed. Poisoning with some form of strychnine is usually the most effective remedy, although they may be held in check by traps and cats.

INSECT ENEMIES IN THE ALFALFA FIELDS.

Grasshoppers are among the worst of the insect enemies which trouble alfalfa. These are worse in the arid and semi-arid sections of the West, where the alfalfa fields are usually the only succulent green growth for miles. The grasshoppers from extended areas are thus led to congregate upon the relatively small fields of alfalfa. A flock of turkeys is usually effective in holding the grasshoppers in check, but when they become especially numerous the device known as a "hopperdozer" is to be recommended. This consists of a sheet-iron device on wheels, which is run over a field and catches the grasshoppers in the open oil-filled pan placed at the rear of the bottom piece of sheet iron and at the bottom of the vertical surface at the back of the device. Disking the field in late winter also tends to hold the grasshoppers in check, as this exposes the young hoppers to the early spring frosts and also to the attacks of birds which are usually hungry at this season of the year. This disking is also quite effective against the alfalfa webworm and any other insects which may pass the winter in the alfalfa field.

Blister beetles and the army worm also prove troublesome at times when they appear in considerable numbers. The general practice is to cut the alfalfa immediately on the appearance of any such pests, when they will be forced to migrate or starve. There is a little black bee or wasp-like insect, which lays its eggs in the young alfalfa seeds. The insect then develops inside the seed just as the grain weevil develops in the kernels of grain. On careful examination the hole in the pod made by the female insect to lay its egg may be seen where this insect is proving troublesome. The brood of newly-developed insects appear after the seed is harvested and may be seen crawling over the top of the seed, having left the hollow seed behind them. This insect has been observed in nearly all the alfalfa seed producing sections of this country and it is probable that many of the failures to produce a satisfactory seed crop may be laid up against this inconspicuous, but exceedingly destructive enemy. This insect is known as the clover and alfalfa seed chalcis fly.

DISEASES OF THE ALFALFA PLANT.

There are two types of diseases which affect alfalfa, namely, those which exist on roots and those which attack the stems and leaves. In Texas, the root rot is especially destructive and has been observed to prove troublesome as far west as Arizona. This disease appears to be similar or identical with the cotton root rot and does much to prevent the successful production of alfalfa over a considerable portion of eastern and southern Texas. This disease spreads in widening circles in various places over the field. In this way

the almost complete destruction of the stand is gradually brought about as the disease progresses. No practical remedy has thus far been obtained and the land so affected must be kept out of alfalfa or cotton for several years. Of the diseases which attack the leaves and stems, the leaf-spot disease is the most important. This disease appears as minute black spots on the matured alfalfa leaves. The leaf rust somewhat resembles the leaf spots except that the spots are reddish in color and usually give a reddish powder when rubbed. The most effective remedy against these alfalfa leaf diseases is to mow the field when they begin to prove destructive. This mowing destroys most of the spores or little seed-like bodies, by which the disease is spread and at the same time enables the plant to put out a vigorous second growth, which quite often is able to largely overcome the next attack of the disease.

SUMMARY.

Although alfalfa is such an ancient forage crop in the world there is still much to be learned regarding its requirements. It has been raised in the West for two generations and yet it may be said that the seed production industry is still in its infancy. By a proper study of the conditions affecting the yield of the alfalfa seed crop the yield may be greatly increased in most of the Western sections, which will always enjoy a monopoly of the seed-producing business in this country. The rapid extension of alfalfa to sections of the United States where it is impossible to produce seed, promises to maintain the price of the seed at a high level for years to come. Other things being equal, that seed will be the most successful, which is free from weed seeds and for this reason special precautions should be taken to maintain the quality of seed, especially in sections that wish to become recognized centers for the production of first-class alfalfa seed.

Alfalfa is probably the oldest forage crop in existence and yet is a comparatively new crop in many sections of this country. It is adapted to a wide range of soils, but under conditions not perfectly suited to its growth it demands careful attention to the details of its management. Its long tap root enables it to bring up plant food from the deeper layers of soil which are out of reach of shallow-rooted crops. In this way and also by reason of the nodules on its roots it is able to add to the fertility of the surface layers of the soil. This materially increases the yields of any grain or truck crops which may follow. Besides being of great value as a soil improver it produces several cuttings each season of the most nutritious hay which is relished by all classes of live stock. It increases the flow of milk in the dairy herd, as well as serving to maintain the egg production of the farmer's flock of hens. It can also be utilized to good advantage as a feed for hogs, either green or dry, as hay. It thus not only works for nothing, but has

justly been said to pay for the privilege by increasing the fertility of the land upon which it grows.

The heavy yields and the readiness with which it may be grown in the regular alfalfa sections have led to somewhat wasteful practices which are being corrected as the value of the hay becomes recognized. The importance of harvesting the hay so as to retain the leaves on the stems is especially important as the leaves are worth twice as much for feed as the stems. More care might also be taken to prevent damage by exposure to the elements after being stacked. Those unacquainted with the alfalfa as a hay and pasture plant have difficulty in realizing the value of this crop to American agriculture, especially in the West, where other hay and forage is scarce, especially in winter. By its use whole valleys have been converted into homes for worthy people who could not otherwise have established homes in those sections not adapted to the crops commonly grown in the Eastern States. In passing through the arid sections of the country the alfalfa fields will often be the only green stretches visible in a journey of hundreds of miles. The coming census will doubtless show how rapid has been the extension of the area of successful alfalfa culture in the United States. The greatest percentage of increase will probably be in some of the Eastern States where the acreage is small, but the greatest actual increase in acreage will presumably be in those Western States which have recently had large valleys brought under irrigation and seeded largely to alfalfa.

In the preceding pages the statements have been conservative rather than otherwise. Many of the remarks might be more optimistic. The alfalfa is really a very wonderful plant and too much can hardly be said in its favor. It merits the most careful attention and consideration from all parties who have land suspected of being adapted to this crop. The repeated cuttings which may be secured during a single season place this crop in a class by itself. Perhaps no other crop requires such a variety of different treatments, depending upon the special locality in which it is grown, as does alfalfa. The lack of a complete understanding of all essentials for its successful growth is all that keeps it from being grown upon a much more extensive scale than is at present the case.

There are many sections of the United States where alfalfa is a staple crop and in many other sections it should become a much more staple crop than it is at present. In both classes of sections there is much which has to be learned in regard to the best methods of handling the crop. In the sections where it is a staple crop the points to be learned are the best methods of curing the hay, how to preserve the life of the stand and under what conditions the best seed crops may be secured. In sections where alfalfa is not yet a common crop and where seed is produced with difficulty, the main points to be learned are the essentials to the production of a satisfactory stand. These call for more or less experimenting in the preparation of the ground, time, rate and manner of seeding. In such sections, some special treatment of the stand is usually

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necessary during succeeding years in order to enable it to maintain its vitality. The experiment may be on a small scale, but should always have a check plot which is given the ordinary treatment. This will serve as a definite basis of comparison. The experiment giving the best results can be applied to an increased acreage the succeeding seasons. In this way the experience which would otherwise require a number of seasons to procure can be obtained at the end of the first year. For this reason it would be a valuable addition to American agriculture if each farmer should undertake a small experiment even though it were to determine the relative merits of two kinds of treatment during a single year. With a number of such experiments under way in a community the combined results would not only be of value to those conducting them, but would also prove of great benefit to other interested parties in the adjoining localities.



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