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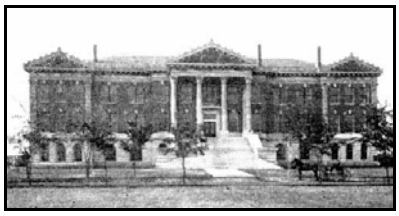
# ALFALFA IN OKLAHOMA

AGRONOMY



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EXPERIMENT STATION, Stillwater, Oklahoma

# ALFALFA IN OKLAHOMA

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## Introduction

Alfalfa has been designated the king of forage crops. If a careful study is made of the advanced steps which this crop has taken in popular favor within the past decade, it will be seen that alfalfa stands without a peer. This statement can be applied more particularly to the central and western portions of the United States rather than to eastern sections; although within the latter area this legume received considerable attention during the closing period of the nineteenth century. It remained for the West, however, to develop this wonderful crop and to demonstrate by practical experience the marvelous monetary value which the alfalfa plant is capable of returning. The irrigated sections of the West furnish an ideal home for alfalfa, and in these sections it will always be found enhancing the beauty of the plain with its verdant blanket. But this is not the only place where this crop can be grown with profit. The regions where alfalfa is gaining a foothold are gradually widening, and it will not be long until the culture and characteristics of this plant will be familiar to every intelligent agriculturist in the United States. The area devoted to alfalfa in Oklahoma is increasing annually, and since this plant has been set in a paramount position, from the standpoint of the live-stock feeder as well as the soil economist, it is proper that some attention be directed toward the problems which are facing the tiller of the soil in the Southwest.

## History

Alfalfa has a unique history. This crop was under cultivation in Europe when Rome had reached the zenith of her power, and even at this date, centuries before the advent of our modern agricultural science, alfalfa was recognized as a valuable forage crop. Alfalfa is a native of western Asia, and is supposed to have originated in the province of Media. From this section it was introduced to the continent of Europe. Traveling in a westerly direction, this plant finally became established in the kingdom of Spain. Mexico was the first home of the alfalfa plant in America. Alfalfa was then taken from Mexico to the western coast of South America, and from thence it found its way, according to the most authentic records, to California about the year 1854. The luxuriant growth which was obtained on the irrigated plains of this western state was an unmistakable indication that the surroundings for alfalfa were ideal in every respect. About the year 1820, alfalfa was introduced into the eastern states, but its culture did not become general, possibly for the reason that difficulties were encountered in getting the crop started. It may be stated, that the red clover plant, which in a measure takes the place of alfalfa, was well known in the New England states, and as farmers were familiar with its culture, there is a possibility that they did not wish to change for a new and untried plant. Alfalfa appeared to be much better adapted to western conditions where dry weather came as a check to plants of the Trifolium group. The long roots of the alfalfa plant enables it to obtain moisture from great depths; hence during seasons of prolonged drouth, even in sections where irrigation is not practiced, this crop has, given fair yields. This is one reason why alfalfa should be given the preference, as compared with its more shallow-rooted companion, red clover, especially on the Oklahoma farm.

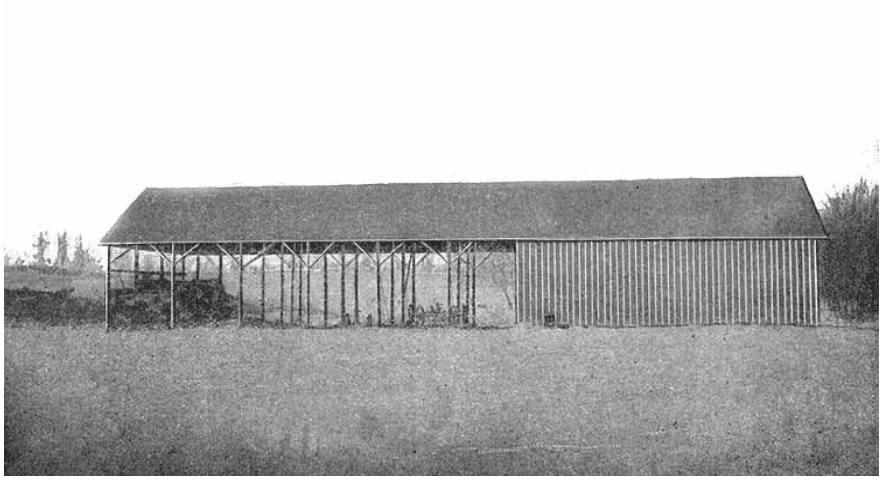
## Composition and Feeding Value

In comparing alfalfa hay with prairie hay, or concentrates like wheat bran, oats, or corn meal, it will be observed that the cured alfalfa is decidedly superior to prairie hay; it contains

almost as much digestible protein as wheat bran; it has the advantage of oats in this respect, and it is much in advance of corn meal with regard to the percentage of nitrogenous material. The feeding experiments which have been conducted by the Oklahoma Station, and other stations, as well, demonstrate the fact that this crop can be fed profitably in conjunction with corn meal and Kafir meal to fattening stock. The latter foods are comparatively rich in starch, but they contain a relatively small amount of protein. On the other hand, alfalfa hay contains a high percentage of this valuable constituent, protein, and as a fodder or forage plant it, makes a splendid combination with corn or Kafir meal. If such a mixture is profitable in the feed-lot where mature animals are prepared for the block, the chief object being the production of fat, one would be safe in the assertion that a ration containing alfalfa hay ought to bring maximum gains when fed to young and growing stock where the chief object is the building up of bone and muscle. The field of practical experience affords ample evidence of the value of this plant when used as a hay or pasture for young stock. It is relished by all classes of farm animals, and after it has been given a trial, it becomes an indispensable part of the stockman's supply of winter feed.

## Botanical Relations

Alfalfa (Medicago sativa) is a member of that well-known family of plants which has been named Leguminosae. It is a deep rooted, perennial forage plant, having an upright habit of growth. There are one or more so-called varieties of alfalfa in addition to the common cultivated type. Sand lucerne is thought by some investigators to be a distinct variety of alfaifa; others have intimated that it is probably the result of a cross between common alfalfa (Medicago sativa) and yellow lucerne (Medicago falcata). In the north central states, sand lucerne has produced good yields on light, sandy soils. It must not be inferred that this variety will give satisfactory returns on similar types of soil in the southwest. The climatic conditions which prevail in Oklahoma are unlike the conditions which are



Alfalfa hay barn on the farm of Ewers White, McLoud Oklahoma. The open shed is used for storage of loose hay. The protected portion is used for storing baled hay. Baling is done under cover.

met in northern states, and it will remain for the grower in the former area to develop strains of alfalfa which will prove to be admirably well adapted to their environment. It is our opinion that such adaptations may be found within many well-defined districts in the new state. This office has received some inquiries with reference to types of alfalfa which are common to outside sections; hence a brief explanation will therefore serve to indicate the characteristics and to inform our readers in regard to the more important types.

*Turkestan Alfalfa*. This strain or variety gets its name from the country in which the seed was procured. It was introduced into this country several years ago by the National Department of Agriculture, and it has been grown with some measure of success in various parts of the United States. The plants from which the first seed was selected were found growing in a semi-arid region, and as they appeared to display certain desirable qualities with regard to drouth resistance, selections were made for importation. Observations which have been made on the growth of this type, especially in the dry non-irrigated portions of the West and in the older sections of the Northwest, indicate that Turkestan alfalfa is probably better suited in these districts than common alfalfa. The writer was informed that a small quantity of Turkestan alfalfa seed was sown on the Station farm several years ago; but as far as we have been able to determine, this type had no advantage over the local strains. It would seem, however, that if the Turkestan alfalfa proves beyond question its superiority as a plant for the semi-arid sections, this type ought to be given further trial in Oklahoma, but until definite information is advanced concerning the productive capacity of this variety, and until we have a method of ascertaining whether the seed which is placed upon the market really belongs to this group, no special premium should be attached to such in comparison with home grown types.

*Grimm Alfalfa* was developed in Carver County, Minnesota, and was subsequently introduced to the trade by the Minnesota Experiment Station. Since the Grimm alfalfa is a product of one of the states on our northern border, and inasmuch as it

has been developed in a climate where the temperatures run comparatively low in the winter season, it has undoubtedly shown some resistance to cold; however, this adaptation will not be of much interest to Oklahoma growers, with the possible exception of those men who are raising alfalfa in the high-plains areas, and even in such sections new types must be well tested before they are recommended.

*Arabian Alfalfa and Algerian Alfalfa* are importations which were obtained by the Bureau of Plant Industry. The respective types appear to have some, desirable characteristics, and they may find a place in the warmer sections of this country. Some seed has been planted at this Station, but the test has not proceeded far enough to enable us to make any report.

*Peruvian Alfalfa* is a recent acquisition which promises some features for the Southwest, and there is a probability that the Oklahoma grower may have some interest in the introduction and development of this strain. The type under consideration was brought to this country from Peru, being imported by the Bureau of Plant Industry. Some tests have been made with this seed in the Southwest, and favorable comments have been passed on the growth of the Peruvian plants.

## Nitrogen Is Obtained from the Soil Air

Alfalfa, in co-operation with small plants called bacteria, collects nitrogen from the soil air. The plants, which are classified as legumes, have a characteristic which, according to our present knowledge, is not possessed by other plants. They are able, through the medium of microscopic organisms which are found within small nodules located on the root systems, to assimilate free nitrogen from the soil air. Nitrogen is one of the most expensive and necessary elements in our list of plant-food substances, and with many of our southern types of soil this element becomes a limiting factor in crop production at an early stage under average systems of farm management. Commercial nitrogen costs fifteen or sixteen cents per pound. Furthermore, the application of a soluble fertilizer is always attended

with some loss, and if the purchaser fails to make a thorough study of his work, the margin of profits may be exceedingly low. On the other hand, there is an inexhaustible supply of nitrogen lying immediately over each farm, and this may be turned to good account by growing alfalfa. It has been estimated that nitrogen can be secured through the agency of these microscopic plants known as bacteria at a cost not to exceed two or three cents a pound. Where the proper organism is present-and it is safe to assume that in most instances alfalfa bacteria will be found in our fields-large amounts of nitrogen can be collected for the replenishment of our soil stores. The losses which may take place through the use of an organic fertilizer containing nitrogen will be much less than in cases where soluble material is used.

### Alfalfa Is a Deep-Rooted Plant

The benefits which are to be derived through the introduction of alfalfa into any rotation are seen not only in the fact that this plant has the free nitrogen in the soil air at its disposal, and is able to find a supply of moisture at depths far removed from the roots of other crops, but they are also apparent in the physical improvement which is brought about through accumulation of humus or vegetable matter in the soil. One writer has made the statement that the physical condition of the soil -- namely, its capacity for absorbing and radiating heat, its permeability to roots, its capacity for absorbing and retaining water -- is of more importance than its strictly speaking chemical composition. The essential elements which are required by the plant may be present in large quantities in a given soil, but if that soil is defective in its mechanical structure, the crop may not secure a sufficient supply of these elements for maximum production. The incorporation of vegetable matter with the surface-layer of soil has a tendency to make the compact type somewhat more open in structure; while on the other hand, the coarse or open soil is changed to a more compact form by this method of soil treatment. Again, the alfalfa roots act as tillers of the soil, because, in their quest for moisture

The main portion of this field, which is shown in the photograph, was seeded early in October, 1907; five crops were taken from this area in 1908.

and plant food they penetrate the subsoil to a remarkable depth. In their downward passage the roots enter the very small openings which are found, even in soils of close texture, and as the root increases in size the openings enlarge. The decomposition of these roots will result, at a later period, in the admission of larger quantities of oxygen to these lower areas, and inert supplies of plant food will be changed to more available forms. Alfalfa, as we have seen, enjoys a very extensive feeding area; consequently, it is able not only to reach new stores of plant food, but it is also in a position to retrieve and bring to the surface, plant food which has been carried down through the soil by the percolating action of water until it is far beyond the reach of the shallow-rooted crop.

### Alfalfa Produces Several Crops Each Season

Alfalfa yields a large amount of hay under average conditions of soil and climate. This fact alone enhances the value of alfalfa in the estimation of the stockman and farmer. In Oklahoma, four or five good crops can be taken from the field during a single season. On upland soils the total yield per acre will range all the way from two and one-half to four tons. The native grasses will yield, ordinarily, one to one and one-quarter tons of cured hay per acre, and with special care this record can be increased from one-quarter to one-half ton per acre; but even returns of this amount fall considerably below the yields of the alfalfa plant. In making this comparison we do not wish to convey the idea that all the native grass lands should be plowed up and seeded to alfalfa in order to obtain more profitable yields. The native grasses have their place on the average Oklahoma farm, because in most cases they are grown upon upland fields, which are not exceptionally well adapted to alfalfa. Many rolling fields which are not well suited to alfalfa should remain permanently in grass.

### Alfalfa Is a Perennial Crop

There is another feature which should receive some consid-

eration. Alfalfa is a perennial plant, hence if a good stand is secured at the first seeding, the field can be allowed to remain intact for a number of years. There are fields on the Station farm which have been in alfalfa from seven to nine years, and although the crab-grass has been very persistent on these areas, the alfalfa is still in very fair condition, as evidenced by the yields obtained within recent years. In other sections of the country cases are on record where the alfalfa has been allowed to remain in the same fields for periods of ten to fifteen years, or even longer, and at the expiration of this time the crop appeared to be in a thrifty condition. No good reason can be advanced for following the practice of leaving the alfalfa sod unturned for a long period of time; in fact, it would appear to be desirable to plow these fields at the end of a six or eight-year period, and give other sections of the farm the advantage which comes through the growth of this legume. It is true that some difficulty is met in getting a first-class stand, and when a good set is secured the farmer is loath to break his field; but as soon as the culture of this crop is understood, a systematic plan of cropping will surely be adopted.

## Soil

Alfalfa makes its best growth on well-drained, loamy soils, and in selecting a field for this plant this fact should be kept in view; however, good crops can be grown in places where the subsoil is comparatively, close, but in such instances the roots must have ample opportunity to penetrate the soil deeply, so that they may be able to reach very liberal supplies of moisture. A large amount of moisture is used by this crop during the growing season, hence to attain the very best yields some attention must be paid to the water-holding capacity of the soil, as well as to the supply of bottom water which is present. It has been estimated that our ordinary crops, as wheat or barley, remove about three hundred times their dry weight of moisture during the growing season, while the alfalfa crop uses from four hundred to four hundred and fifty times its dry weight of moisture. Where a yield of three tons of dry matter is ob-

tained from one acre, an exceedingly large amount of moisture is consumed throughout the summer months. Any soil that is underlaid with an impervious hard-pan is not well adapted to alfalfa, since the capacity of such a soil as a storehouse for moisture is naturally limited. River and creek bottom lands are more suitable for alfalfa than uplands, because the bottom water is generally within reach of the roots and such soils are usually more fertile than soil types in the other class. The fertility of the soil should be considered when we make our selection of an area to devote to alfalfa, for the crop always responds liberally when there is a full supply of plant food on hand. This statement is not given in contradiction to facts which have already been presented, for even though alfalfa is a nitrogen gatherer and is able to store up this element from atmospheric sources, there are other elements, phosphorus, potassium; and calcium, to be supplied.

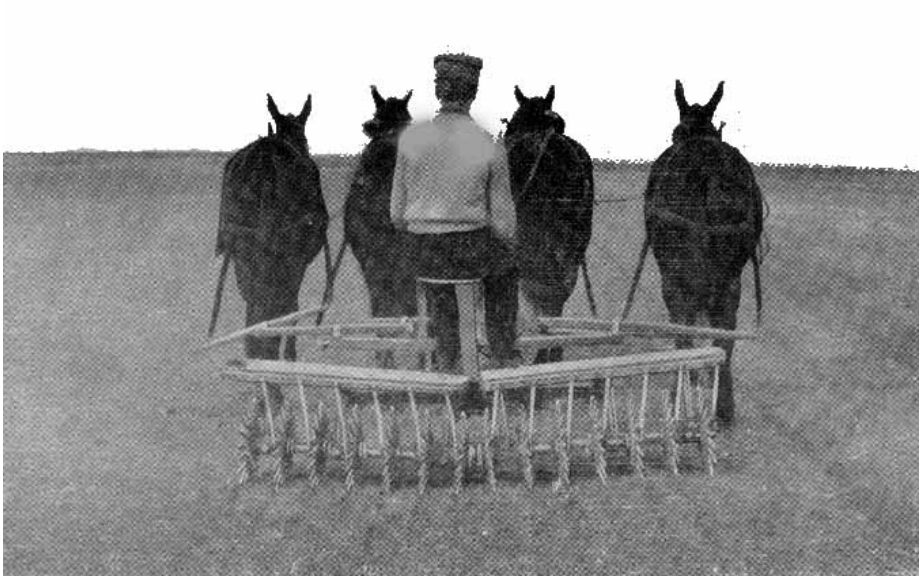
## Farmyard Manure Can Be Turned to Good Account On Poor Land

Where the type of soil which is to be seeded to alfalfa is thin and does not have the power to produce normal yields of wheat or Indian corn, it is a good plan to treat such fields with a liberal application of barnyard manure; however, such material should be incorporated with the soil at least six months, or preferably, one year, prior to the date of seeding. This early treatment will give the surface due time to settle, and any weed seeds which are found within the manure will probably germinate soon enough to be destroyed by subsequent cultivations. Farm manure may have a direct and an indirect action upon the soil. It contains small quantities of plant food, and these elements may stimulate plant growth; it also changes the physical structure of the soil, and in this manner makes the home of the plant more congenial. The latter is the principal reason why manure should be worked into thin soil. The decomposition of organic matter in the soil also exerts some influence in the chemical changes which are concerned with the modification of unavailable plant food; hence we must infer

that a soil well provided with organic matter is in a much better position to meet the requirements of the young crop than the same type which has but little of this essential constituent in the surface area. Manure may not only be applied to the less productive type land while the preparatory work of securing a seed-bed is under way, but it can also be used to advantage as a top dressing on fields which do not produce a vigorous growth alfalfa. The effect of manure as a top dressing is shown in some tests which were made by the Station on an upland section in central Oklahoma. Three of the plats in question were cropped to sorghum in 1900; an adjoining plat produced a crop of oats and was then placed under fallow. One of the sorghum plats, No. 3, was treated with a coat of barnyard manure in the spring before the ground was plowed. The fallowed plat was given generous cultivation throughout the summer months, and was seeded to alfalfa in the autumn. An excellent set was secured, and the plants carne through the winter in good condition. The remaining plats in the series were plowed as soon as the sorghum was harvested in October, and they were therefore exposed to the frosts of winter before being seeded. The seeding was done about the middle of April. A good germination was reported, and the plants made a strong growth early in the season, but they were checked somewhat at a later date by the growth of crab grass. The yields for the succeeding seasons, with two cuttings for a fourth season, are reported, in tons of cured hay per acre, in the following table:

| | 1902 | 1903 | 1904 | 1905 |
|---|---|---|---|---|
| | Five Cuttings | Five Cuttings | Five Cuttings | Two Cuttings |
| Plat 1 . . . . . | 1.69 | 1.85 | 3.07 | 1.23 |
| Plat 2 . . . . . | 3.07 | 3.90 | 4.28 | 2.28 |
| Plat 3 . . . . . | 2.59 | 3.07 | 3.97 | 2.06 |
| Plat 4 . . . . . | 3.43 | 4.33 | 1.90 | 1.28 |

In the spring of 1904, plats 1, 2, and 3 were treated with an average application of farmyard manure. During the seasons



The use of the alfalfa renovator in the spring encourages the alfalfa and discourages weed growth.

1902-3 the fall seeding, No. 4, gave much better returns than the other plats; it had the advantage in that the stand of alfalfa was more uniform than on the other areas. Manuring assisted in raising the yields on plats 1-3, in spite of the fact that the set was imperfect. It is the opinion of the writer that the increase which is reported for these plats was due not so much to the plant food found in the manure, because this amount is small at best, but the better crop was made possible through the absorption and storage of more moisture in the manured land.

Mention should be made of the increased growth of crab grass which came with the alfalfa in 1904. This material added somewhat to the total production on all plats, but the growth was strongest on the areas which received manure. Two cuttings only were reported for 1905, and with the exception of plat No. 1, where, the alfalfa was very scattering, the manured sections are much in advance of the untreated plat. It has been stated that plat No. 3 was manured, in the spring of 1900, and an examination of the table of yields for 1902-3 indicates that this area gave a much lower average yield than either No. 2, which was cropped in the same manner without manure, or No. 4. This may be explained in the former case by a difference in the total number of plants on plats 2 and 3, while in, the latter we merely suggest that the fall seeding was more successful than the spring.

## Problems in Soil Cultivation

The remark has been made that any soil which will produce good Indian corn will give profitable returns if it is well prepared and then seeded to alfalfa. While this statement rnay be taken as a general rule, there are some exceptions, but where failure occurs, the conditions ought to receive earnest study, and several attempts should be made to start alfalfa. The types of soil upon which alfalfa is being grown with success range from loose sand or sandy loam, down to the heavier types which are classified as heavy clay lands. Although our creek and river bottom lands furnish an ideal home for alfalfa, every

farm in Oklahoma is not located adjacent to these streams; consequently, if this crop is to be grown, it must be assigned to an upland area. It will be shown later that alfalfa makes very good crops on such types. One of the most trying obstacles which confronts the grower who is required to cultivate sandy land is found in the fact that high winds move the soil particles to and fro across the fields, with the result that the young plants are seriously damaged. Alfalfa. is a tender plant during the early stages of growth; hence, if the soil particles lend themselves readily to the action of the wind, and the change of position continues for several days in succession at a critical period in the life of the crop, there is strong probability that the stand may be impaired perceptibly. Such types of soil may be improved and the particles can be held in place to some degree, simply by replenishing the supply of humus or organic matter.

## Alfalfa Yields On Upland Soil

Alfalfa has been grown on medium and also extreme upland areas for several seasons, and our observations seem to point in the direction of the conclusion that if the soil conditions are at all suitable, this plant should have some consideration in the rotation plans which are to be adopted. The soil on the Station farm has been described as a clay loam. It is close in texture, rather difficult to handle when either too dry or rather moist, and it is underlaid with a hard-pan which is somewhat impervious. In seasons of unfavorable weather conditions the alfalfa does not make a thrifty growth, and during these periods it is injured perceptibly by the growth of crab grass. Frequent mowing and thorough cultivation with a disk harrow at such times have assisted in checking the growth of crab grass, but this has not resulted in the total eradication of the pest. The area under study which contained about five and one-half acres, was seeded in the spring of 1899. A good stand was secured with this first attempt, and the field has been devoted to alfalfa from the date indicated to the present time. Complete records of the yields for the years 1900 and 1901 are not available, but

during the four succeeding years careful observations were made on the growth of the plants, and the total production during this period will assist the reader in forming an opinion with regard to the amount of hay which may be expected from land which is not well suited to the requirements of alfalfa. It should be observed in passing, that the soil in this field was placed in good condition prior to seeding, first through the incorporation of a fair supply of farm manure with the surface layer of soil, and in the second place, the cultivated area was given thorough tillage, which is an essential step in securing good texture.

YIELDS FOR THE YEARS 1902-1905:

| | 1902 | 1903 | 1904 | 1905 | Average |
|---|---|---|---|---|---|
| First Cutting . . . . . | 1.19 | 1.46 | .58 | .68 | .98 |
| Second Cutting . . . . . | 1.96 | .99 | .72 | .56 | 1.06 |
| Third Cutting . . . . . | .42 | .24 | .64 | .53 | .46 |
| Fourth Cutting . . . . . | .36 | .08 | .18 | .31 | .24 |
| Fifth Cutting . . . . . | .27 | .11 | None | .19 | .14 |
| Total . . . . . | 4.20 | 2.88 | 2.12 | 2.27 | 2.88 |

The yields are given in tons of cured hay per acre. A study of the above table shows that two-thirds of the total crop of hay was taken from the field in the first two cuttings of the season. The latter harvests always contained considerable crab grass, hence the late hay lacked in quality as compared with the first two crops. Weather conditions are not always ideal early in the summer, and as heavy rains frequently occur at this season, special care must be exercised in handling the early mowings. This field gave an average yield of 2.88 tons of cured hay per annum. In 1903 the area comprising this section was increased slightly by some fresh seedings. These strips or sections did not produce large yields; consequently the amount of hay reported per acre for the entire field was reduced slightly. Seasonal conditions also exerted an influence in checking the growth during the years 1904 and 1905.

## A Poor Subsoil May be the Cause of Failure

The surface layer of soil is under control of tillage implements, thus the more open types may be given treatment which will render them more compact, while heavy land can be made less tenacious so that it will respond to the pulverizing action, of the plow with greater ease, but in cases where unfavorable conditions exist below the subsurface line or in the true sub-soil as for example, the presence of an impervious layer or hardpan, such a line of interference to the extension and development of plant roots may be one or more feet below the plow line or the sub-soiler, and it cannot therefore be modified, nor can it be broken up by the husbandman. A stratum of this character which is located only a short distance below the plowed area may stand as a barrier to deep rooted plants. Failure to grow alfalfa may in some instances be explained by, the existence of untoward or undesirable soil formations. Over against the hardpan structure which has been described may be placed another unfavorable condition of the sub-soil, which may be described as open in character. Plant roots have no difficulty in working down, through an open sub-soil and the crop might thrive, if this, section were underlaid with material which will retain water, however, the entire sub-soil may be so coarse and open that practically all the water passing into it is readily drained away and the crop cannot absorb a sufficient quantity to produce even an average yield of forage. It will be seen that a good sub-soil is a valuable asset in the cultivation of alfalfa. The physical properties of the surface soil may be imperfect, but they can be changed almost at will by the grower. An imperfect sub-soil is difficult to correct.

## Alfalfa Will Not Stand Wet Feet

A well drained soil facilitates the growth, and insures the permanency of the stand of alfalfa. The soil ought to drain readily to a depth of thirty or thirty-six inches. If free water stands in or near the sub-surface, the roots will not increase in length or reach down into the sub-soil and the plants will most

The low basins in this field contain no alfalfa, but they do raise a crop of weeds. Alfalfa will not stand wet feet. Tile drainage is the remedy.

assuredly lack in vigor. Stagnant water close to the surface is a serious menace to the alfalfa. The past year has been a record breaker in so far as the total precipitation or rain fall for the state is concerned, thus many of the best alfalfa fields have been well tested. In this section more than sixty inches fell during the year, and on two or three occasions eight inches of rain-fall were reported for individual periods. The creeks and rivers were not large enough to carry the surplus water, consequently bottom lands were covered with overflow water for periods of twenty-four to thirty-six hours. On many of our river bottom fields small depressions or troughs may be found. Water remained in these basins for several days and if the field happened to be devoted to alfalfa, the crop was destroyed entirely. Many of these basins could be improved at small cost with a few tile drains. Under ordinary circumstances they produce no alfalfa, but they do provide vacant space for noxious weeds, thus an attempt to change the level of the free water in these sections through underdrainage will not only make possible the growth of alfalfa or other crops on these areas, but it will also serve as a means to an end in the total eradication of plants which have no value. Drainage aids in admitting oxygen to the soil and thereby promotes nitrification; the removal of the free water also precludes the necessity of evaporating this surplus from the surface which action reduces the temperature of the soil, and indirectly checks all the processes of growth in the springtime. The illustration on the opposite page is positive evidence that alfalfa will not stand wet feet.

## The Seed Bed

A well prepared seed bed is an essential factor in the cultivation of alfalfa, if success is to be insured. Although good stands have been secured on land which received very poor preparation, careful investigation will reveal the fact that it pays well to sow seed, on a well cultivated seed bed. The reasons for advocating such a practice are obvious. In the first place, we are using a very small seed, and if the particles of soil are coarse, the surface layer of earth will lose

its moisture readily and a poor germination will be the result. Second, the alfalfa plant is very tender during the early stages of its growth, hence if soil conditions are unfavorable, a portion or perhaps the entire stand. may succumb and the crop is pronounced a failure. The soil must be fine enough so as to allow the particles to come directly in contact with the seed, and the surface should be sufficiently firm to facilitate capillarity which, in turn, will supply the plant with the required amount of moisture. Special forethought and planning will be necessary in order to get the soil in the proper condition at the seeding season, since it always takes more or less time to plow and cultivate the field, after which preparation, a sufficient period should elapse to allow the seed bed to settle firmly. Successful growers lay particular stress upon the preparation of a first class seed bed.

## Fall Seeding

The land should be plowed early in July, and the subsequent treatment should be such as to obtain a seed bed similar to that described in the preceding paragraph. This work can be accomplished by using an ordinary float, or a roller to compact the surface after plowing, and these implements can be followed with a smoothing harrow or acme harrow so that a light surface mulch may be formed for the conservation of the soil moisture. It will be necessary to repeat the treatment with the harrow after each rain. Soil tillage of this character will break the crust, which always forms after a shower, and will keep the field in excellent form. Cultivation also hastens the germination of weed seeds, thus these injurious plants are destroyed by the succeeding cultivations. In cases where the soil is badly infested with weeds, it is a good practice to grow a hoed crop or two on the field, and this will, afford an opportunity to clean the land thoroughly. It is impossible on many farms to get all the ground plowed at an early date, but in such cases, the store of moisture may be retained by giving the surface of the field a thorough discing. During the summer a disk harrow can frequently be used to good advantage, more especially in fields where small weeds and grass get a start.

This machine should not be worked promiscuously late in the summer, for the reason that it stirs the soil deeply; hence a heavy mulch accumulates on the surface and an imperfect germination of the seed will be the outcome. Fall seeding is preferable in the south for two reasons: first, the alfalfa plants have an excellent chance to get a start in advance of the weeds and grass, and are not likely to be smothered out the succeeding season; second, the plants root deeply in the fall, and having made a fair growth by spring two or three cuttings (see illustration page 10) may be procured the first season.

## Spring Seeding

The principles which are advocated in connection with the preparation of the field for fall seeding, should be observed in the cultivation and preparation of land to be seeded in the spring. Impervious or compact clay soils should be plowed in the fall of the year. There is no better method of securing a mellow friable surface in the case of our compact types of soil than by allowing the frosts of winter, silently and yet surely to perform their work. With the advent of the first warm days of spring the surface soil can be given a thorough cultivation, care being taken not to obtain too loose a mulch. If spring plowing is resorted to, the work should be carried out as early as possible, inasmuch as a well settled seed bed is of prime importance even at this season of the year. Some soils are exceptionally open in character, and in such cases, some advantage might be gained by using a packer to firm the sub-surface.

## Seed Selection

The real value of making a special study of small insignificant seeds like alfalfa is frequently overlooked, and yet this crop is one of the most profitable crops in our farm system. If a good stand is obtained, the field continues to produce excellent crops for ten, fifteen, or, perchance twenty years in succession. When one considers the fact that many samples of alfalfa fail to give a germination test of more than 50 or 60 per cent, and some run as low as 30, and when one notes as well

that some of these samples contain large numbers of noxious weed seeds, we are certainly justified in making the assertion that alfalfa seed should be studied carefully from the standpoint of vitality and purity before they are scattered over the field. During the past two years the station has examined about 400 samples of alfalfa seed. In most cases the vitality was good, and apart from a few minor weed seeds, the samples made a splendid showing with regard to purity. Samples were examined, however, which proved to be very objectionable. In one instance, a five-gram lot of alfalfa seed contained 80 Russian thistle seeds; the alfalfa seeds in this sample also gave a low germination test. The most common weed seeds found in these samples were green and yellow fox tail, plantain or rib grass, pigweed, lambs quarter, and crab grass.

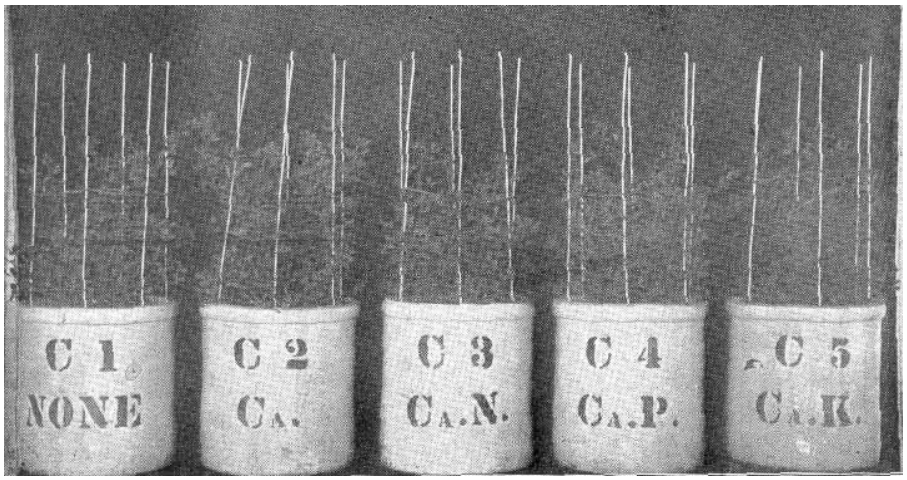
## Rate of Seeding

Alfalfa is sown at the rate of fifteen to eighteen pounds per acre. Some growers recommend a larger amount than this, using as high as twenty pounds per acre, while others claim that ten or twelve pounds per acre is sufficient. It is certain that in cases where the soil is placed in first class condition, and the seed purchased has a high germinative power, good results can be obtained by using fifteen to sixteen pounds of seed per acre; but if these conditions are not met, then a larger amount of seed will be required. The method of seeding varies in different sections of the state; but whatever the method may be, one should always aim to secure a uniform distribution of the seed. Any up-to-date grass seeder will accomplish this object, or an ordinary shoe drill can be used advantageously. Some drills are built with a grass seeder attachment from which the seed can be scattered in front of the drill, and the shoe or disc in passing over the surface will give sufficient covering. Placing the seed at a depth of more than one inch is not advisable. The amount of plant food which is stored up for the young embryo is limited, and when the seed is placed in the soil with a layer of earth to the depth of one or two inches above it, the amount of food is insufficient to carry the little plant above the surface, hence large numbers perish. As

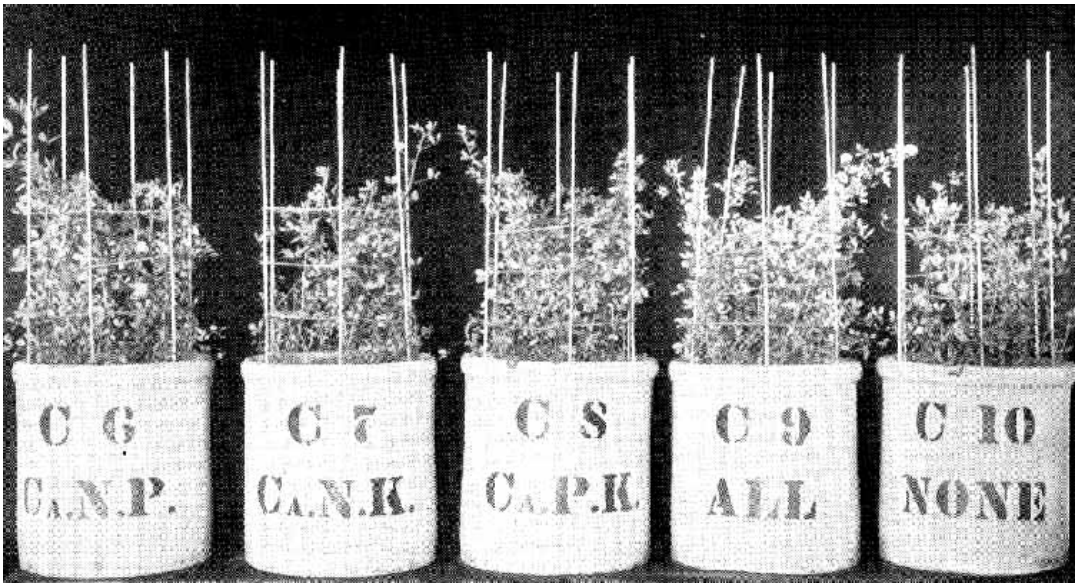
soon as the plant reaches the sunlight, it is able to collect new supplies of food from the soil and atmosphere. It has not been our practice to use a nurse crop with alfalfa.

## Pasturing

Alfalfa is one of the most valuable pasture plants included in the list of forage crops which are grown upon the American farm, but care must be exercised in its use in order to prevent loss from bloating in cases where ruminants, as cattle, or sheep are allowed to graze upon the field. The stand of alfalfa is frequently injured by pasturing heavy stock upon the field when the soil is full of moisture. Close grazing is also detrimental to the growth of the crop. The following extract from the annual report of this Station for the year '02-'03 sounds a note of warning with regard to close pasturing: "After it is too late to pasture wheat that is to be cut for grain and before the grass begins to furnish feed, there is a period of a month, or six weeks, when the temptation to pasture alfalfa is hard to resist. Pasturing during this period is about the surest way of destroying a good stand of alfalfa. Aside from weakening the plants by the removal of the first tender growth, the ground is kept bare and crab grass and weeds are allowed to get a good start ahead of the alfalfa. The longer the pasturing is continued, the more serious are the harmful effects. Many farmers in Oklahoma think they have tried alfalfa when, after securing a good stand by fall seeding, they have lost it by pasturing early the following spring. It takes about three years for alfalfa to become thoroughly established, and during that time it should not be pastured at all. It would be better if it were never pastured, especially on uplands. The Experiment Station has been tracing the causes of failures to succeed with alfalfa, and in nearly every instance that has been observed, pasturing, especially in the spring, has been one of the chief reasons." Alfalfa is pre-eminently a hay plant, and in most cases, greater profits will accrue by using it as such. At the same time, extraordinary gains have been secured by using alfalfa as a pasture crop for bogs, but in most of these instances the crop is was grown on an ideal soil.




Pot Culture Fertility Test. The soil used was taken from an upland area. The treatments are as follows: C 1, nothing applied; C 2, lime; C 3, lime and nitrogen; C 4, lime and phosphorus; C 5, lime and potash (See page 29)




Pot Culture Fertility Test. The soil used was taken from an upland area. The treatments are as follows: C 6, lime, nitrogen and phosphorus; C 7, lime, nitrogen and potash; C 8, lime, phosphorus, and potash; C 9, lime, nitrogen, phosphorus, and potash; C 10, nothing applied. (See page 29)

## POT CULTURE TRIALS

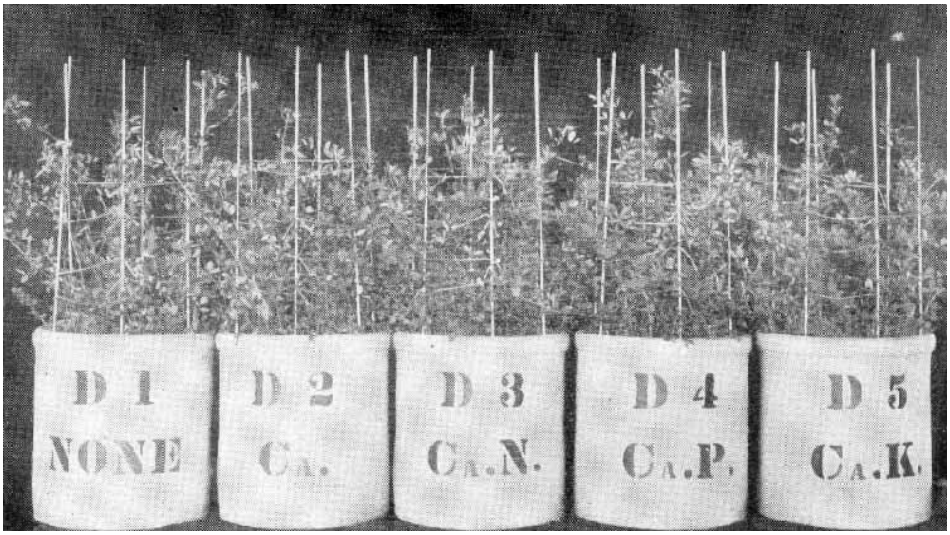
There are ten elements which are essential to the growth of the plant, namely: carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, calcium, sulphur, magnesium and iron. Three of the members of this group have been singled out for definite study from a fertility point of view. Nitrogen, phosphorus and potassium are considered more important than the remaining elements because they play the role of limiting constituents in crop production; thus when one or more of these three elements is deficient it becomes necessary to make some return to the soil in order to secure the best yields. Farm manure or commercial fertilizers are applied to the land for the purpose of meeting the needs of the crops which are grown on the farm. To use these manures with profit, one must have a knowledge of the soil, and he must also have some acquaintance with the materials which ultimately become a part of the plant. The total amount of nitrogen, phosphorus, and potassium, which a given soil contains may be determined with some accuracy by a chemical analysis; but such an examination will not reveal the quantity which may be classified as available plant food. The laboratory investigation if supplemented by a fertility test will enable the grower to draw certain conclusions with reference to the needs of the type under study; however, these field trials which include the application of the three elements, singly and in combination, should be continued for several consecutive seasons, and if the records for these years are properly kept, the differences observed will serve to show which element may be supplied with profit. Lime is also used in field and pot culture work. Several fertility tests have been undertaken by the Experiment Station, but the field work has not proceeded far enough to warrant us in making recommendations. Last season there,was practically no variation in the returns which were reported for treated alfalfa land. Two pot culture trials were conducted during the summer of 1908. One sample of soil was taken from an up-land area, while the other was secured from a creek bottom field. In the former type the soil is

close in texture and is underlaid with a very close sub-soil; the latter type is a mellow loam soil, and well adapted to alfalfa. A complete test was made with each soil (see ilustrations on pages 26 and 27, 30 and 31). Lime was applied in the form of calcium carbonate, dried blood was used to furnish nitrogen; phosphorus was obtained in steamed bone meal; and potassium was added as potassium sulphate. The first cutting is reported in the following table:

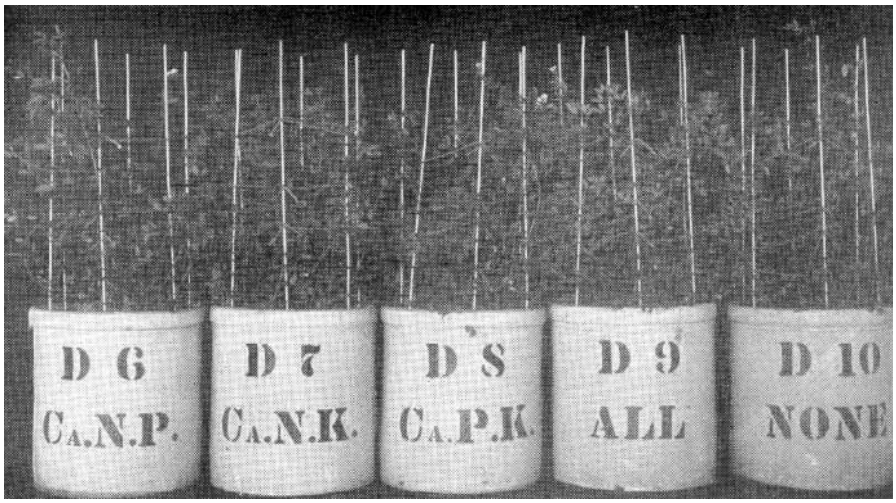
POT CULTURE EXPERIMENT WITH ALFALFA.

| UPLAND SOIL | | | BOTTOM SOIL | | | TREATMENT |
|---|---|---|---|---|---|---|
| SERIES | AIR DRY HAY | | SERIES | AIR DRY HAY | | |
| C-1 | 7.30 | gr'ms | D-1 | 13.30 | gr'ms | Check |
| C-2 | 14.55 | " | D-2 | 19.65 | " | Ca |
| C-3 | 10.90 | " | D-3 | 16.55 | " | CaxN |
| C-4 | 13.50 | " | D-4 | 19.80 | " | CaxP |
| C-5 | 10.00 | " | D-5 | 16.10 | " | CaxK |
| C-6 | 16.50 | " | D-6 | 26.65 | " | CaxNxP |
| C-7 | 13.35 | " | D-7 | 16.30 | " | CaxNxK |
| C-8 | 21.75 | " | D-8 | 24.40 | " | CaxPxK |
| C-9 | 19.85 | " | D-9 | 21.50 | " | CaxNxPxK |
| C-10 | 6.05 | " | D-10 | 12.25 | " | Check |

These results appear to indicate a deficiency in the case of calcium; our regular field tests together with practical experience have not shown lime to be a necessity in starting the crop. After these soils have been cultivated for a few years liming may give beneficial results. If the soil is acid in character, the alfalfa will not start readily; in fact failure to obtain a stand may be due to a sour condition of the cultivated area. Lime corrects acidity and in turn promotes the growth of the soil organisms. This substance also has a flocculating action upon clay land, thus it brings about a desirable physical change in this heavy material. Plant food may also be liberated in soils where lime is applied.




Pot Culture Fertility Test. The soil used was taken from a creek bottom area. The treatments are as follows: D 1, nothing applied; D 2, lime; D 3, lime and nitrogen; D 4, Lime and phosphorus; D 5, lime and potash, (See page 29)




Pot Culture Fertility Test. The soil used was taken from a creek bottom area. The treatments are as follows: D 6, lime nitrogen and phosphorus; D 7, lime, nitrogen and potash; D 8, lime, phosphorus and potash; D 9 lime, nitrogen, phosphorus and potash; D 10, nothing applied. (See page 29)