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ALFALFA

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Alfalfa

By ELIAS NELSON, Irrigationist.

As a forage Alfalfa excels all crops in yield, cost of production and feeding value. Of all crops it is our chief one. Not only that, but it is the basis of agriculture in Idaho, for by no other means than the culture of alfalfa can we so cheaply make our soil highly productive.

Alfalfa or lucerne, botanically known as Medicago sativa, is a native of Asia, coming from the region of Persia. It belongs to the pea family which also embraces the clovers, field peas, vetches, soy bean, cow peas, and esparcette. As forage all these leguminous plants are characterized by their high protein contents. They differ from other field crops in that they are able to utilize atmospheric nitrogen. Alfalfa was introduced by the Spaniards into Mexico, Chile and Peru and it is chiefly from these countries that it found its way into the western United States where it is generally known by the Spanish name Alfalfa.

TYPES AND VARIETIES

The cultivation of alfalfa for several hundred years in arid America has produced a somewhat distinct type known as the "American" or "Western" alfalfa. That type succeeds in the middle Rocky Mountain region from Texas to South Dakota eastward to the Mississippi River and beyond and in the Pacific Northwest. It is the alfalfa with which we are familiar. Besides this type four others are found in the United States. The Turkestan type outyields it at higher altitudes and in the more severe climates to the northward. The taller but less hardy types, the Arabian and the Peruvian, are better adapted to the

southwest. Another type, the German, has outyielded the "American" in some of the eastern states.

The Turkestan alfalfa is a very hardy and drought-resisting variety chiefly valuable for very cold and dry climates. It is generally somewhat lower than the common sort and the stems slightly more spreading and smaller and somewhat wiry. The leaves, moreover, are usually narrower, smaller and slightly more hairy. The seed has a distinct reddish tinge. Though these differences may generally be noticed, it is not always possible to distinguish the Turkestan from the common American type. Under the more favorable climatic conditions it is not as productive as the ordinary sort.

While we recognize five fairly distinct regional types of alfalfa in the United States, all belonging to the same species, there is but one named variety, the Grimm Alfalfa. That is a hardy sort grown to some extent in Montana and North Dakota. We know that there are many different agricultural varieties of the various recognized types. In almost any alfalfa field may be found individual plants differing one from another in one or more particulars such as habit or growth, form and size of leaves, density of foliage, succulence of stems and color of flowers. There are also differences as regards drought-resistance, vigor of growth, resistance to heat and cold and seed production. Some of the Experiment stations of the different states have undertaken the selection and breeding of alfalfa. The Wyoming Plant and Breeding Company at Worland is growing 40 varieties. Fourteen types and varieties have been started at the Auxiliary station at Caldwell, Idaho, among them a yellow Siberian alfalfa.

Besides the common alfalfa the Turkestan is handled by most seedsmen and the Grimm alfalfa may be procured from certain firms. The ordinary alfalfa is sufficiently hardy and succeeds practically throughout Idaho. At the higher altitudes the Turkestan and the Grimm may do better but at elevations of 5,500 and under those varieties have no advantage over the common sort, in fact it is superior to them in productiveness.

"Dry-land" alfalfa is merely the common alfalfa which through continuous culture without irrigation on arid land has acquired more or less drought-resisting qualities.

ALFALFA SEED

There is considerable seed produced in Idaho, hence it is not always necessary to send outside the state for it. The seed produced at home is generally as good if not better than that produced elsewhere. Alfalfa has been grown for many years in Idaho and is adapting itself to our climatic conditions, hence the home grown seed when properly cleaned is to be preferred to any other. When thrashed it is separated into three or sometimes two grades. The first grade should be almost if not quite free from all brown or imperfect seed and have plump, shiny, light green or golden yellow kernels. The other grade or grades contain a considerable percentage of shriveled seed that are either incapable of germination or produce weak plants. The better grade of seed is generally cheaper in the end as a lesser amount is required to give the desired stand Whether to use the best grade or a cheaper grade will depend upon the germinating strength of the sample and the price.

The vitality of any sample of seed may be ascertained in the following manner: In a cigar box or on a plate place a sheet of wet blotting paper. Over this sprinkle some alfalfa seed. Cover with another sheet and keep both of the sheets moist continuously. After about 5 days examine the seed and note the number of seeds that have germinated. At the end of ten days the test may be discontinued and the percentage of germination calculated. The stronger seeds germinate in from three to five days. The seeds that are of low vitality sprout later and more slowly. A good sample should give a germination of at least 85 per cent.

Not only does the farmer desire to get seed of good vitality; but he also wants it free from weed seeds. Most of the weed seeds may be separated by proper cleaning. Some weed seeds, however, approach so close to the size and weight of the alfalfa seed that they cannot be separated. One of these is Sweet Clover. The seeds are generally shorter and less distinctly kidney-shaped than those of alfalfa. A person with an acute sense of smell may be able to detect it.

Regarding the detection of sweet Clover in alfalfa seed Prof. P. K. Blinn of the Colorado Station says: "The overcrowding in the alfalfa pods causes irregular shaped seeds, so little dependence can be placed on

the shape of the seeds of alfalfa; the seeds in white clover are very regular in form as the seeds are produced singly in little pods. The scar of attachment on the sweet clover seed is near one end and the seed is nearly oval in form and quite regular, never in shape like alfalfa seed.

"By spreading a sample of seed thinly on a sheet of paper, any seeds suspected of being sweet clover can be separated with the aid of the lens; and then, by chewing them fine, their taste will determine their identity, without a doubt. Alfalfa seed has a distinct beany flavor, while sweet clover will taste like the sweet clover plant smells, strongly vernal.

"The form of the seed, and the taste, are the characteristic points to determine the identity of the seed; and with a little practice, especially if one can compare the two, there will be no mistake in determination."

Dodder or "Love-vine" is another weed which cannot be completely separated from alfalfa seed: Its presence may be detected by means of a hand lens. The seeds are of a dull, grayish-white color, oblong or round in form, often angular and the surface pitted. The alfalfa seed on the other hand is smooth and shining and more or less distinctly kidney-shaped. If a little pains be taken in examining alfalfa seed before purchasing the farmer may guard against introducing it in his fields.

The requisites of a good sample of alfalfa seed is that it be pure, that it have good vitality and that it be free from immature, dead and decayed alfalfa seed, weed seeds and inert matter.

Adulterations of alfalfa are not common. However, yellow trefoil and Bur-clover both have been fraudulently substituted wholly or in part. Both of these are closely related to alfalfa and their seeds are with difficulty distinguished from it. They are both annuals and have no particular value as forage plants with us. They would be found only in inported seed as our home grown seed, as far as we know, is free from those clovers.

PREPARATION OF LAND FOR THE IRRIGATION OF ALFALFA

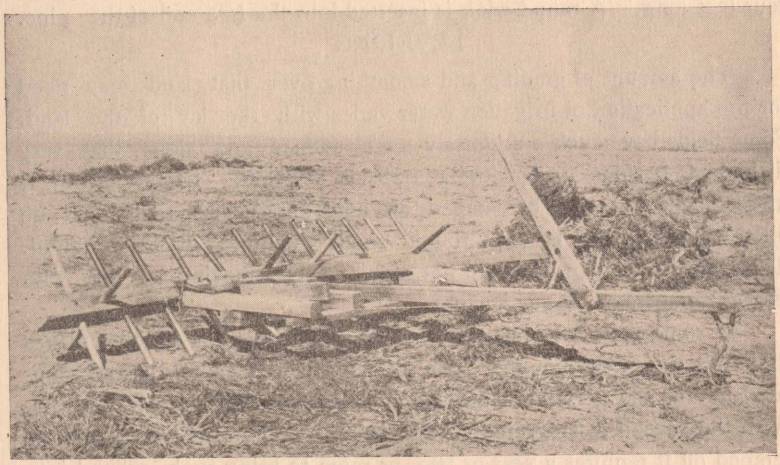
In Idaho, as in most of the arid states, alfalfa is chiefly grown with irrigation. While drought resisting and adapted to arid conditions it

responds to irrigation as no other forage crop does. Vast areas of sage brush lands are being brought under cultivation and a large percentage of these lands will and ought to be devoted to the culture of alfalfa, hence, an account of the clearing and preparation of new land will be given.

CLEARING

The best and most satisfactory clearing is where as much as possible of the root is removed with the brush and where the brush is well cleared up and burned. Grubbing by hand though expensive is quite satisfactory as the root is generally cut several inches below the surface of the ground. Cutting with an axe leaves a short stump which gives some trouble when it comes to grading and leveling. Plowing up the brush and then pulling it up by hand is not a good method as the smaller brush is turned under and covered over. Remaining there in the bottom of the furrow sluice, it holds the plowed soil apart from the subsoil and thus prevents that close capillary connection that should exist. Moreover it is not a wise plan to plow before grading.

"Railing" is often practised in clearing land of brush. Two iron rails, 16 feet long, are bolted together firmly and drawn by four horses



SAGE BRUSH RAKE

COURTESY OF PAYETTE-BOISE WATER USERS' ASSOCIATION

over the ground, the team doubling back over the same track. In this way more than half the brush is torn up. The remainder has to be grubbed by hand. The rail pulls some brush out by the roots, some is torn off at the surface while some is broken at some distance above the ground. To facilitate burning, the brush is raked into windrows. For this purpose an especially constructed rake is used. There are several styles of these. The one shown in the figure is attached to the front half of the running gear of a wagon and is operated by one man.

A machine grubber known as "steel grubber" has been used with much success where no rocks occur. This has a V-shaped share which cuts the brush four to six inches below the surface and a chain dragging behind upsets the brush leaving it loose on the ground. The share is made in different widths according to the number of horses used. With four horses, four or five acres per day are grubbed while as many as ten acres have been covered in a day with a team of eight horses. The clearing with the machine grubber is more satisfactory than other methods since a part of the root is removed and cleaner work is done than where the iron rail is used.

A kerosene torch greatly expedites burning. It consists of a quart can to which is soldered and securely fastened a half-inch pipe four feet long. A round wick is inserted into the free end of the pipe.

LEVELING

The amount of grading and smoothing over that land may need for the application of irrigation water varies with the lay of the land. Some fields have such a uniformly even surface and slope that very little work besides a smoothing over is required. Often, however, knolls occur that must be scraped off and depressions that must be filled where the land is very rough much grading will be required. There are few fields which will not require some moving of dirt with Fresno scrapers or tongue scrapers.

In some parts of Idaho leveling is overdone while in other places there has not been enough. The surface soil as we know has accumulated humus and is well aerated and thus suited to the growth of plants. With the subsoil it is different. Whenever therefore the surface soil is scraped off it requires a year or two or more to bring such ground into a productive state. On this account no more leveling should be done

than is necessary for proper irrigation. Where the soil is deep heavy grading may be done but where it is shallow, the grading should be limited.

The purpose of leveling and grading is to so fashion the land that water may be evenly distributed over it. Often, however, some extra leveling is advisable to do away with ditches that would otherwise be required and that would cut up the land in irregular shapes.

It is a great mistake not to level the land well in the first instance so that crops can be readily irrigated for if it is done properly at the outset it is done for all time. On the other hand it is also a mistake to grade excessively when there is no real necessity.

The best time to level is in summer or in fall as the soil is dryer then and hence not so heavy to move and there is no trouble about puddling the soil. In spring when the soil is moist or wet leveling cannot be done so advantageously.

The location of the ditches is determined by the lay of the land and the system of applying water to be installed. In general we may say that it is desirable to run the ditches at right angles to the line fences whenever the lay of the land will permit of it. Such ditches of course will not have a uniform grade. Where ditches are located in that way the fields are rectangular and hence all farm operations can be more easily performed. Often it may be well even to make fills so as to make ditches straight rather than following curved lines.

On many farms the lay of the land is such that the ditches cannot be run at right angles to the line fences but must conform in a measure to the contours making irregular shaped fields unavoidable Under such conditions make the ditches on a grade of from .08 to .15 part of foot per 100 feet.

As a general thing we should figure to irrigate with the general slope of the land as by so doing water can be more evenly and expeditiously distributed over the land. As regards the location of the ditches and the details of the system of applying water each farm is a problem in itself. Where the whole farm has one general slope it is a simple matter to determine where the ditches should go. Often, however, there are various slopes and the system of ditches must be constructed to suit. Often land lies so flat that even an experienced eye cannot

tell with certainty the true slope of the land. That must be known definitely before any attempt is made to locate the ditches. The services of a surveyor may thus be required both to determine for the farmer the true slope and if necessary to survey the ditches.

The character of the soil and subsoil and the amount of slope determines the method of applying water and therefore the manner of leveling the land. The system should be decided upon and the location of the ditches determined before the leveling is begun.

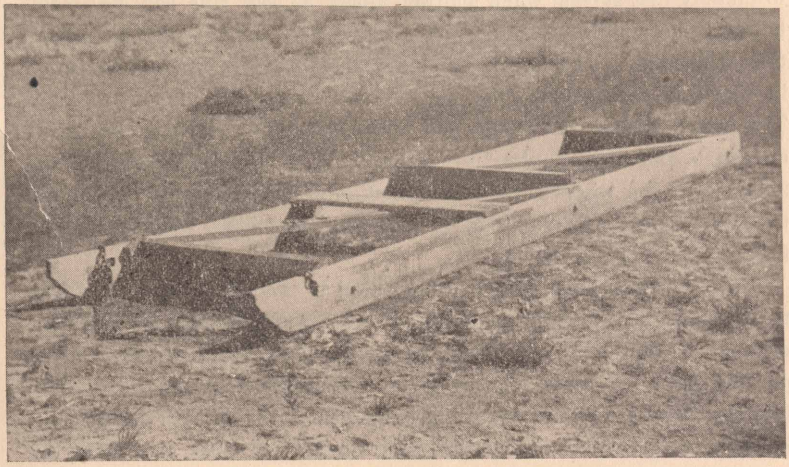
The land having been cleared of brush the procedure may be as follows: Note the places that must be scraped off and also those from which soil may be taken to fill up the depressions. Then disk these. Move the soil thus loosened and spread it over the ground which is too low. If necessary there may be a second disking. Should as much as eight to ten inches need to be scraped off plow such portions. Where any considerable amount of soil has to be moved there is no better tool than the Fresno scraper. The tongue-scraper will not move dirt as fast or as economically as the Fresno. Where the hauls are short and the depressions to be filled are shallow the buck scraper is a very good tool. In some sections of Washington it is used almost exclusively. In our state, however, it is little known though in certain portions of southern Idaho it would be valuable.

The grading or rough work having been done, plow the land and work it down fine. Then go over it twice with the rectangular leveler, once each way. This should leave it nice and smooth. If the plowing be done after the grading no more plowing will be required to prepare for seeding.

The Fresno scraper and the tongue-scraper need no description as they may be procured from implement dealers. The rectangular leveler often called "float" or "joiner" is made of 2x12 plank. Two pieces 20 feet long form the sides or runners and these are separated by three pieces of plank, one near each end and one about the center. In order that the leveler may hold its shape an iron rod is placed alongside of each cross piece and two pieces of 2x4 inch scantling are used for braces. The cross pieces at the ends are inclined backward and are placed about two inches from the bottom of the runners so they will not load up with dirt. The center one is given a slight inclination

forward and is set far enough down so that it will load up. It should be shod with iron so as to stand the wear. It can be made in different widths according to the number of horses to be used. A width of five feet is about right for four horses.

The beam shown in the figure is used on small plots of ground where there is too much turning for the use of the large rectangular leveler. It is made of 6x6 inch stuff and the length may be 12 or 16 feet as desired.



RECTANGULAR LEVELER

COURTESY OF PAYETTE-BOISE WATER USERS' ASSOCIATION

In the figure is shown a handy tool for making small ditches. It does good work in soil that is reasonably dry and makes both banks of the ditch at once. A small platform may be made on the tail piece for the driver to stand on. This tool is constructed of 2x10 inch stuff. The A— scraper makes but one bank of the ditch at once and therefore has not a heavy draft. Either one of these home-made ditching tools may be made of a size to suit the dimension of the farm ditches to be constructed.

METHOD OF APPLYING

The character of the soil and subsoil and the amount of slope

determine the method of applying water. The furrow system can be employed under a variety of conditions. Where the land is quite flat and the water therefore does not flow along readily, flooding must be practiced. Where the soil is so porous that the water sinks quickly flooding must also be employed. On steep slopes, where flooding would tend to wash, the furrow system can be used if a very small amount of water is run in each furrow.

THE FURROW SYSTEM

Furrow irrigation has many advantages. It is particularly advisable to employ that system when starting alfalfa as the soil can be maintained in better tilth and the young plants will make a better growth than if flooded. The furrows then made will aid in leading the water in a straight course across the field should flooding be practiced later. The furrow system can easily and with but little expense be made automatic and then requires little attention. It is even used for old alfalfa fields but where such is the practice it is necessary to clean out the furrows once a year. That is done with the marker used for making furrows in the first instance.

The head ditches should be from 264 to 330 feet apart. Make the ditches "square with the world" if the conformation of the land permits it. If obliged to run them on grade allow a fall of .08 of a foot per 100 feet. A crude way to divert the water from the head ditch into the furrows is to cut the ditch bank with a shovel. It is difficult, however, to give each furrow the same amount in that way and the water is liable to cut deeper in places and a stream large enough to do damage go down one furrow. Where there is very little slope it is possible to manage furrow irrigation in that way but on steep land special appliances are required. Tubes, called spouts, made of lath and two feet in length are set in the ditch bank just below the surface of the water. Each spout will divert enough water for from one to four furrows depending upon the slope of the land. To make the system automatic and to raise the water high enough to run through the spouts check boxes are set in the head ditch at certain intervals. The distance will depend upon the grade of the ditch. If the grade is .08 feet they will be 250 feet apart. The splash boards in each check box are so adjusted as to raise the water in the ditch until it flows through the lath

tubes. The excess water in any section of the ditch flows on into the next until the whole head is diverted through the lath tubes, By taking out the splash boards entirely the water falls below the level of the spouts. Each head ditch below the highest one in use catches the water from the furrows above it and redistributes it. There thus needs to be no waste except on the lowest part of the farm.

For making the furrows a furrower or "marker" is used. This consists of a platform 3x5 feet, to the under side of which are bolted two or three runners. The front end of each runner is sharpened and shod with steel. A tongue is fixed solidly to the platform. This home-made tool is drawn by two horses and makes from two to three furrows at a stroke. Different soils will require furrows at different distances apart, hence the marker should be constructed to suit. In soils where water percolates readily in a lateral direction they may be from two to three feet apart while in soils that take water less readily they may need to be as close as 18 inches apart The furrows should be about 3 inches deep and 5 inches wide. If the runners are shod and the tongue is placed at the proper angle and made solid to the platform the marker will make furrows in the old alalfa fields as well as in recently plowed or loose ground.

FLOODING FOR ALFALFA

While furrow irrigation is employed in starting alfalfa, flooding is very largely practiced in old alfalfa fields. On very steep land, however, flooding can not very well be practiced. Since alfalfa shades the ground during the greater part of the season there is not so much evaporation or baking of the surface. Flooding is therefore as objectionable for alfalfa as for other crops especially if the fields are disked at least once a year. Unless the alfalfa fields are "marked out" every year we must of course irrigate by flooding. There are several methods of flooding and a description of these follows:

FREE FLOODING

The term free flooding is used to denote flooding on land that has had no special leveling except such as is required for furrow irrigation. The same system of head ditches run on grade, as are often used in furrow irrigation, may serve for free flooding. The ditches should have

the same check boxes; but instead of lath tubes there should be one or several gates in each section through which to turn water onto the alfalfa. Large heads of water are used so that it will spread over the land in a reasonably short time. The same head ditches and check boxes can thus serve for furrow irrigation of first-year alfalfa and for flooding later.

There is one disadvantage that free flooding has, namely the difficulty of getting a thorough and uniform irrigation on the lower end of the run unless the land lies well. The runs should not be too long where this system is employed. In the system just described the supply ditches run across the slope, that is, about at right angles to a line following the greatest slope. In another method of free flooding the ditches run down the slope dividing the land into long strips. These ditches may have permanent check boxes at certain intervals and water may be diverted on either strip bordering on the ditch or on both sides if desired. This method is suited to the use of large heads of water and require frequent shifting. It is a good method on soils that are porous and where percolation is rapid.

BORDER METHOD

This is a method of flooding requiring very careful leveling of the land. The fields are laid off into narrow strips, 4 to 6 rods wide. These strips of land extend down the general slope and are bounded on either side by levees or borders which confines the water within each strip as it blows down the slope. The strips must be made perfectly level crosswise so that the water will spread evenly. The borders are made by throwing together four furrow slices and smoothing them over with a ridger. The strips should not be more than 300 to 500 feet long. A common mistake is to let them extend the entire length of a 40-acre field. These strips or "lands" should be marked out at the outset when seeded to alfalfa. The border method is suited to land that lies well and has but a slight slope and it permits of the use of large heads of water. A second foot of water is often used on one strip The borders should be 8 to 10 inches high and three and a half feet wide at the base. These borders should be seeded down the same as the rest of the ground in order that weeds may not get a foothold on them.

In some places in southen Idaho the leveling of land for border irrigation has been carried too far. Land that could have been irrigated nicely by the furrow method has often been prepared at great expense for border irrigation. A great deal of grading is often done in order that the water may be run in a certain direction. This often necessitates a drop from one strip to the next and there is some difficulty in keeping the levees intact.

CHECK METHOD

On land that is almost or quite level where it is difficult to spread water over the land, a method of flooding termed the check method may be employed. Levees are thrown up dividing the fields into small areas ranging in size from half an acre to two acres. A large head of water is used and each "check" is in turn flooded with water to the desired depth. The checks may be square or rectangular and the surface of the land in each one should be graded perfectly level. Scrapers are used for making the levees and the soil needed for their construction is taken from the highest part of the check or if the land is level from the whole surface. The levees should be nine inches high and six feet wide at the base with a uniform slope from the center to the base on either side. If so constructed the levees will not interfere with farm work as implements will pass over them. The levees should be seeded down so that all the ground be occupied. For land that is flat we would recommend the check system; but it should not be used on land that has sufficient slope for other methods of flooding or for the furrow system.

SEEDING ALFALFA

Good preparation of the land for planting is important. The soil should be quite firm and should have a mulch of loose soil an inch and a half or two inches deep over the surface. Fall plowing will ensure sufficient packing of the soil and in the spring the surface can be worked up into a good seed bed. This early cultivation should begin as soon in spring as the ground can be worked and be continued to conserve moisture until danger of heavy freezing is over, when seeding may be done. There should be sufficient moisture in the soil to bring up the alfalfa and keep it growing until it is eight to ten inches high

when water may be applied if needed. With spring plowing it is difficult to get a seed bed firm enough and one that will retain moisture well enough for best results. The soil will be too loose and will dry out quickly. It is therefore advisable when the land is plowed in spring to irrigate before seeding provided there has not been an abundance of rain. Alfalfa may be started at any time during the season until as late as August or even September provided the land is irrigated beforehand. In some localities where early fall frosts occur seeding in September may not be practicable.

For best results the seeding should be tolerably early in spring. The particular time will depend upon the altitude and the local climatic conditions. A few degrees of frost will do no serious injury but a heavy frost is likely to kill alfalfa when just out of the ground.

If the seed bed is in perfect condition and a drill be used, eight to twelve pounds of first grade seed per acre should be sufficient for a good stand. Where the soil conditions are unfavorable or where broadcasting is practiced, from twelve to eighteen pounds may be required. On irrigated land it is better to have a thick than a thin stand.

The use of a seeder that sows in drills and covers the seed is to be recommended as the seeds are covered and each seed is given an equal chance for germination with every other. A drill with press wheels attached is also desirable. The seeds should be sown shallow—from one-half inch to two inches deep. If a drill is not to be had the alfalfa may be broadcasted and harrowed in. The author has seen very good stands from broadcasting with the wheelbarrow seeder. Drilling, however, is the better method.

Seeding without a nurse crop will give best results. Especially is this true on raw sage brush land and on land that has not been in alfalfa before. Sown alone the alfalfa will make a fairly good growth the first year and under favorable conditions may make a light crop. It will become well established and yield well the second year. When sown with a nurse crop on new land it generally makes but a spindling growth the first year and does not produce a root system and a crown strong enough to enable it to make good returns the second year. Thus seeding with a nurse crop is not a good practice, at least not on new land, as the nurse crop does not make up for the loss in yield of alfalfa the second year.

On land that has been in alfalfa once and is in good tilth seeding with a nurse crop is allowable and may give good results. The grain should be sown at the proper time in spring but the seeding of alfalfa should be delayed until just before the first irrigation. At that time broadcast and harrow it in. If the furrow system of irrigation is employed run the harrow with the furrows so as not to fill them up. The seeding of alfalfa and the first irrigation must of course take place before the grain gets too high. When sown in this way the irrigation water can be applied according as the grain crop may require while if sown together with the nurse crop there may be need of irrigation earlier than is ordinarily beneficial for grain.

When the soil is light, and heavy winds are prevalent it is necessary to seed with a nurse crop as a protection against the wind. One-half or two-thirds the seed used when the grain is sown alone should be used.

INOCULATION

The presence of certain kinds of bacteria on the roots is necessary for proper development and thrifty growth of alfalfa. In some regions it is necessary to inoculate the soil with these germs to make alfalfa succeed. The lack of them is indicated by a yellowish color and an unthrifty appearance. In Idaho as far as we have observed alfalfa does not appear to need artificial inoculation, as it takes on a healthy green color from the first. We do not therefore advise farmers to go to the expense of purchasing inoculating material. Should the behavior of new alfalfa indicate that inoculation is required get a quantity of soil from an old alfalfa field, sow it broadcast over the field and harrow it in.

TREATMENT DURING FIRST SEASON

Under favorable conditions and when started by itself alfalfa may give one cutting of from one to two tons per acre the first year; but generally no crop can be expected the first year. Should the alfalfa not make sufficient growth to cut for hay, let it in any event be clipped once to promote stooling. By so doing the energies of the plant which otherwise would be expended in seed production are directed toward crown development.

The first irrigation of young alfalfa should be withheld as long as possible and no water applied until there is real need of moisture.

This is to encourage deep rooting which is desirable. Early irrigation and a continuous and abundant supply of moisture will tend toward shallow rooting.

CULTIVATION OF IRRIGATED ALFALFA

Disking and harrowing alfalfa fields early in spring is beneficial in that it stirs and loosens the soil compacted by the irrigation of the previous season. The soil is thus aerated and irrigation water can penetrate more readily than otherwise. Such cultivation also kills weeds and greatly aids in holding them in check.

Disking cuts up the crowns more or less and this has the effect of inducing stooling. It may be practiced on old alfalfa fields with benefit, but in disking second year alfalfa the disks should be set nearly or quite straight so as not to cut off too many of the young crowns. While the disk harrow does good work the "alfalfa cultivator" is a better tool in that it stirs the soil more completely and does not ridge the ground. On light soils the drag harrow may be used with benefit. Cultivating alfalfa after each cutting is of much benefit. This can be practiced where the fields are flooded, but is not practicable where the furrow system is employed as the furrows would be obliterated. With furrow irrigation the land must be marked out for irrigation as soon as disked in spring.

WEEDS

Certain weeds are prevalent in alfalfa fields in Idaho. The chief ones are dodder, sweet clover, Russian thistle and squirrel-tail grass. One of these, dodder, is a parasite on the alfalfa. The others are all pernicious because they occupy space that should produce alfalfa. Only one, however, squirrel-tail grass, seriously affects the quality of the hay.

Dodder, or "love-vine" germinates from seed and the young plants when of sufficient height entwines itself about the alfalfa stem and then becomes disconnected from its own root and thenceforth feeds upon the alfalfa plant. As it grows the numerous tendril-like stems reach out and form dense mats over the alfalfa. Toward the close of the season it produces seed which may germinate next spring and thus perpetuate the weed in the field. Dodder is injurious chiefly

because it makes a drain on the vitality of the alfalfa and so in a slight degree decreases the yield. Where patches of it have appeared the alfalfa may be cut close to the ground before the dodder blossoms and be removed from the field and destroyed, or straw may be piled on the patches affected and burned. In Idaho dodder is most injurious on first year alfalfa. Usually it disappears completely or nearly so in later years, hence in some districts at least is not a serious menace.

Sweet clover being a biennial, living only two years, disappears if prevented from going to seed. It, however, persists on ditch banks and in fence corners and here matures seed which finds its way into the irrigation water and is thus carried to the fields. While it is not a serious menace in alfalfa grown for hay it is a pest in fields to be harvested for seed because when present in alfalfa seed it lessens the market value of it. It is therefore important that when seed is grown the fields be kept free ftom sweet clover. Should it occur along ditches care should be taken that none of it gets into the seed crop when harvested.

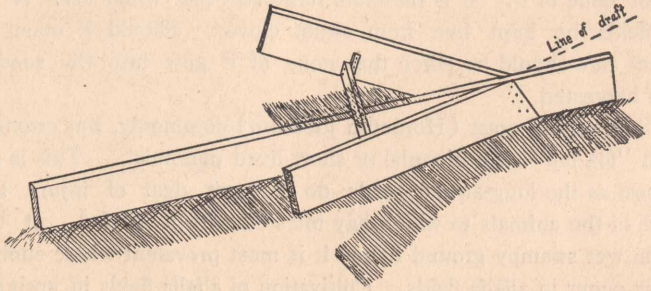
Squirrel-tail grass (Hordeum jubatum) commonly, but erroneously called "fox-tail", is a biennial or short lived perennial. This is a serious pest as the long-awned seeds do a great deal of injury to the mouth of the animals to which hay infested with it is fed. It thrives best in wet swampy ground hence it is most prevalent where such conditions occur in alfalfa fields. Cultivation of alfalfa fields in spring will do a great deal towards keeping down squirrel-tail grass as the young seedlings may thus be destroyed. It is a most insidious weed and the only effective treatment of fields badly infested is to plow them up and grow an annual crop. Many farmers have been forced to do this. Squirrel-tail has thus been a blessing in disguise to those who are disinclined to practice rotation and are loth to plow up alfalfa. Lack of cultivation and excessive use of water favor the spread of squirrel-tail grass.

Russian thistle does not give trouble where there is a good stand of alfalfa. However, where it is thin and bare spots occur it soon finds lodgement. Where the border system is in vogue the levees usually become foul with it. The levees should therefore be seeded down to alfalfa.

PRACTISE OF IRRIGATION

As regards the frequency of irrigation and the amount required for one irrigation or for the season the soil conditions and the climate must determine the proper treatment. The deeper the soil and the more retentive of moisture it is, the more economically may irrigation water be used and the less frequent the irrigations. The shallower the soil and the more impervious it is the more frequent must the irrigation be and the less economically is the water used.

Irrigation in spring should not begin until warm weather has arrived and then not until the moisture condition of the soil is such as to require it. If irrigated when cold weather is yet prevalent injury may be done to the crop which is indicated by a yellow color of the foliage.



HOME MADE TOOL FOR MAKING SMALL DITCHES

COURTESY OF PAYETTE-BOISE WATER USERS' ASSOCIATION

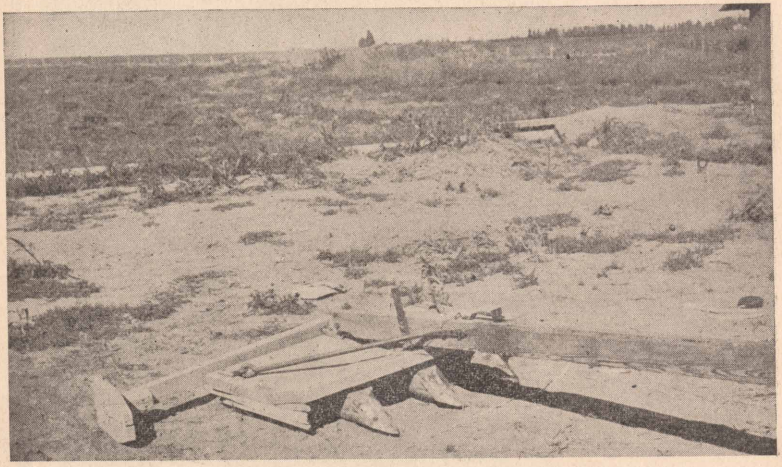
Especially at the higher altitudes is this likely to occur. At the lower altitudes of our state irrigation water is often applied in the latter part of April without any bad effects as the weather then is tolerably warm and the crop requires it. At higher altitudes the first irrigation may be as much as a month later.

As regards the amount of water to apply that should be gauged by our knowledge of the requirements of the crop. To apply any more than is beneficial and can be put to use is a waste. The alfalfa plant as we know roots deeply and can draw moisture from a considerable depth and thus will not suffer so quickly as other crops as it can draw upon the reserve in the deeper soil. We know that alfalfa roots pene-

trate no deeper than the water table which should teach us that a saturated soil is uncongenial and something which alfalfa cannot withstand. We should therefore avoid such excessive irrigation as will keep the soil saturated. In a general way we may say that the desirable condition is that of half air and half water in the soil. The closer we can approach to this the better. Irrigation therefore means replenishing the moisture contents of the soil to such a depth of subsoil as is permeable and stopping the irrigation so as not to saturate the soil through and through.

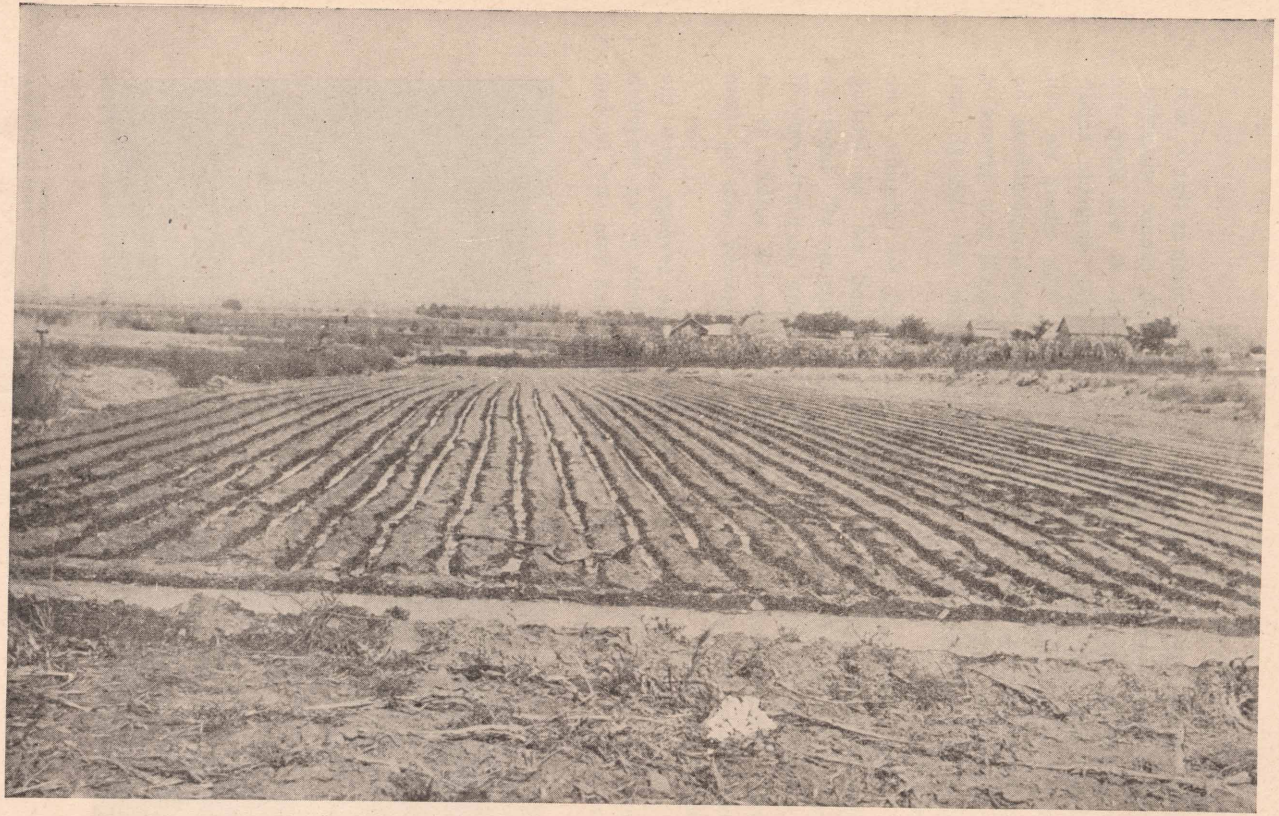
Where the water table is liable to be affected by irrigation care should be taken not to apply so much that it is raised and the feeding area of the roots in that way restricted. Over irrigation will aggravate or cause waterlogging of the soil and the attending accumulations of alkali. Where ground water is within two feet of the surface as on some river bottoms alfalfa does not thrive and generally dies in from three to four years.

There are localities in foot hill districts where seepage from the mountains supplies enough moisture so that very little or no irrigation is required. At the higher altitudes water is applied from one to four



HOME MADE FURROWER

COURTESY OF PAYETTE-BOISE WATER USERS' ASSOCIATION



FURROW METHOD OF IRRIGATION EMPLOYED IN STARTING ALFALFA--COURTESY OF PAYETTE-BOISE WATER USERS' ASSOCIATION

times, the number depending upon conditions, and two cuttings are harvested. At lower altitudes there are from three to five or even six irrigations and the alfalfa is cut three times. On soils that are not readily permeable to irrigation water, and therefore have small storage capacity more than three irrigations are necessary. Generally on such soils there are two irrigations before the first crop is cut, two irrigations between the first and second cuttings and but one between the second and third. The irrigations are so timed that the second irrigation comes a few days before the first cutting and the fourth just before the second cutting. The alfalfa is cut as soon after those irrigations as the surface of the soil has dried enough so that the mowing can be done. That will be in from four to seven days. By irrigating in this way before cutting moisture is supplied to give the next crop a start. It also delays blcoming and so increases the period during which alfalfa is in proper condition to cut, thus in fact lengthening the cutting period where large fields are to be harvested. Alfalfa matures quicker when the soil is dry and if in that condition when being cut some of it will get too far along before it is mowed to make good hay.

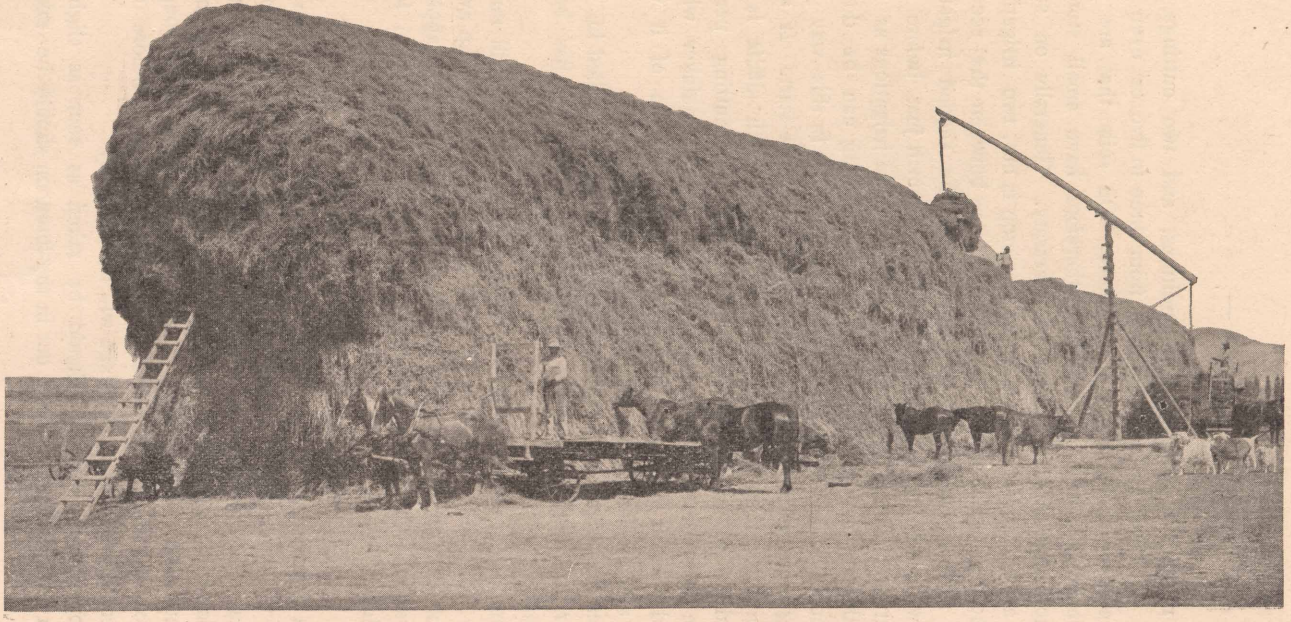
Besides the irrigations mentioned water is generally applied in the fall in order that the fields may not go into winter dry. That has been found beneficial.

The amount of water required by alfalfa for the season will range from 15 to 30 inches in depth or $1\frac{1}{4}$ to $2\frac{1}{2}$ acrefeet per acre. An average of about six inches in depth or half an acrefoot per acre is applied at one irrigation. Our impervious soils will absorb no more than four inches in depth.

CUTTING AND HARVESTING HAY

Alfalfa to have the highest feeding value should be cut when it first begins to bloom or at the stage when about one-tenth is in bloom. If cut at that time the next crop will make a quicker start than if the alfalfa is allowed to become mature. The leaves also will stay on better if it is cut early. If there is a considerable acreage to be cut begin cutting before the alfalfa has reached the proper stage. Before the cutting is completed the proper stage will have passed.

To properly cure alfalfa it should be raked as soon as slightly wilted. In fair weather the alfalfa cut in the forenoon should be raked



METHOD OF STACKING ALFALFA IN VOGUE IN SOUTHERN IDAHO

COURTESY OF PAYETTE-BOISE WATER USERS' ASSOCIATION

in the afternoon and that cut in the afternoon raked the next forenoon. Let lie in windrows half a day and two to four days in cocks. Some bunch with a rake but the best method is to put the hay in cocks with a fork as that insures the better curing. Properly cured hay has a bright green color. It should not lie in cocks until it is bleached, but stacked before it becomes brittle. If well stacked, alfalfa will keep in good condition especially at the lower altitudes. As we have little or no rain in July and August it is usually safe to stack the second cutting on top of the first; but the third crop had better be stacked by itself. Stacking each cutting separately is no doubt the best practice as it should then keep better. Moreover the different cuttings have a somewhat different feeding value and it may be well to have each one accessible for use. We would discourage placing stacks end to end and close together as no one however skillful can join the stacks together so well that rain or water from melting snow will not run down between and spoil some of the hay. It is better to have a space of two feet between.

ALFALFA ON DRY LAND

The growing of alfalfa on dry land has been a success in various sections in southern Idaho. The depth and character of the soil, the amount of precipitation and the presence of ground water determine the degree of success that may be had with alfalfa. In and about the foot-hills it often produces two crops of hay. There are localities where seepage from the mountains brings ground water near enough to the surface to supply moisture to the crop. Where the ground water, however, gets close to the surface alfalfa will not thrive. Some farmers allow the second crop to produce seed. There being some rain in spring the first crop tends to be leafy and rank and so is cut for hay. By the time the second crop starts to grow the weather is dry hence it is lighter and is left for seed. Very good seed is often grown in this way as the supply of moisture is about right for a seed crop.

In the dryer localities and where the soil is heavy but one crop is produced. After this is removed the alfalfa remains in a dormant condition, often not a green leaf showing until the fall rains come. The yield of the one crop will range from $\frac{3}{4}$ to a ton and half per acre.

On the open plains alfalfa is but little grown. On sandy loam

soils of good depth it may give one crop; but where the subsoil is more or less impervious the culture of alfalfa would be a doubtful venture.

In starting alfalfa experience has shown that best results are secured on land summer-fallowed the year before. It makes a much better growth the first year on such land than on new land or land cropped the year before. The seeding should be early in spring. The best method of seeding is with a press drill that sows it in drill rows and covers the seed. Plant 2 to 3 inches deep. But 4 to 8 lbs. per acre is required if a drill be used while if broadcasted at least twice that amount of seed is necessary. Too heavy seeding should be avoided for a thick stand does not give good results. A nurse crop should not be used as the supposed protection that such a crop affords does not compensate for the moisture which it exhausts from the soil and which might have been at the disposal of the alfalfa. With a nurse crop the alfalfa makes a lesser growth the first year than otherwise and the plants are spindling and do not branch as much at the crown.

Under less favorable conditions at least no effort should be made to harvest a crop, but clipping it once or twice and leaving the cut foliage on the ground is a benefit. The young alfalfa may be harrowed several times to conserve moisture. The second year it should be disked in spring, the disks set nearly straight. After the second year it will withstand a thorough disking. Dry land alfalfa does not reach its full development until the third year.

Seed grown without irrigation should always be taken in preference to that from irrigated farms. "Dry land alfalfa" is simply the ordinary sort which has been grown on dry land and acquired marked drought-resisting qualities.

Alfalfa is valuable to use in rotations on dry land. It is needed to add humus and nitrogen to the soil and may be used in rotation with small grain. It may be allowed to remain on the ground three or four years or as many as may be desired.

ALFALFA FOR PASTURE

Horses and hogs may be pastured on alfalfa without danger of bloating. Pasturing hogs on alfalfa has proven a very profitable method of utilizing the crop. Generally one pound of grain per day is fed for every 100 pounds of live weight. An average field will support con-

tinuously through the season about ten large hogs.

There is more or less trouble from bloating when cattle or sheep are pastured on alfalfa. On that account many farmers discourage the use of alfalfa for pasture. However, if certain precautions are taken there need be little trouble from bloat. Animals not used to it should be accustomed to it gradually. They should not be turned on alfalfa with empty stomachs but be fed some dry feed immediately before. If that is done they will not gorge themselves and there will be little likelihood of bloating. Neither should they be turned on alfalfa when wet with dew, nor on wet days as experience has shown that under those conditions there is greater liability of bloating.

In pasturing alfalfa some care is required that the stand be not injured. Horses and sheep graze more closely than cattle. To prevent rooting, hogs should have their noses ringed. Stock should be kept off the fields for a day or two after irrigation and while the ground is soft. Pasturing hay meadows in spring has the effect of decreasing the yield of the first cutting of hay. Pasturing in the fall should not be too close as the crowns should not go into winter bare and unprotected. When it has been closely cropped in the fall alfalfa does not make as rapid and vigorous growth the following spring. Many farmers follow the practice of pasturing the third crop.

Where pasturing of hay meadows is practiced the alfalfa should be disked in spring to loosen up the ground compacted by grazing animals.

There are some objections to the pasturing of fields which are also to produce hay. Some of the alfalfa may be killed and the grazing tends to foster alfalfa diseases which often occasion serious damage. There is also always some liability of cattle and sheep bloating. Many prefer soiling to pasturing and with good reason as that is certainly much more economical.

The use of alfalfa in pasture mixtures of tame grasses such as orchard grass, meadow fescue and tall meadow oat-grass has much to commend it. Such a pasture is better for all kinds of stock and the danger of bloat is greatly lessened. The proportion should not be more than half a stand of alfalfa.

Blue grass has a tendency to crowd out alfalfa, hence it should not be used in connection with it. To use the same field of alfalfa for

pasture or for hay production as desired is not entirely satisfactory. Everything considered, it were better never to pasture any hay meadows but provide fields for pasture only.

ALFALFA SEED PRODUCTION UNDER IRRIGATION

The production of alfalfa seed in Idaho has largely been incidental to hay production. Few if any growers plant alfalfa especially for seed production and fields usually cut for hay are occasionally allowed to produce seed. Hence no particular attention has been given to the securing of a thin stand though some grow seed where there is an imperfect stand of alfalfa. Considerable seed, however, is being grown in parts of Idaho and in some sections alfalfa hullers have been introduced.

Alfalfa seed is in great demand as the supply is not commensurate with the demand and it brings a good price. Hence it is a line of farming that might be greatly expanded in southern Idaho. The yields range from 3 to 9 bushels per acre. A seed crop of four bushels per acre has about the same market value as a crop of 5 tons of alfalfa hay per acre not counting the one hay crop cut when alfalfa seed is produced. It will therefore be seen that alfalfa seed production should prove quite profitable. It should be a profitable business and more profitable than at present with us if suitable management of the fields be adopted and there be special planting. If it is profitable in occasional years on the ordinary hay meadow it should be even more so on fields properly planted for seed production and given suitable care and cultivation.

The two chief requisites for successful seed production are a moderate amount of moisture and a thin stand. The plants must not be crowded but have sufficient room and plenty of light. Three to six pounds of seed per acre should give a thick enough stand. Planting in rows with a drill is to be recommended. Let there be one row between each irrigation furrow. The distance between rows will then depend upon the rate of percolation of irrigation water. Stop up a certain number of holes in the drill or in some other way fix it so that it will seed in rows the desired distance apart. The drill should be set to feed with reference to the number of drills actually seeding. If, for instance, it is desired to sow five pounds per acre and one fourth of the drills are in use then set at four times the rate or 20 lbs. If the

drill does not plant little enough mix fine sawdust with the seed or mix with it millet seed that has been subjected to a high temperature in an oven for three hours to destroy its vitality. When using those drills that have an alfalfa or clover seed attachment with spouts leading into the grain tubes disconnect those spouts which are not to sow seed and tie firmly around the lower end of each tube a small sack to catch the seed. If the plants are so thick in the rows as to be crowded harrow crosswise of the rows when the alfalfa is a few inches high to kill a portion. During the first season irrigate as required using the furrow method and clip once, setting the sickle bar to cut the plants half way down.

Usually one hay crop is cut besides the seed crop. Which crop should be saved for seed will depend upon the altitude and the particular climatic conditions of each locality. The crop that will mature during the hottest part of the summer season produces the best seed. Where the season is short, due either to the altitude or to a northern latitude the first crop will generally be the seed crop and there is no second crop. At the lower altitudes where there are three cuttings in hay meadows the first crop is cut for hay and the second allowed to produce seed and there is no third crop. The time of cutting the hay crop can be varied as the conditions require. In order that the seed crop may come on somewhat earlier than otherwise the first crop or hay crop may be cut earlier than usual in hay meadows. The first crop generally matures before insects are numerous enough for the proper fertilization of the flowers and it generally does not mature as evenly as does the second. The third crop matures too late for best seed production.

The cultivation of alfalfa grown in rows for seed is practiced elsewhere to some extent. In Idaho it is practically untried. It will without doubt be beneficial to the crop yet we are unable to say whether it might prove profitable. It appears that it may be necessary to cultivate alfalfa if seed production is to be placed on a firm basis. Experience has shown that a thick stand will not produce seed satisfactorily and farmers often let fields having a thin stand produce seed. Generally after two crops of seed have been harvested enough seed will have shattered on the ground to give a thick stand and seed production after

that is not practical on those fields. By cultivation, however, proper thickness of stand may be maintained. For seed production alfalfa requires a moderate amount of moisture. There must be sufficient shortage of moisture so that a leafy growth will not result but on the other hand seed production induced. When the alfalfa nears maturity basal shoots start from the crown. If moisture is abundant these basal shoots will make considerable growth to the detriment of the seed crop. The alfalfa, however, must not suffer from lack of moisture as that will cut down the yield.

When the first crop is taken for seed it is generally not irrigated. When the second crop is the seed crop irrigate before cutting the hay crop and apply no more water unless the soil conditions are such that there is no reserve moisture in the subsoil. Furrow irrigation is the best method of applying water where alfalfa is grown for seed.

Alfalfa seed is not always a certain crop. Many failures are due either to too thick a stand or too rank a growth due to over irrigation or may be due to ravages by grasshoppers. As a whole, climatic conditions in Idaho are more favorable than further east. We have not the rains to interfere with the proper fertilization of the flower, the maturing of the crop or its harvesting. Grasshoppers, however, have given some trouble in southwestern Idaho. Often there is a failure to produce seed, the reason for which we do not definitely know. We feel confident, however, that there would be few failures if the proper thickness of stands were secured, the fields properly irrigated and an abundance of bees in the neighborhood supplied.

A rank leafy growth rarely gives a good crop of seed, but where it is of medium size and has many branches the prospects are good. Proper fertilization is indicated by the flowers drying and sticking to the plants for a few days. When not fertilized they drop off quickly leaving the stems bare. To give a satisfactory crop there should be an abundance of seed pods, several in each flower truss. If on examination the pods are few, have little curl in them and contain but one or two seeds each, then the seed crop will be light.

Various insects aid in pollinating the flowers. Bumblebees are perhaps the most valuable. The presence of the honey bee and its visitation to the flowers is very beneficial to the seed crop as it insures

more complete fertilization and therefore a better yield. Where grasshoppers are abundant the seed crop may be ruined. Grasshoppers are transmitted through the winter season by eggs deposited in the ground in fall. If the alfalfa be disked a depth of three or four inches early in spring before the advent of warm weather, when the eggs hatch, a great many of the eggs may be destroyed which will in a large measure lessen the number of grasshoppers that may appear. For combating them when they are numerous the "hopper dozer" may be employed. It "consists of a shallow, high-backed pan mounted upon runners sufficiently high that its bottom will scrape the tops of the alfalfa, and is filled with water covered with a film of kerosene. It should be used as soon as the hoppers are noticed in abundance and during the warm part of the day, because they are then most active."*

The seed crops should be cut when two-thirds to three-fourths of the pods have turned brown and the plant is yet more or less green.

A crude way of harvesting is to cut with a mower and rake into windrows the same as hay or have men follow behind the mower and fork the alfalfa out of the way of the team. Mowers with windrow attachments are also used. The self-rake reaper is an excellent machine and is now considerably used. Even the binder has been used for harvesting alfalfa.

Alfalfa for seed should not lie in the windrows but be forked into cocks of a size that a man can handle. When the self-rake is used three to four gavels should be thrown together. The seed crop may be stacked as soon as throughly dry. If the stacks are large a stack ventilator should be used. If not threshed from the field or within two or three days after being stacked it should remain in the stack until it has gone through sweating which will be several weeks.

ALFALFA FOR SOIL IMPROVEMENT

Alfalfa is just as important as an improver of the soil as it is as a hay crop. If the farmers of Idaho realized this and managed their cropping accordingly they would be vastly more prosperous. The difficulty is not that there is not enough alfalfa grown but that the farmers are loth to plow it up and introduce some rotation. We find

* *Kansas Bulletin No. 155.*

that our soils are very well supplied with the mineral elements essential to plant growth, but are deficient in humus and nitrogen. Fortunate it is that these constituents which are lacking can easily be added by growing alfalfa. Such crops as small grain, potatoes and sugar beets add scarcely any nitrogen but on the other hand draw upon that contained in the soil. Grain stubble and such portions of those crops as become incorporated into the soil supply humus. Since alfalfa is our chief leguminous crop and can supply the nitrogen which ordinary crops do not add to the soil its great value for soil improvement may be appreciated.

Nitrogen is found in abundance in the air but ordinary crops cannot take it up and utilize it in its gaseous form. The so-called nitrogen-fixing bacteria which are found in the nodules on alfalfa roots take up atmospheric nitrogen and elaborate it into nitrogenous compounds (protein) which are assimilated and stored up in the leaves and stems of the alfalfa plant. It is this protein which makes alfalfa such a valuable forage. The root growth of the plant and the decay and renewal of tubercles on the roots enriches the soil with nitrogen. Leaves dropping off also add some. By plowing under a crop of alfalfa a still greater amount of nitrogen is added to the soil. In these various ways alfalfa enriches the soil.

Were it not for the fact that the cultivation of alfalfa and other legumes add nitrogen to the soil we should, in addition to the utilization of all stable manure, be obliged to purchase expensive commercial nitrogen such as nitrate of soda and guano and apply them to the land.

To supply the deficiency of nitrogen is imperative on our new land as there is no cheaper or more practicable way of making our soil fertile on any considerable scale. The various field crops yield nearly if not twice as much after alfalfa has occupied the land as before. A crop of alfalfa turned under is worth ten tons of sugar beets per acre.

Since alfalfa thus has such a marked beneficial effect on the crop that follows it may also be used in rotation. Alfalfa should not be kept permanently on the land but plowed up at certain intervals and other crops such as small grain, potatoes and sugar beets grown in rotation with it. A certain amount of alfalfa should be plowed up every year and the same amount seeded down. Such a system will mean more

profitable farming. The rotation may be a five to eight year rotation or even longer. Alfalfa should occupy the land at least three years as three seasons are required for it to reach its full development.

There is often some difficulty in getting rid of a stand of alfalfa. For satisfactory work a sod plow with a long mouldboard should be used. The share should be kept in good cutting condition by frequent sharpenings and a file should be taken along into the field and the edge of the share sharpened several times a day. The plow should be set to cut several inches less than the full width so that no alfalfa roots at the outer edge of the furrow slice will be left uncut. The depth should be from four to five inches. In order that the alfalfa roots may be cut with a drawing cut rather that a lifting one do not give the share too much suction but set to run nearly straight from point to keel. A lifting cut may be prevented by having one and a half or two inches of the edge rolled so as to run almost flat on the bottom of the furrow, thus cutting ahead of the lift and avoiding a dragging cut. A horizontal cutter may be bolted to the landside to cut a part of the roots in the next furrow.

Alfalfa may be killed quite successfully on irrigated land in midsummer. The fields may be irrigated a short time before plowing. Let the land be harrowed after plowing to close it up and preserve moisture. Do not let the ground dry out but irrigate if necessary. With the soil moist and the weather warm the roots as well as the foliage turned under will decompose readily. The decay spreading to the roots insures the killing of the alfalfa. Late in the fall plow again, this time deeply.

Alfalfa may also be killed satisfactorily by fall plowing. This should be shallow so as to leave the roots exposed which will ensure complete killing during winter. Deep plowing in spring will cover them up. Some kill alfalfa successfully by plowing late in spring when it is 10 to 12 inches high.

Whether the plowing be in midsummer or in fall the roots should be finally left in the ground to decay as thereby the full fertilizer value of the alfalfa is secured. Some farmers rake out the roots and haul them off in wagon loads. Much valuable organic matter and plant food is lost by such a practice.

ALFALFA BY-PRODUCTS

The manufacture of alfalfa meal from alfalfa hay has during recent years assumed considerable importance east of the Rocky Mountains. Not only is the alfalfa sold as ground but it is also mixed with such concentrated carbohydrates as molasses and corn chop, thus making a more nearly balanced ration. The ground alfalfa has the advantage that

it may be fed with less waste than hay, and it is in a more convenient form for shipment. The cost of manufacture precludes any considerable use of alfalfa meal when alfalfa hay is produced in abundance. It may, however, be shipped to districts where it is not grown and there will be a demand for it in cities. No mills have as yet been established in Idaho. We expect that some will be installed in the near future.

COMPOSITION AND FEEDING VALUE OF ALFALFA

Hay cut when one-tenth in bloom contains a much largor percentage of both the total protein and digestible protein than when cut half in bloom or in full bloom. Both diminish as the alfalfa matures while the total carbohydrates and digestible carbohydrates increase. When cut in the early stage the nutritive ratio is considerable narrower than when cut later. Since the protein is the most valuable of the constiuents of alfalfa we naturally will cut the alfalfa when it contains the greater amount of it, and that has been found to be when one-tenth in bloom.

The average composition of the first and second cuttings, there being no third cutting, is reported in bulletin No. 78 of the Wyoming Experiment Station, as follows:

	Water	Ash	Protein	Fiber	Carbohydrates	Fat
First cutting	7.64	9.33	15.84	29.54	35.75	1.87
Second cutting	6.46	8.68	14.75	31.67	36.82	1.61

In the same bulletin the digestible nutrients in 100 lbs. are reported as follows:

	Dry matter	Protein	Carbohydrates	Fat	Nutritive ratio
First cutting	57.22	12.27	39.74	.72	1:3.4
Second cutting	60.99	11.73	42.38	.72	1:3.8

The composition and digestibility of alfalfa hay at higher altitudes in Idaho where there are but two cuttings may be expected to be similar to the above figures.

The composition of the different parts is reported in bulletin No. 155 of the Kansas Experiment Station, as follows:

Part of plant	Yield per cent	Ash	Protein	Fiber	Carbohydrates	Fat
Stalks	58.75	47.69	38.73	81.17	55.68	19.03
Leaves	38.43	49.62	56.74	17.39	41.01	79.34
Flowers	2.82	2.69	4.53	11.44	3.31	1.63

The distribution of the different constituents in the different parts is of interest. While the stalks yield 58.75 per cent, they contain but 38.73 per cent of the protein. They also contain 81.17 per cent of the fiber which has a nutritive value much inferior to the other carbohydrates. The leaves are high in protein and fat contents. These figures show the importance of so handling the hay that the leaves are not lost in harvesting. Often in feeding hay the leaves and more tender parts of the stacks are eaten first and a considerable portion of the stalks is not consumed. By means of feed cutters the hay may be cut up so that there is practically no waste, but all the stalks utilized. Economy, however, is not the only consideration, for, when all is utilized, a smaller access of protein is consumed than where a portion of the stalks are wasted. Cut alfalfa is therefore a better feed for stock as the ration then is not as narrow as otherwise.

The composition of alfalfa and other feeds and forages are given in a table that follows. These figures are from bulletin No. 132 of the California Experiment Station.

COMPOSITION OF FEED STUFFS

Feed Stuffs	Water	Ash	Protein	Carbohydrates	Fat
Fresh alfalfa.....	80 00	1.72	4.94	12.60	0.74
Fresh clover.....	70.80	2.10	4 40	21.60	1.10
Alfalfa hay.....	10.90	6.40	17.60	61.90	3.10
Clover hay.....	15.30	6.20	12.30	62.90	3.30
Wheat bran...	11.70	5.20	14.05	65.50	3.60
Wheat.....	11.50	1.80	11.80	72.80	2.00
Oats	11.00	3.00	11.80	69.20	5.00
Wheat straw.....	9.60	4.20	3.40	81.50	1.30
Oat straw.....	9.20	5.10	4.00	79.40	2.30
Shelled corn.....	10.60	1.50	10.30	72.60	5.00
Corn fodder, green...	79.30	1.20	1.80	17.20	0.50
Corn fodder, dry.....	42.2	2.70	4.50	49.00	1.60
Corn silage.....	75.4	1.60	2.10	20.20	0.80
Manger wurzels.....	90.90	1.10	1.40	6.40	0.20
Orchard grass hay.....	9.90	6.00	8.10	73.40	2.60
Timothy hay.....	15.00	4.50	6.00	71.50	3.00

It will be noted that alfalfa runs high in protein, containing almost as much as wheat bran. Alfalfa is thus a valuable feed. In the eastern

states where crops rich in carbohydrates are largely grown the problem of the feeder is to supply protein to balance the ration. With us where alfalfa is produced so cheaply it is crops that will supply that will supply the necessary carbohydrates that are generally lacking.

The constituents of foods which chiefly concern us are the nitrogenous matter or protein and the non-nitrogenous ones or carbohydrates (starch, sugars, etc.) and fats.

Protein is used in the animal economy for building up and repairing the muscle, brain, nerves, internal organs and gelatinous part of the bones and tendons. It can serve as fuel but is not normally so used. The carbohydrates and fat are consumed in the animal body in the production of heat and energy. In considering the feeding value of alfalfa we need to take into account its digestibility as well as its composition. The digestibility of alfalfa and other feeding stuffs are given in the following table:

DRY MATTER AND DIGESTIBLE NUTRIENTS IN 100 POUNDS

Feed Stuffs	Dry Matter in 100 lbs	Digestible Nutrients in 100 lbs.			Nutritive Ratio
		Protein	Carbohydrates	Fat	
Fresh alfalfa	20.0	3.7	7.3	.6	1:2.3
Fresh clover.....	29.2	2.9	14.8	.7	1:5.6
Alfalfa hay.....	89.1	12.3	37.1	1.6	1:3.3
Clover hay	84.7	6.8	35.8	1.7	1:5.8
Wheat bran.....	88.3	11.2	42.2	2.5	1:4.3
Wheat..	88.5	9.5	49.9	1.4	1:5.6
Oats.....	89.0	9.2	47.3	4.2	1:6.2
Wheat straw.....	90.4	.4	36.3	.4	1:13.0
Oat straw.....	90.8	1.2	38.6	.8	1:13.6
Shelled corn.....	89.4	7.8	66.7	4.3	1:9.8
Corn fodder, green	20.7	1.0	11.6	.4	1:12.5
Corn fodder, dry...	57.8	2.5	34.6	1.2	1:15.0
Corn silage.....	24.6	1.3	13 5	.6	1:11.7
Mangel wurzels...	9.1	1.1	5.4	.1	1:5.1
Orchard grass hay	90.1	4.9	42.3	1.4	1:8.3
Timothy hay.....	86.8	2.8	43.4	1.4	1:16.6

Taken from California Bulletin No. 132.

The term nutritive ratio is used to denote the ratio between the digestible protein and the other digestible matter in any food stuff.

The proper ratio is about 1:5. Reference to the table shows that alfalfa has a "narrow ratio," that is, it contains a larger percentage of protein than stock require for sustenance. This fact points to the need of combining with alfalfa other food to balance the ration. To do this feeds that contain an excess of carbohydrates must be used. Such are corn, wheat, oats, corn fodder, corn silage, oat straw, mangels, and the true grasses, such as orchard grass, timothy and meadow fescue.

The adaptability of the different kinds of seeds and forage to different kinds of stock, the market value of the feed, and practicability of its economical production in any locality will determine which feed or forage should be used to balance the alfalfa ration.

Various grasses may be sown with alfalfa in order that the hay harvested may constitute a more nearly balanced ration. The more valuable ones are orchard grass, meadow fescue, and tall meadow oat grass. Tne rate of seeding for hay may be as follows:

Orchard grass.....6 lbs.
Meadow fescue..... .....6 lbs.
Tall meadow Oat grass.....6 lbs.
Alfalfa.....8 lbs

Timothy is not included in this mixture, as it is inferior in feeding value in the grasses recommended. The mixture makes excellent hay, especially for horses. When alfalfa straight is fed to horses it is an excellent plan to allow them as much wheat or oat straw as they will consume. Mangels and coarse fodder, such as corn fodder or corn silage, are valuable to combine with alfalfa for dairy cows. Where corn cannot be grown oat straw may be used as additional roughage. Since alfalfa has very nearly the same composition as wheat bran it is unwise to feed it in connection with alfalfa.

The tables that are included are intended to give the feeder some knowledge of the composition and digestibility of the substance fed. They are meant for a guide but must not be followed too closely. The feeder should take into account various local circumstances. He must know that besides containing the required amount of nutrients the ration must furnish the necessary bulk of indigestible matter in the form of roughage. Various qualities and properties of feeds and their effect on different kinds of stock must be considered, as must also the purpose of the ration, whether for growing stock, for maintenance, fattening, or for cows giving milk.