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ALFALFA IN KANSAS.

Making hay in Kansas.

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ALFALFA IN KANSAS.

SUMMARY.

Over one million acres of alfalfa are now growing in Kansas. The acreage could be doubled with profit.

Jewell county produces more alfalfa than any other county in the state, but Jewell county has less than thirteen per cent of its cultivated land in this crop.

A seed bed for alfalfa should be firm and well stored with moisture and available plant food. To accomplish this end the ground should be plowed thoroughly and kept cultivated for a period of at least two months preceding planting time.

Only clean, viable seed, free from obnoxious weeds, should be planted. In order to make sure that only this kind of seed is planted seed houses and alfalfa seed dealers should be requested to submit samples of the grade of seed offered for sale.

In eastern Kansas the best results are usually obtained from fall seeding. In western Kansas spring seeding is preferable.

Artificial inoculation of alfalfa is unnecessary in central and western Kansas, but in certain sections of eastern Kansas it is essential in order to secure a satisfactory stand.

In southeastern Kansas alfalfa can not be grown on much of the upland soil without manuring, liming, and underdraining.

Alfalfa planted in rows and cultivated will succeed under drier conditions than when seeded broadcast. It has been grown successfully in rows on the uplands in western Kansas. Rowed alfalfa will usually produce more seed than when it is planted in the ordinary way.

Alfalfa should be cut for seed when about fifty per cent of the seed pods are brown. Most farmers cut their seed too soon.

When alfalfa is grown for hay and the hay sold from the farm, very little plant food is added to the soil and large quantities are removed. In order to secure the greatest increase in soil fertility from alfalfa, it must be fed to live

stock on the farm and the manure carefully saved and returned to the fields.

Alfalfa leaves the ground dry. Over most of Kansas it should be followed by a drouth-resistant crop like kafir.

Alfalfa responds quickly to applications of barnyard manure. While manure benefits an old stand, the greatest benefit in eastern Kansas is usually derived when the manure is applied to the crop preceding alfalfa in the rotation.

The alfalfa weevil is causing thousands of dollars of damage in Utah. Alfalfa growers should guard against its introduction into Kansas.

Credit is due G. H. Dean for the preparation of the subject matter relating to the insects and other animals injuring alfalfa, and to F. A. Wirt for the plans of the alfalfa hay barn.

ALFALFA IN KANSAS.

By W. M. JARDINE, Director, and L. E. CALL, Agronomist.

Kansas has an approximate land area of 52,000,000 acres, 43,385,000 acres, or eighty-three per cent, being in farms. Of the land in farms, 30,000,000 acres, or sixty-nine per cent, are improved, that is, under cultivation. Of the thirty million acres improved, eight million acres are devoted to corn, six million to wheat, and one million to alfalfa. The one million acres of alfalfa yield approximately two million tons of hay annually, which is at the rate of two tons to the acre. Kansas has twice the acreage in alfalfa of any other state.

TABLE I.

Table showing the acreage, tons, and yield per acre of alfalfa in the leading alfalfa states. Census 1909.

State.	*Acres.*	*Tons.*	*Av. 1 acre, Tons.*
Kansas	1,000,000	2,000,000	2.
Nebraska	685,000	1,500,000	2.2
Colorado	509,000	1,270,000	2.5
California	484,000	1,640,000	3.4
Idaho	309,000	965,000	3.1
Utah	284,000	791,000	2.8
Oklahoma	207,000	322,000	1.5
Wyoming	170,000	398,000	2.3
Oregon	120,000	376,000	3.1
New Mexico	103,000	266,000	2.6
Washington	95,000	358,000	3.8

Although the acreage of alfalfa in Kansas is larger in comparison than it is in other states, it is less by one-half of what it should and profitably could be. At least a million acres of the fourteen million now annually devoted to corn and wheat would be planted to alfalfa with profit to the farmer and to the state. With the present high prices of all kinds of live stock and their products, and with every prospect that they will continue to be high for several years to come, it would seem self-evident to an observant farmer that the great opportunity of the future lies along the lines of a greater production of alfalfa and live stock in conjunction with a smaller acreage but larger yields of grain. A combination of alfalfa, grain, and live-stock farming is the only practical system that will insure the permanent upkeep of the fertility of the land.

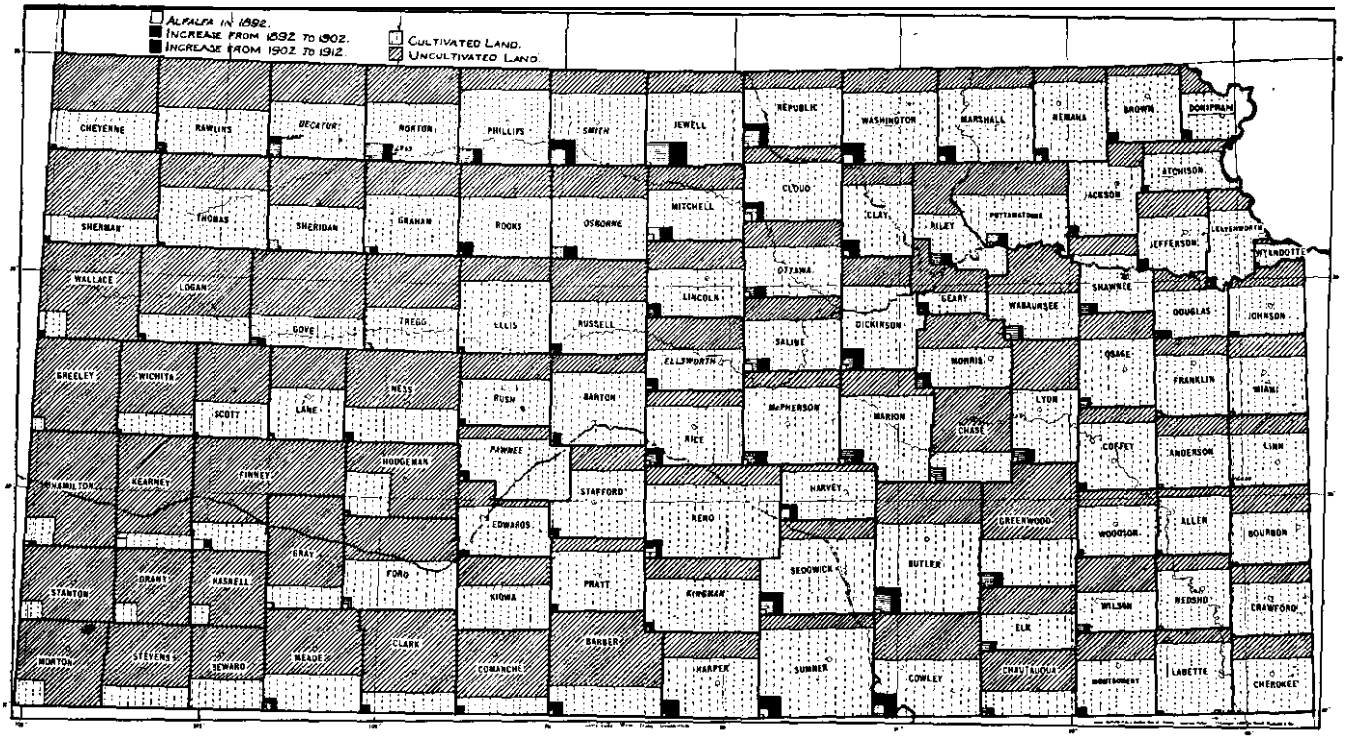

FIG. 2. A map of Kansas showing the proportion of cultivated and uncultivated land in each county, and the proportion of the county in alfalfa in 1892, 1902 and 1912.

Of equal importance with the increase in acreage of alfalfa is the increase in the yield per acre. Alfalfa responds readily to careful treatment. It is doubtful if there is any crop that will pay better for timely cultivation and an occasional top dressing of barnyard manure. A little extra attention along these lines on the part of the farmer would undoubtedly bring reward in increased yields.

Figure 2 is a map of Kansas arranged to show the development of the alfalfa industry in the state during the last twenty years. In addition to this it brings out the relative acreage of cultivated and uncultivated or unimproved land in the state. In 1892 there were 62,584 acres of alfalfa; in 1902 there were 458,485 acres, and in 1912, 1,000,783 acres, which represents an increase for the first ten years of 632 per cent; and for the second ten years, of 118 per cent.

It will be seen from the map that the greatest development in alfalfa production has taken place in north central and northeastern Kansas, although in the counties of Harper, Sumner, and Cowley, in south central Kansas, an equal increase is shown. Practically all of the alfalfa in Kansas is grown in the central third of the state. In this territory the annual rainfall averages about thirty inches, and the soil is usually well suited to its culture. In southeastern Kansas scarcely any alfalfa is grown, because of the acid condition of the soil and tight subsoil. Alfalfa, as is shown later, does not thrive in a soil that is inclined to be acid. In the western third of Kansas over one-half of the land area is still uncultivated or in grass, and very little of the cultivated area is in alfalfa. The rainfall of this section is insufficient to make the growing of alfalfa profitable except on first-bottom land. The alfalfa of western Kansas is grown almost entirely along the streams or on first-bottom ground. In Chase, Greenwood, and Butler counties, a large percentage of the land is still uncultivated or unimproved. In these counties lies what is commonly known as the flint hills district, a type of land that is suited principally for grazing purposes. In these three counties more live stock are grazed annually than, perhaps, in any other equal area of the United States.

The following table shows the acreage of alfalfa in the respective counties of the state for the years 1892, 1902, and 1912, together with the percentage of cultivated land in each county that is devoted to alfalfa.

TABLE II.

Table showing the acreage of alfalfa in Kansas in 1892, 1902 and 1912, and the per cent of improved land in alfalfa in 1912.

COUNTY.	Acres of alfalfa in 1892.	Acres of alfalfa in 1902.	Acres of alfalfa in 1912.	Per cent of improved land in alfalfa, 1912.
Allen	25	970	1,388	.5
Anderson	10	1,089	1,910	.76
Atchison	0	359	2,974	1.4
Barber	873	1,430	12,496	5.6
Barton	622	2,157	8,393	1.8
Bourbon	9	1,039	1,550	.6
Brown	27	870	6,326	2.1
Butler	1,773	21,651	34,663	5.5
Chase	1,918	12,106	13,521	8.2
Chautauqua	799	4,175	7,889	5.1
Cherokee	73	98	163	.06
Cheyenne	408	425	1,113	.41
Clark	949	244	3,870	2.9
Cloud	3,455	9,618	21,977	5.7
Clay	196	2,802	17,310	5.3
Coffey	57	3,224	3,530	1.2
Comanche	57	100	3,982	3.7
Cowley	200	7,239	31,812	7.8
Crawford	1	204	420	.15
Decatur	487	10,264	5,040	1.5
Dickinson	1,326	7,680	28,416	6.5
Doniphan	0	842	5,534	2.8
Douglas	11	2,537	6,543	2.95
Edwards	541	1,559	3,143	1.02
Elk	4	4,932	8,357	3.8
Ellis	97	385	2,285	.5
Ellsworth	183	2,079	8,883	3.5
Finney	7,000	11,945	12,137	9.1
Ford	1,392	5,352	6,604	1.8
Franklin	17	2,230	2,615	.9
Geary	341	1,943	7,385	7.2
Gove	1	2,924	3,484	1.5
Graham	164	2,520	5,662	1.5
Grant	10	0	168	.6
Gray	1,649	2,280	1,410	1.3
Greeley	67	0	90	.5
Greenwood	524	12,247	18,726	6.4
Hamilton	1,401	2,401	3,419	6.6
Harper	614	198	15,545	4.1
Harvey	483	6,004	16,087	5.3
Haskell	8	0	5	.02
Hodgeman	37	315	1,800	1.4
Jackson	126	1,346	5,733	1.8
Jefferson	0	1,413	6,293	2.6
Jewell	1,183	33,976	58,984	12.9
Johnson	0	1,015	2,306	.9
Kearny	6,152	6,801	5,062	6.9
Kingman	195	924	5,399	1.3
Kiowa	72	208	787	.3
Labette	7	690	1,818	.5
Lane	99	605	2,248	.9
Leavenworth	0	826	6,348	3.0
Lincoln	841	3,231	10,711	3.6
Linn	5	1,185	884	.3
Logan	60	670	3,002	1.5
Lyon	1,500	11,719	16,280	5.1
Marion	1,539	12,111	19,947	4.3
Marshall	92	4,199	16,638	3.6
McPherson	1,446	9,778	19,161	3.9
Meade	627	3,432	9,486	4.1

County.	Acres of alfalfa in 1892.	Acres of alfalfa in 1902.	Acres of alfalfa in 1912.	Per cent of improved land in alfalfa, 1912.
Miami	90	1,117	1,472	.5
Mitchell	2,283	11,314	21,527	.7
Montgomery	81	939	5,602	1.9
Morris	195	4,427	12,478	5.0
Morton	8	0	30	.065
Nemaha	59	3,425	11,254	2.9
Neosho	11	1,015	1,302	.46
Ness	60	344	3,771	1.6
Norton	903	19,351	10,684	3.0
Osage	40	4,704	5,493	1.6
Osborne	1,187	9,511	20,085	5.4
Ottawa	1,424	5,582	12,517	4.0
Pawnee	347	884	6,386	1.8
Phillips	475	13,110	21,159	4.7
Pottawatomie	459	9,867	17,439	5.6
Pratt	233	186	2,631	.7
Rawlins	359	2,079	5,123	1.5
Reno	1,338	8,393	18,093	2.8
Republic	1,010	17,452	33,836	8.9
Rice	1,126	7,525	18,276	4.9
Riley	497	8,181	15,855	6.9
Rooks	168	1,877	12,763	3.5
Rush	78	283	2,571	.9
Russell	293	1,087	6,295	2.1
Saline	3,361	9,553	19,448	5.9
Scott	58	257	985	.6
Sedgwick	1,541	11,496	31,553	5.8
Seward	17	26	256	.2
Shawnee	77	5,670	10,212	4.4
Sheridan	103	5,420	5,779	2.1
Sherman	250	1	1,723	.9
Smith	247	14,620	40,116	9.0
Stafford	171	815	4,945	1.3
Stanton	22	0	0	0
Stevens	22	0	0	0
Sumner	606	4,972	28,077	4.4
Thomas	64	641	1,228	.3
Trego	42	2,689	3,020	1.2
Wabaunsee	1,645	11,751	15,077	6.1
Wallace	125	842	3,155	6.3
Washington	199	6,070	28,803	6.4
Wichita	34	305	617	.54
Wilson	49	3,889	6,310	2.5
Woodson	62	1,966	1,985	.8
Wyandotte	2	283	1,140	2.0

It will be seen that Jewell county not only has the largest number of acres of alfalfa of any county in the state, but has a larger per cent of the improved land in alfalfa than any other county. In this county 12.9 acres out of every 100 of improved land are in alfalfa. Other counties having a high per cent of the improved land in alfalfa are: Finney with 9.1 per cent, Smith with 9 per cent, Republic with 8.9 per cent, Chase with 8.2 per cent, Geary with 7.2 per cent. and Kearny with 6.9 per cent.

THE SEED BED,

Success in starting alfalfa depends largely upon the preparation of the seed bed. A poor seed bed has been responsible for more failures with this crop than any other one factor. A

Fig. 3. The Western land roller. A good implement to use in preparing land for alfalfa.

good seed bed is firm, well settled, not too hard, and with the surface soil mellow and finely pulverized as deep as the seed is to be sown. A firm seed bed of this character allows free movement of the capillary water from the subsoil, and at the same time furnishes the plant with the proper root hold. Moisture is not available for the young alfalfa plant in a deep, loose subsoil, for the loose soil prevents the rise of capillary water. Besides being mellow and firm at planting time, the seed bed should contain ample moisture and available plant food. Time is required to store moisture and to liberate plant food, hence the earlier the preparation of the seed bed can begin, the better will be the results.

A very satisfactory bed for fall seeding may be prepared by shallow-plowing wheat or spring-grain stubble immediately after harvest and working the ground sufficiently thereafter to

kill all weeds and maintain the soil in good tilth until seeding time. The plowing should be as shallow as possible and cover the stubble well; otherwise, unless heavy rains come between plotting and planting time, it would be impossible to establish a firm seed bed. It takes several months' time and considerable rainfall to re-firm a deeply plowed soil. Where it is advisable to loosen up the soil to a considerable depth before seeding, the ground should be plowed deeply for the crop preceding alfalfa. A clean field of wheat, oats, or barley stubble can be put into good seed-bed condition by disking under the stubble thoroughly soon after the crop has been taken from the land, and then keeping it well tilled until planting time. Likewise, in favorable seasons, alfalfa may be successfully fall-seeded after a crop of cowpeas, flax, or millet, by disking the ground thoroughly as soon as possible after the crop is removed and keeping it well worked until time to plant.

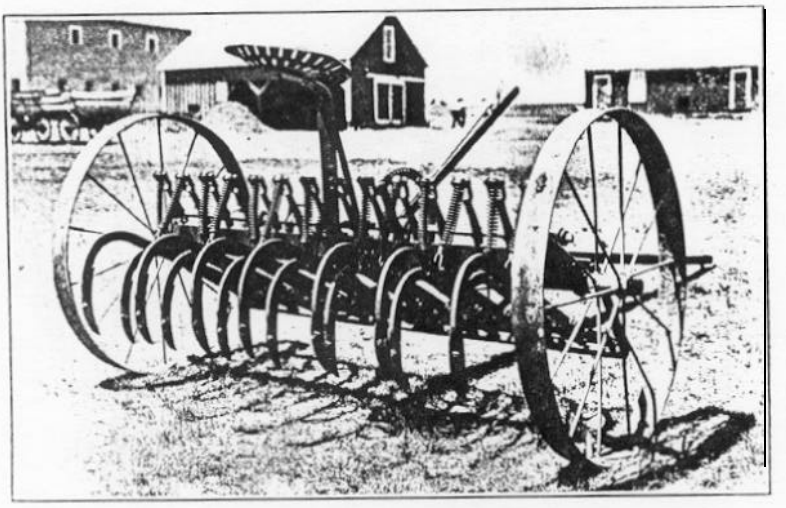

FIG. 4. A good type of alfalfa renovator.

When alfalfa is to be seeded in the spring, the best seed bed can be prepared by plowing the ground the fall preceding, leaving it rough over winter, and then working it into good condition with the disk and harrow. A fair seed bed can often be prepared in the spring simply by disking corn-stubble land, especially where the corn was kept well cultivated and free from weeds during its growth. When such land can not be fall plowed, this method is to be preferred to spring plowing.

Another satisfactory method of preparing a seed bed, and one that is adapted to land deficient in available plant food, or to parts of the state where conditions are too dry to start alfalfa readily, is to plow the land in the fall or spring and cultivate it sufficiently thereafter to kill the weeds and maintain a soil mulch. The alfalfa may be seeded late in the spring, choosing a time after a rain when the soil is moist and weather conditions favorable; or the land may be cultivated throughout the summer and the alfalfa seeded in the fall. Soil that is kept fallow and well tilled throughout a long period of time accumulates an extra supply of available plant food and an abundance of moisture. With favorable weather conditions thereafter, a satisfactory stand of alfalfa will be secured on soil on which difficulty ordinarily is experienced in starting the crop.

THE KIND OF SEED TO PLANT.

The second step in importance to secure a stand of alfalfa is to plant pure, viable seed, at the time when the soil is in the best condition. Great care should be exercised in procuring seed that is pure, as much of the commercial seed on the market contains more or less foreign matter, such as dodder. bind weed, Russian thistle, etc. It is very possible to introduce weeds which will spread from year to year and become a permanent nuisance, exceedingly difficult to eradicate. Home-grown seed of the native variety of alfalfa *(Medicago sativa)* is as good as can be had to plant in this state. New varieties have been introduced into this country in recent years, but so far as is known at this time, none succeeds better under Kansas conditions than the standard variety which has been grown here since alfalfa was first introduced.

Home-grown seed, whenever it can be secured pure, should be used in preference to imported seed. Wherever alfalfa seed is known to have come from a field free from weeds and as near home as possible, that seed is to be preferred. There will be no occasion to go outside the state for seed, except in years of a great shortage. (The Kansas Experiment Station will be glad to put any one in touch with growers and dealers who have pure alfalfa seed.) Too much emphasis can not be laid upon the importance of planting pure, viable seed, which is sure to germinate and to grow into thrifty plants, otherwise, great damage may be caused by introducing injurious weed seeds.

RATE OF PLANTING.

The best rate of planting alfalfa varies according to the locality in which it is planted. In central and eastern portions of Kansas, where the rainfall is ample, probably fifteen to twenty pounds will be about right, although if an ideal seed bed has been prepared and everything is favorable for quick germination and speedy growth, half this amount of seed will produce sufficient plants to cover the ground thoroughly.

In western Kansas, where the rainfall is not sufficient to support a heavy stand of alfalfa, light seeding will produce

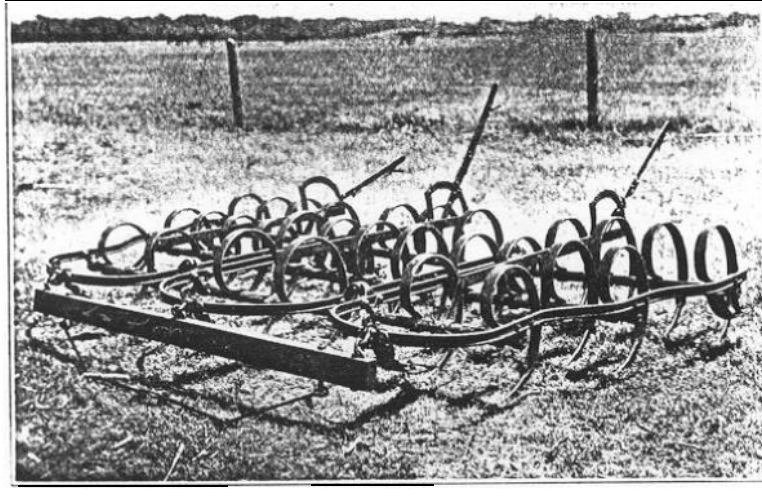

FIG. 5. The spring-tooth alfalfa renovator.

best results. From eight to twelve pounds per acre should be ample. On the uplands, even less than this should be sufficient. The writers have seen splendid stands obtained with from four to six pounds where seeding was done under ideal seed-bed and soil-moisture conditions. A well-prepared seed bed does not demand as much seed as one poorly prepared, and localities where rainfall is slight do not demand the large quantity of seed used where the rainfall is abundant. It is not wise to limit the amount of seed to a minimum, for a considerable percentage of that sown under average conditions fails to grow.

TIME OF PLANTING.

In the eastern two-thirds of the state, the best results are usually obtained from fall seeding. Alfalfa planted in the fall is able to establish itself, because there are fewer weeds to contend with at that time than in the spring. Nearly a year's time is saved by planting in the fall after a crop of grain has been removed, instead of planting in the spring, as considerable hay may be cut the first year following fall planting, whereas, when spring planted, the entire season is devoted to securing a stand. Weeds are the greatest drawback to spring planting. They compete with the young alfalfa for growing space and moisture, and if they become too abundant the young alfalfa plants will be smothered.

In western Kansas spring seeding produces satisfactory results, because the moisture is less abundant in the fall, and very little trouble is experienced in eradicating the weeds. Fall planting is likely to winter kill, as the young plants would not be strong enough to withstand the first cold.

A satisfactory stand may be obtained either with spring or fall planting in practically every section of the state, providing weather conditions are ideal for a time and the seed bed has been prepared satisfactorily. Farmers must use their own judgment in determining the best time to plant, bearing in mind that moisture conditions and seed-bed preparation are the essential factors for success.

In sections of Kansas where the rainfall is usually abundant in the spring, satisfactory stands are sometimes obtained by planting alfalfa with a nurse crop, such as oats, barley, or even by spring planting in winter wheat. The nurse crop should be planted more thinly than when it is grown alone. However, this method of planting alfalfa is not satisfactory as a rule, and is not recommended except in special cases.

METHOD OF PLANTING.

There are two general methods of planting alfalfa in use at the present time. The most common method is to seed broadcast with a wheelbarrow seeder, an end-gate seeder, or by hand. The seed is usually covered by harrowing the field lightly. The seed will be covered better and more uniformly if the field is left a little rough before seeding, as when worked with a disk. Another good method is to roll the field with a

Western land roller before seeding. This firms the soil, leaves the surface rough, and makes it possible to cover the seed well by cross-harrowing.

Under most conditions, the best method of seeding is with the drill. A good press-drill covers all the seed, presses the soil around it and insures better germination. Small grass drills that sow the seed in rows from four to six inches apart give good results in eastern Kansas. By means of these drills it is possible to distribute the seed more evenly and to plant it at a more uniformly shallow depth than is possible when the grain drill is used.

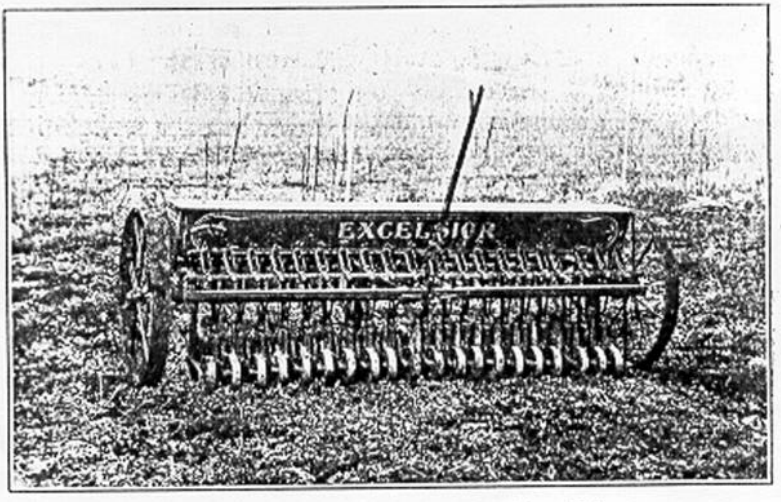

FIG. 6. A grass seeder often used in seeding alfalfa.

Alfalfa seed should not be covered too deeply. The depth of seeding will depend somewhat upon the character of the soil. In a loose sandy soil that does not bake after packing rains, it is possible to seed deeper than in soils of heavier types. As a rule, alfalfa seed should not be covered deeper then one inch.

INOCULATION.

Artificial inculation is unnecessary in central and western Kansas for the successful growth of alfalfa. In localities in eastern Kansas where difficulty has been experienced in securing a stand, it is advisable to inoculate before seeding, but in communities where alfalfa has been growing for several years with success, inoculation is probably a useless expense.

There are two general methods of inoculating soil for alfalfa. The most successful and usually the cheapest is known as the soil transfer method. This method consists in spreading soil from an old, vigorous alfalfa field over the land that is to be inoculated, at the rate of three hundred to four hundred pounds to the acre. Good results will usually follow when this method is used, providing the soil is not exposed to the hot, bright sun or allowed to dry out before it is spread. It is advisable to spread the soil on a cloudy day and to harrow it in immediately after it is spread. Only soil from healthy alfalfa fields should be used.

The other method of inoculating is by means of cultures. The culture comes in bottles and is used on the seed in much the same manner as in treating wheat for smut. Instructions as to the use of the culture accompany it. This method is usually more expensive and less certain than the soil transfer method, and should he employed only when satisfactory soil for inoculating purposes can not be obtained. The commercial cultures can be obtained from seed houses or sometimes in small quantities from the United States Department of Agriculture.

ALFALFA IN EASTERN KANSAS.

The eastern third of Kansas may be divided into two quite distinct alfalfa regions. One of these lies north and the other south of the Kansas river.

In northeastern Kansas, difficulty has been experienced in starting alfalfa, mainly because the soils in that part of the state are lacking in alfalfa bacteria. Alfalfa bacteria live upon the roots of the alfalfa plants and assimilate nitrogen from the air. When these bacteria are not present, the alfalfa may start vigorously, but after a few months' growth, it will turn yellow and die. Alfalfa should not be seeded in this section of the state upon ground where it has not been previously grown without first inoculating the soil with alfalfa bacteria.

Other failures have occurred from winterkilling, the result of late fall seeding, from attempts to seed alfalfa in poorly drained fields or on soils of an acid or sour character, and upon soils so deficient in available plant food that the young plants in their starved condition were unable to resist adverse

weather conditions. Alfalfa is a rapid- and rank-growing plant. To produce this rapid growth and maintain the young plants in a vigorous, healthy condition, an ample supply of available nitrogen is required. Old alfalfa plants, if supplied with the nitrogen-fixing bacteria, can secure an abundance of nitrogen from the air, while young plants, during the early stages of their growth, are dependent upon the nitrogen in the soil. Soils deficient in available plant food should be fertilized or manured before seeding alfalfa, in order to insure a healthy, vigorous growth of the young plants. One of the most effective methods of supplying the needed fertility to the soil is by applying barnyard manure to the crop preceding alfalfa. The manure supplied in this way becomes decayed and its plant food is made available by the time the young alfalfa plants can use it. By applying the manure at this time, any weed seed applied with the manure will have had an opportunity to germinate and to be killed before the alfalfa is seeded.

In southeastern Kansas there are three distinct soil classes: limestone soils, sandstone soils, and shale soils. Limestone soils occur commonly in the northern part of this area, but become less common toward the southeastern part, until, in Cherokee county, practically no limestone soils occur north of Spring river with the exception of small areas in the northwestern part of the county. Upon the limestone soils of southeastern Kansas no difficulty has been encountered in starting alfalfa wherever the soil was fertile and deep enough to grow the crop and where a proper seed bed was prepared and the coil inoculated with the nitrogen-fixing bacteria.

Upon the shale soils, however, nearly every attempt to start alfalfa has failed. These soils are poorly drained, sour or acid naturally, and are somewhat deficient in organic matter and phosphorus. If a successful stand of alfalfa is to be obtained upon this type of soil, it must first be thoroughly drained. Alfalfa will not live in a poorly drained soil, and when seeded under such conditions is usually drowned out by the first wet spell. The only practical method of draining these soils is by means of tile underdrains.

The only successful stand of alfalfa on shale soil in southeastern Kansas known to the writers is on the farm of Mr. O. A. Rhoades, four miles southeast of Columbus, Kan. Mr. Rhoades has five acres of alfalfa, seeded in the summer of

1911, which at the present time is making an excellent growth. The land upon which this alfalfa is growing was thoroughly tile underdrained, limed with ground lime rock at the rate of two tons to the acre, manured with twenty tons of barnyard manure, and inoculated with alfalfa bacteria before the alfalfa was seeded.

Alfalfa will not grow in an acid soil, and to correct this condition lime must be used. The cheapest form is ground limestone. This can be obtained at the quarries in south-

FIG. 7. An alfalfa field on the upland farm of Mr. O. A. Rhoades, Cherokee county, Kansas, three years after seeding. This excellent stand was secured by manuring, liming and underdraining the field.

eastern Kansas in carload quantities at one dollar per ton. About two tons of ground limestone should be applied to the acre as a top dressing on plowed ground and thoroughly incorporated with the soil from six months to a year before the alfalfa is seeded.

As stated above, barnyard manure should be applied to the crop preceding alfalfa to supply organic matter and plant food to the soil. Fifteen or twenty tons should be applied to an acre. If manure can not be obtained, a fertilizer rich in phosphorus should be applied at the time the alfalfa is seeded. Before seeding, the field should be inoculated with alfalfa bacteria.

Considering the trouble and expense involved in starting alfalfa on the shale soils of southeastern Kansas, it is doubtful if it is practical to attempt to seed a large acreage of land to this crop, especially in any one year. Every farmer, however, should strive to secure a few acres, which undoubtedly will prove to be a valuable asset. Land that is slightly rolling, the soil of which is inclined to be loamy, should be selected.

GROWING ALFALFA IN ROWS

Alfalfa has been grown successfully in rows for seed in Southeastern Germany and in Algeria, where the annual rainfall is light, but experiments and practical demonstrations in this country not been sufficiently extensive or of long enough duration to warrant one' s drawing many definite conclusions. It is the opinion, however, of the investigators who have made a study of the question of growing alfalfa in rows, as well as the opinion of some practical farmers who have tried it that, alfalfa planted in this way and cultivated will succeed under somewhat drier conditions than when planted in the ordinary manner.

In those parts of the state where the rainfall is relatively heavy, it is a practice which may enable the farmers to bring under profitable cultivation the higher and drier portions of the farms. Such land may be utilized especially for alfalfa seed production. The row method will no doubt prove to be the most profitable way to grow this crop in the western part of Kansas, especially on the upland. At the present time in the western third of Kansas it is only on first-bottom land that alfalfa is grown profitably, except under irrigation. Much of the bench land, or second-bottom land, eventually may be utilized in alfalfa production by planting it in rows and cultivating it the same as corn.

Alfalfa is a crop that responds to cultivation as generously as do other crops. Cultivation conserves the soil moisture and develops plant food. Hence when alfalfa is planted in rows there will be fewer plants on a given area, but those growing will have more water and more food than plants in a thicker stand. Alfalfa develops seed better where the air may circulate freely and where the insects assisting in pollination may get in and out easily. Those interested in alfalfa

have noticed that the plants with plenty of room are always the heaviest seed producers.

The seeding of alfalfa in rows may be accomplished by stopping up a sufficient number of feeds on a regular grain drill, or by babbitting the holes in the corn-planter plates and checkrowing. At San Antonio, Tex., and Highmore, S. Dak., it has been found profitable to double-row, leaving two holes open in a grain drill and stopping up three or four. The double rows will then be eight inches apart, while the space left for intertillage will be thirty-two or forty inches

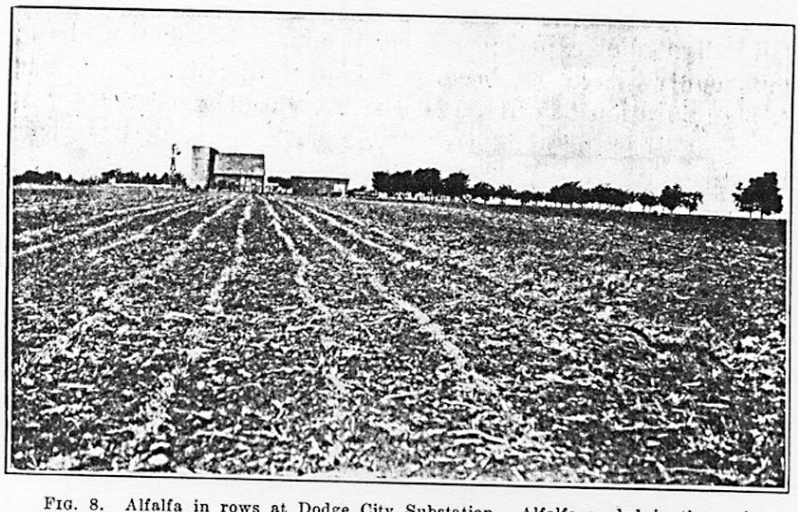

FIG. 8. Alfalfa in rows at Dodge City Substation. Alfalfa seeded in the spring of 1912. Photograph taken immediately after the first crop was harvested in 1913, and shows the clean condition of the ground.

wide. Garden drills also have been successfully used, though it would be impracticable to plant a very extensive acreage in this way.

In sections where sugar beets are grown, the beet drill or the beet cultivator easily may be adapted to seeding and cultivating alfalfa in rows. One of the difficulties experienced in growing alfalfa in rows is the keeping down of the weeds. This is especially true the first year, when the growth of weeds is usually more rapid than the growth of the young alfalfa plants. Consistent and timely cultivation, however, will be all that is necessary to keep the weeds in check and the ground in ideal condition to permit the best development of the young plants. Most of the machinery that is now in use on the

farms of the state can be adapted to the planting and cultivation of alfalfa in rows, so there will be no occasion for a farmer to incur extra operating expense.

Mr. Albert Weaver, of Bird City, Kan., reports that he has been producing alfalfa successfully on the uplands of Cheyenne county for the past five years. He plants the crop in rows on ground that is summer tilled before seeding. Mr. Weaver says: "I have a surface weeder that I made, and I find that by running this over the ground previous to seeding, allowing the ground to dry off about one day after the rain, this will get the little weeds and give the alfalfa an equal start with the weeds. If I fail to get a stand in two weeks, I can run the surface weeder over again and repeat the seeding after a rain, and in this way not stir up the ground deeply, as the ground wants to be reasonably solid beneath the surface."

Dry-land Lucern and Turkestan were the varieties of alfalfa planted. Mr. Weaver says : "Dry-land Lucern seems to prove best one year with another." The ordinary grain drill, properly adjusted, may be used in seeding the alfalfa (the rows should be thirty-five or thirty-six inches apart)--or the Planet Junior garden drill, or the single-disk seeder, may be used. "If the single-disk seeder is used, the ground should be harrowed immediately after seeding so if a heavy rain comes it will not wash the seed under. . . . I find it advisable to seed the alfalfa rather thickly and harrow it out until I get about the right stand. It is advisable to have a good stand, so that no weeds can grow in the row.

"I find June the most satisfactory time to seed here, after an inch or more of rain. . . . I have seeded alfalfa the last five years from May to September, and the only successful stands that I have had were those planted in June. I work the ground with an Osborne spring-tooth harrow. I do not use an ordinary disk on the alfalfa at all. I think the roots are too small to use a disk on this upland alfalfa. I usually cross the rows in the early spring with a spring-tooth harrow, and later harrow it with the rows, and then when it is about a foot high, take out two teeth where each row comes, taking two rows at once, and hitching three horses to the harrow. This cleans out the weeds and leaves the ground in fine condition. . . . This can be done any time before the plants get over a foot high, and if it is reasonably clean when it gets that

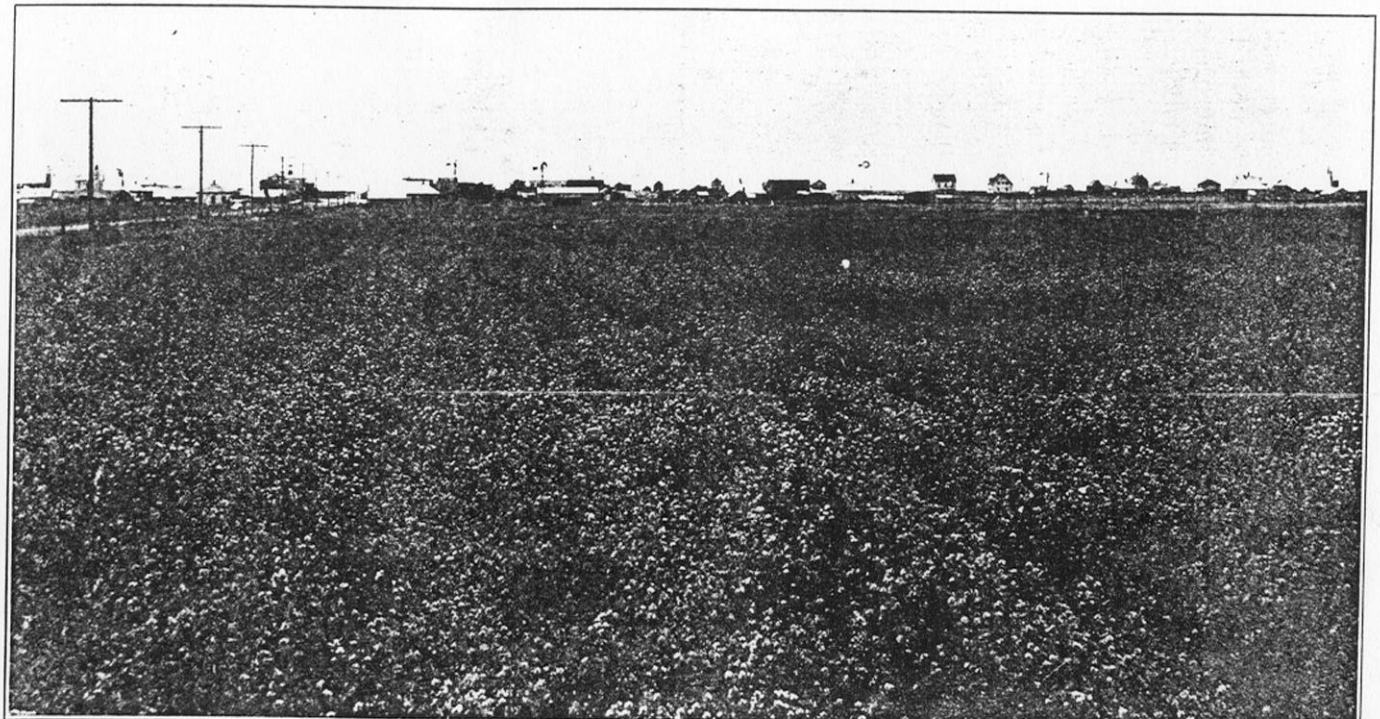

FIG. 9. Alfalfa in rows on the farm of Mr. Albert Weaver, Cheyenne county, Kansas. The crop was seeded in 1909.

high--the weeds after that will not bother until time to cut the seed or harvest for hay, and this treatment keeps the ground nice and loose and holds the moisture. . . . I think the average yield here, two crops a season, will produce about a ton of hay to the acre."

Mr. H. R. Kent, of Woodward, Okla., gives the following as his experience in alfalfa production in northwestern Oklahoma :

"In seeding alfalfa in rows thirty inches apart for continual cultivation after the crop is started, I use a wheat drill by tacking a tin plate over some of the drill holes, only allowing the seed to be deposited in rows the proper distance apart, or thirty inches. Then I follow up with a thorough cultivation with a one-horse five-tooth cultivator, or a small-shovel two-horse cultivator, cultivating just as close to the plants as is possible and immediately after each good rain. It does not matter if you do cover up some of the plants after they have been well rooted in the ground, but in so doing the cultivation should be followed immediately with a steel-tooth smoothing harrow. As a general thing, the alfalfa planted in rows should be cultivated two or three times between each crop cutting. Planting alfalfa in rows will, with this system, I find, be more profitable than either the broadcast or close-drilled alfalfa for both the hay and the seed crop. It produces a great deal better quality of hay and more seed per acre, and will mature about six days earlier for each cutting, thus giving one extra crop each season over the broadcast or close-drilled crop."

HAY.

For general purposes, it is advisable to cut alfalfa hay when about one-tenth in bloom. The earlier it is cut after blooming starts the better will be the quality of the hay for cattle and hogs. When cut for horse feed, it is perhaps better to let the crop stand until from one-fourth to one-half in bloom. It is not always possible to judge from the stage of blossoming the proper time to cut the hay crop in order to secure the maximum production and at the same time the best quality of hay. It is usually a safer practice to be governed in time of cutting by the development of new shoots from the crown of the plant. When new shoots start to develop and have reached a growth of an inch to two inches, the hay should be cut. It frequently

happens, due to unfavorable weather conditions, that alfalfa is checked in its growth and blossoming is retarded. When the weather again becomes favorable, these young shoots will start from the crown of the plant and the alfalfa should be cut regardless of the stage of blossoming.

Alfalfa hay is easily injured by rain and care should be taken to cure the crop if possible without getting it wet. However, a rain or two does not necessarily ruin the crop. It is a good practice in putting up alfalfa hay to cut it in the morning of a good curing day, rake into windrows with a side-delivery rake in the late afternoon, allow it to lie in the windrows over night, and bunch with a rake the next morning after the dew is off. The hay should be ready to put into the stack or mow by the second afternoon. The hay should not be allowed to cure too long in the swath, for too many leaves will be lost in raking and handling the crop, and the leaves are the most valuable part of the plant. Besides, when the alfalfa is raked before the leaves are entirely cured, they continue to draw moisture from the stem and thereby insure a more uniform curing of the crop. It is not profitable under Kansas conditions to attempt to cure alfalfa hay in the cock except where rain is inevitable. The hay should then be put into small cocks that will shed a certain amount of the water and that will permit the hay to dry out rapidly when the weather clears.

Alfalfa hay is sometimes baled direct from the field. It is possible to handle alfalfa in this way during the drier portion of the summer, but it is almost impossible to secure hay of the best quality by this method. Hay cured in the field dry enough to bale will lose a great many leaves in handling, while hay baled when it contains sufficient moisture to handle without loss will usually mold in the bale unless extremely dry weather follows. It is very seldom possible to bale the first cutting of alfalfa from the field. The safest practice is to stack or mow the hay in a barn or hay shed.

Figure 10 shows the plan of a good, practical and inexpensive hay barn. This alfalfa barn is thirty feet wide and eighty feet long, and will hold one hundred tons. The shed is built with poles twenty feet long and about five inches in diameter at the top. The poles are set in concrete at the base. The concrete should come up well above the surface of the ground. The

amount of material necessary for the construction of the barn is shown in the bill of material. The cost of construction will vary with the price of material in different localities.

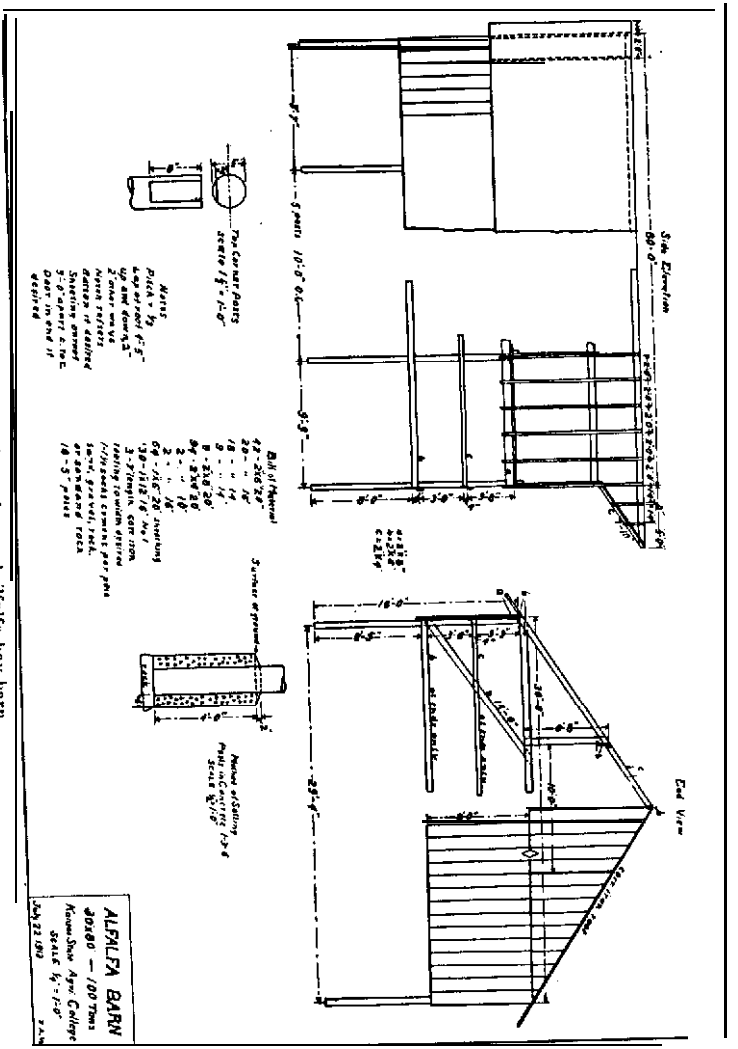

FIG. 10. Plans of a good alfalfa hay barn.

THE SEED CROP.

In western Kansas good crops of alfalfa seed are frequently harvested, but in central and eastern Kansas profitable crops of seed are produced only in the driest seasons. To insure a good crop of seed no heavy rains should fall during the blooming period, and to insure seed of the best quality the weather should continue dry until after the seed is harvested. Wet weather in the later stages of growth either causes the plants to continue blooming or starts a second growth of the crop. In western Kansas the second cutting is usually left for seed, although in some instances the first cutting is used. In eastern Kansas the third cutting will usually produce the best

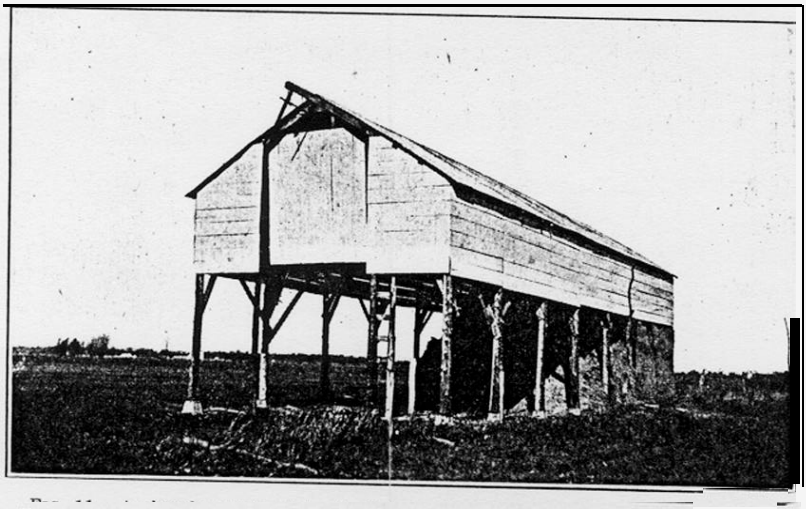

FIG. 11. A cheaply constructed yet efficient alfalfa hay barn on the Deming ranch, Labette county, Kansas.

crop of seed, although in extremely dry years the second cutting seeds heavily, and in 1913 was the most profitable crop to save.

Alfalfa is a very uncertain seed crop in eastern Kansas, and it is absolutely impossible to tell, in the early stages of its growth, whether it will produce profitable seed or not. With the normal rainfall it will not be profitably produced. It is only one year in six or eight, when the season is unusually dry, that seed will set well. If the ground is wet and the crop is making a rank, vigorous growth at blossoming time, the crop should be cut for hay. If heavy rain falls during the blossom-

ing period, although conditions preceding have been favorable, it is best to cut the crop for hay; and even after the seed has formed, if an unusually wet period follows and a second growth of alfalfa starts, it is best to cut the crop at once for hay, as the seed will ripen unevenly and be very difficult. to cure.

Alfalfa should be cut for seed when about fifty per cent of the seed pods are brown. Most farmers cut their seed too soon. Alfalfa seed is sometimes cut with a binder and is bound and shocked. This is a good method when the crop

FIG. 12. An alfalfa hay barn and feed shed combined on the Casement ranch, Riley county, Kansas. Affords a splendid opportunity for saving manure.

makes a sufficiently rank growth to bind. A header is sometimes used in western Kansas. The self-rake reaper is in common use and is one of the best machines with which to harvest the crop, as very little seed is lost in this way. The mowing machine is most commonly used, and when provided with a buncher or windrower attachment is satisfactory. Alfalfa for seed can not be cut with a mowing machine and raked into windrows the same as hay without a great loss of seed. Whenever this method must be used, the crop should be cut and raked in the early morning while damp. After cutting, the alfalfa should be put into small cocks, just large enough to handle in one good forkful, and allowed to cure. It may be hulled directly from the field or placed in a stack or

mow, and hulled later. Unless a huller can be obtained when needed, it is the safest to stack the seed and thresh when convenient.

THE INFLUENCE OF ALFALFA ON SOIL FERTILITY.

A common practice among farmers of this state is to seed land to alfalfa that has been in other crops for a number of years and that has become exhausted in fertility through continuous cropping. Alfalfa is a good crop to use in rotation with other crops, like corn and wheat, because it is a deep-rooted leguminous plant. Its deep roots enable it to penetrate the subsoil and there to secure food beyond the reach of the shallower-rooted crops. Some of the plant food brought from the deep subsoil is left near the surface by the decaying alfalfa roots, where it later becomes available to corn, wheat, etc. Alfalfa, being a leguminous crop, has the ability to secure its nitrogen from the air, while corn, wheat and other non-leguminous plants are dependent entirely upon the soil for their nitrogen. Thus alfalfa may make a satisfactory growth, after it has become established, in a soil so deficient in nitrogen that other crops upon the same soil may fail.

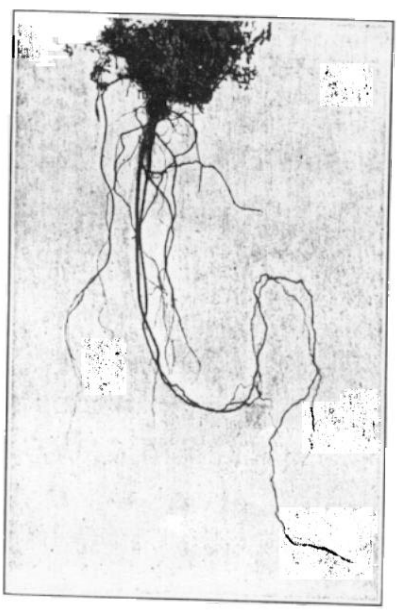

FIG. 13. An alfalfa plant with root 9½ feet long. Alfalfa is deep-rooted and can secure moisture and plant food below the reach of other crops.

Although alfalfa succeeds upon soils deficient in nitrogen, it does not necessarily mean, as many erroneouslv suppose, that it adds materially to the nitrogen supply of the soil. In other words, alfalfa has the power to take nitrogen from the soil as well as from the air, and if the soil in which alfalfa is growing happens to be rich in nitrogen, the plants are likely to feed upon the nitrogen available at the roots, rather than to extract the nitrogen from the air. On the other hand, if

the soil is low in nitrogen, the plant will be obliged to utilize its function of taking nitrogen out of the air.

Where alfalfa is grown for hay, and the hay removed and sold from the farm, very little plant food is added to the soil and large quantities are removed. Four tons of alfalfa hay remove from the soil nearly eighteen pounds of phosphorus, ninety-five pounds of potassium, and one hundred thirty-five pounds of calcium. While two hundred pounds of nitrogen is also removed in the hay, most of this came from the air. A thirty-bushel crop of wheat removes in the grain thirty-three pounds of nitrogen, six and one-fifth pounds of phosphorus, seven and three-fourths pounds of potassium, and three-fourths pound of calcium. Therefore alfalfa removes from the soil nearly three times as much phosphorus, twelve times as much potassium, and one hundred eighty times as much calcium as an equivalent crop of wheat when the wheat straw is left on the field. The nitrogen removed by the wheat comes from the soil, while in alfalfa it is secured from the air. Thus it will be seen that while alfalfa does not exhaust the soil of nitrogen, as does wheat, it does remove in much larger quantities the essential plant foods, phosphorus, potassium, and calcium. While the soils of Kansas are liberally supplied with potassium, they are, as a rule, low in phosphorus, and some of the soils, especially those of southeastern Kansas, are deficient in calcium.

In order to secure the greatest increase in soil fertility from alfalfa it must be fed to live stock on the farm and the manure produced by the stock carefully saved and returned to the fields. When this practice is followed much of the plant food removed by alfalfa from the soil is returned in the manure, while the nitrogen secured by the alfalfa from the air is also returned in part to the soil. It is possible by following this practice gradually to enrich the soil in nitrogen.

INFLUENCE OF ALFALFA ON SUCCEEDING CROPS.

Alfalfa leaves in the soil a small amount of the nitrogen taken from the air; also, some of the mineral plant food brought up from the deep subsoil. When an alfalfa field is broken up, the plant food which is contained in the large alfalfa roots becomes available for the crop first planted after alfalfa. It is this plant food which produces the very rank,

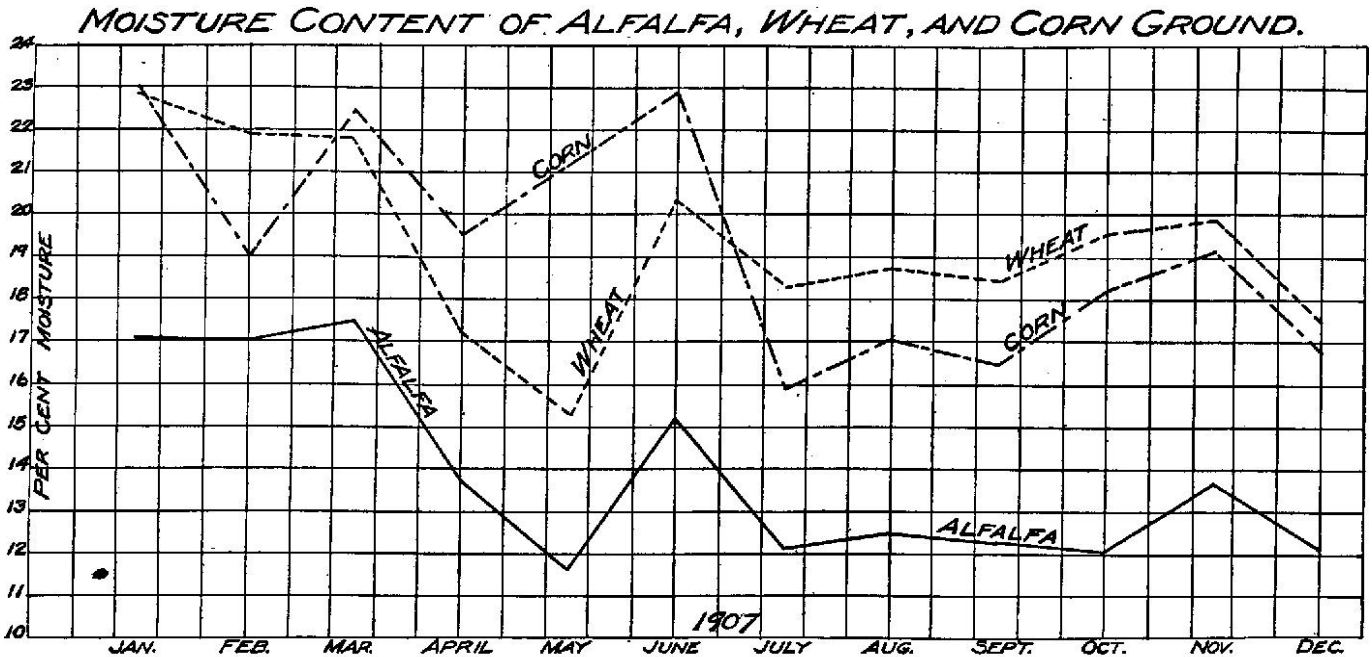

FIG. 14. Graphic chart illustrating moisture content of fields cropped to alfalfa, wheat and corn.

vigorous growth that follows alfalfa when the soil is well supplied with moisture. This explains why, in eastern Kansas, some of the largest crops of corn are grown in wet seasons the first year after alfalfa, but in dry seasons the yield is unsatisfactory. In central and western Kansas, crops are often a failure the first season after alfalfa. The cause is due to drouth, as alfalfa uses practically all the moisture available in producing its own growth. This is true in seasons of more than normal rainfall. Thus, when other crops are planted on alfalfa sod, the stimulated growth early in the season and the dry condition of the subsoil cause the crop to burn if the rainfall during the growing season is not abundant.

In 1907, soil samples were taken each month on three adjoining fields, where one of these fields was in alfalfa, another in wheat, and the third in corn. The samples were taken to a depth of six feet. Figure 14 shows diagramatically the results of these moisture determinations.

It will be seen that in January, 1907, alfalfa ground to a depth of six feet contained but 17.1 inches of water, while adjoining wheat and corn ground at this same date contained in each case about 23 inches of water. This same difference in moisture held throughout the year. The alfalfa ground at each date of soil sampling contained from four to six inches less water than wheat or corn ground. In December, 1907, the alfalfa ground contained but 12.1 inches of water in the six feet of soil, while corn ground held 16.7 inches, and wheat ground 17.2 inches. The alfalfa ground at that time contained over 4½ inches less water to a depth of six feet than ground that had been in corn, and 5¼, inches less water than ground that had been in wheat the preceding season. Had these fields all been planted to corn the following season, this deficiency of 4½ inches of water in the alfalfa ground would have been sufficient to have caused a reduced yield, had the season been dry.

ROTATION.

Alfalfa is not a crop always included in a rotation, because the first start is a tedious and difficult task. The loss of seed, labor, use of land, etc., resulting from an initial attempt, make a farmer far too slow in breaking the alfalfa sod. Five to eight years is the most that alfalfa should be permitted to grow continuously in one field. At the expiration of this period,

the deep roots remaining in the soil contain a wealth of plant food, which is available for the crops following alfalfa.

The crops to follow alfalfa are corn, kafir, and sweet sorghums. Alfalfa leaves the ground dry to a considerable depth, and the crop to follow is likely to suffer the first year because of a lack of moisture. Sorghums are usually the best crop to follow, because of their drouth-resistant qualities, unless it is in a part of the state where the land is low and the rainfall very abundant. The second and third years following alfalfa, corn usually pays best, although sorghums do better those years than they do the first year. The fourth year corn may again be planted, but it is about time to return to sorghums. Wheat or oats could be planted if the farmer needs those crops that season. Where potatoes are grown commercially, as in the Kansas river valley, they succeed well the second and third years after alfalfa, perhaps as well as any other crop. Also, where beets are grown under irrigation, they do splendidly the second and third years after, and where alfalfa is plowed up, say every five years or less, beets and even potatoes often do well the first year after alfalfa.

The ground should be planted either to wheat or oats the year preceding the time alfalfa is to be replanted, especially when it is to be fall-planted, because the right kind of seed bed can be prepared then, better than following sorghum or corn. and at less expense. A farmer can grow a crop of wheat or oats and establish a stand of alfalfa the same year.

The most practical way to utilize alfalfa in a rotation is to plow a small strip of it every year and re-seed an equal area in another field. In case a new stand is not obtained, the farmer is still in possession of the major portion of his usual crop.

MANURING ALFALFA.

Alfalfa responds quickly to applications of barnyard manure. While manure benefits an old established stand, the greatest benefit is usually derived by applying manure to the crop preceding alfalfa in the rotation, as proven by an experiment to determine the benefit of manure in securing a stand and a quick start of alfalfa which was undertaken at this station. A poor upland field of ground was leased for the purpose. The field had been under cultivation for about thirty years; had never been manured in the past, and had been continuously cropped

to corn, wheat, kafir and other grain crops. In the fall of 1906 one acre of the field was top-dressed with barnyard manure at the rate of ten tons of manure per acre. Mixed manure, obtained from the city of Manhattan, was used. Another acre adjoining was left without manure. The field was seeded to Turkey wheat. After the wheat was harvested, the ground was plowed shallow in July, worked down, and alfalfa seeded the last of August. No manure was applied after the first application. The following table gives the results of this test :

VALUE OF MANURE ON ALFALFA.

YIELD OF WHEAT, 1907.

Manured	35.9 bu. per acre.
Unmanured	18.06 bu. per acre.

YIELD OF ALFALFA, SEASON OF 1908.

Pounds per Acre.

	First cutting.	Second cutting.	Third cutting.	Total of season.
Manured	3,533	2,368	2,659	8,560
Unmanured	717	1,870	2,017	4,104

YIELD OF ALFALFA, SEASON OF 1909.

Pounds per Acre.

	First cutting.	Second cutting.	Third cutting.	Fourth cutting.	Total of season.
Manured	3,445	3,369	3,294	1,748	11,856
Unmanured	2,465	2,606	2,530	939	8,541

It will be seen from this table that the manure used as a top dressing on wheat not only doubled the yield of wheat in 1907, but more than doubled the yield of alfalfa in 1908 and gave an increase of nearly one-third in 1909. The greatest benefit from the manure was noticed in the first cutting of alfalfa hay in 1908. On the manured ground the alfalfa produced a full crop the first cutting, while on the unmanured ground the alfalfa made a sickly yellow growth and produced very little hay. Had the season been less favorable for starting alfalfa, the crop would have failed on the unmanured ground, while a stand would have been obtained upon the manured ground. Manure used in this way is often the deciding factor between success and failure in securing a stand of alfalfa.

COMMERCIAL FERTILIZERS FOR ALFALFA.

When barnyard manure is not available, some commercial fertilizer rich in phosphorus, such as bone meal or acid phosphate, can usually be used with profit in starting alfalfa on the poorer areas of soil in the eastern third of the state. At

this Station, alfalfa was seeded on a poor upland field in the fall of 1909. Upon one plot in this field the alfalfa was fertilized with one hundred ninety pounds of acid phosphate per acre each year. This quantity of acid phosphate supplied fourteen pounds of phosphorus annually, and cost $2 per acre. Another plot adjoining was unfertilized. The following table gives the results of this trial:

Effect of phosphorus applied in acid phosphate on alfalfa. Season 1910-1913.

	Pounds per acre.				Total for season.	Value at $10 per ton.	Cost of fertilizing.	Value less cost of fertilizing.
	First cutting.	Second cutting.	Third cutting.	Fourth cutting.				
	Yield of alfalfa, season 1910.							
Fertilized	1,608	.....	.....	.....	1,608	$8.04	$2.09	$5.95
Unfertilized..	1,438	.....	.....	.....	1,438	7.19	.....	7.19
	Yield of alfalfa, season 1911.							
Fertilized	2,690	1,080	900	1,660	6,330	31.65	2.09	29.56
Unfertilized..	2,720	910	660	1,160	5,450	27.25	.....	27.25
	Yield of alfalfa, season 1912.							
Fertilized	1,780	1,930	1,260	400	5,370	26.80	2.09	24.76
Unfertilized..	1,860	1,470	960	200	4,390	21.95	.....	21.95
	Yield of alfalfa, season 1913.							
Fertilized	3,400	1,350	.....	.....	4,750	23.75	2.09	21.66
Unfertilized..	2,360	1,000	.....	.....	3,360	16.80	.....	16.80

FIG. 15. First cutting of alfalfa from manured and unmanured alfalfa plots, agronomy farm, Kansas State Agricultural College, Manhattan, Kan. The cock on the left, unmanured ground, yield 820 pounds per acre; the center cock, manured with 5 tons of barnyard manure per acre, yield 2250 pounds per acre; the cock on the right, manured with 2½ tons of barnyard manure, yield 1520 pounds.

TOTAL, FOUR YEARS

	Value, less cost of fertilizer.
Fertilized	$81.93
Unfertilized	73.19
Difference	$8.74

The result of this test, extending over a period of four years, shows each season an increased yield of hay on the fertilized plot, and with the exception of the first year the increase in the crop was more than sufficient to pay for the cost of fertilizing. During the four years the unfertilized plot produced $73.19 worth of hay per acre, while the plot fertilized produced $81.93 worth of hay, after paying cost of fertilizing, leaving a difference of $8.74 per acre, as a total of the four years, in favor of the fertilized plot.

While paying returns have been obtained where phosphorus was used as a fertilizer for alfalfa, it does not follow that any kind or brand of fertilizer will pay. In this test, other plots fertilized with materials supplying potassium and nitrogen did not produce an increased yield sufficient to pay the cost of fertilizing. From our present knowledge, we would advise, for alfalfa in this section of the state, the use of fertilizer supplying phosphorus only.

SOME ANIMALS AND INSECTS INJURIOUS TO ALFALFA.

POCKET GOPHER *(Geomys bursarius* Shaw)

No other animals attacking the roots of alfalfa equal the gophers in destructiveness. These animals are most active during the fall and spring, at which time they tunnel hither and thither in search of food. At intervals they dig short lateral burrows to the surface, through which they push the excavated earth and dump it outside, thus forming the mounds that are so often seen in alfalfa fields. During the spring and fall one individual may throw up several mounds daily for several weeks at a time.

The natural food of the gopher consists of succulent roots and green vegetation, and thus an alfalfa field, with its deep-growing roots, renders life easy for the gopher, providing it with an abundance of food easily accessible both in winter and summer. Not only does this animal injure alfalfa by actual

consumption of the roots, but also by covering up a considerable portion of the area badly infested, and by rendering the crop in infested fields difficult to harvest.

Many methods of controlling these animals have been tried, but the most efficient and the one requiring the least trouble is to poison them with strychnine. Pieces of potato, apple sweet potato, raisins or prunes may be used as effective conveyors of poison by inserting a few crystals of strychnine into slits made with the point of a knife blade. These should be carefully introduced into fresh runways. These baits are very successful, but since considerable time is required in their preparation, the poison syrup is the more practical and less expensive. For several years the Kansas Experiment Station has manufactured and sold (at cost of material and labor) a poisoned syrup, one quart of which is sufficient to poison one-half bushel of corn. The corn is put to soak in hot water the evening before the bait is to be used. In the morning the water is drained off and the poison is poured over the corn and thoroughly mixed with it. Corn meal is used to take up the excess liquid, and the bait is ready to be introduced into the fresh runways. In introducing the poison, the fresh-looking mounds should always be selected, and after holes into the runways have been opened with a sharpened broom handle or wagon rod, a teaspoonful of the poisoned bait is dropped into the burrow, leaving the hole open. The mounds should then be leveled with a drag, and as fast as new ones appear the burrows should be located and poison introduced into them.

THE ALFALFA WEEVIL *(Phytonomus posticus* Fab.)

At the present time no infestation of this serious pest is known in the Missouri Valley states. Inasmuch, however, as there are millions of the beetles in the infested district of Utah, and since the beetles have been found in considerable number in freight and passenger cars coming from the infested regions of Utah, which cars are constantly passing through the alfalfa districts of Kansas, Nebraska, and Colorado, it is probably only a question of a short time until the weevil will be distributed in the alfalfa fields of these states. It is, therefore, highly important that the alfalfa growers be on guard, and just as soon as this insect is discovered, the entomologists of the experiment stations should be notified

in order that prompt measures for its control and destruction may be put in operation.

The adult is a small, oval, dark-brown snout beetle, about three-sixteenths of an inch long, marked with black and gray hairs, giving them a mottled appearance. The adults feed on the stems, leaves, and buds of the alfalfa plant for several weeks. The larvae are small, footless, alfalfa-green worms with black heads, about one-fourth of an inch in length, and feed in the stalk, in the leaf buds, and on the leaves. They have the habit of feeding in a curved position.

GRASSHOPPERS.

In Kansas, it is not the Rocky Mountain grasshopper, but the homegrown species, that does the most serious damage. Of the native species, the differential grasshopper *(Melanoplus differentialis* Thos.) and the two-striped grasshopper (*Melanoplus bivittatus* Sand.) are the most abundant and do the most injury. The damage done to alfalfa comes mainly from individuals that have hatched and grown either in the field where they work or in the adjacent wheat fields and pastures.

Disking the alfalfa field in the early fall is one of the best methods that can be used to control grasshoppers. The egg-packets will not only be broken up and turned out, but will be exposed to natural enemies and the inclemencies of the weather, and thus vast numbers will be destroyed. The disking should be extended to the roadsides, edges of fields and even to the edges of pastures.

Poisoned bran mash, flavored with oranges or lemons, and sown broadcast in the infested fields early in the morning, is a very effective method of destroying both the young and the mature hoppers. The following formula has proved the most effective and can be most conveniently handled :

Bran	20 lbs.
Paris green	1 lb.
Syrup	2 qts.
Oranges or lemons	3
Water	3½ gals.

In preparing the bran mash, the bran and Paris green should be mixed thoroughly in a washtub while dry. The juice of the oranges or lemons should be squeezed into the water, and the remaining pulp and the peel chopped to fine bits and added to the water. The syrup should be dissolved in the water and the

bran and poison wetted with the solution, being stirred at the same time so that the mash is thoroughly dampened. This bran mash should be sown broadcast in such a manner as to cover about five acres with the amount of bait by using the quantities of ingredients given in the formula. It should be placed where the largest number will find it in the shortest time. In alfalfa fields, in order to secure the best results the bait should be applied after a crop has been removed and before the new crop is started.

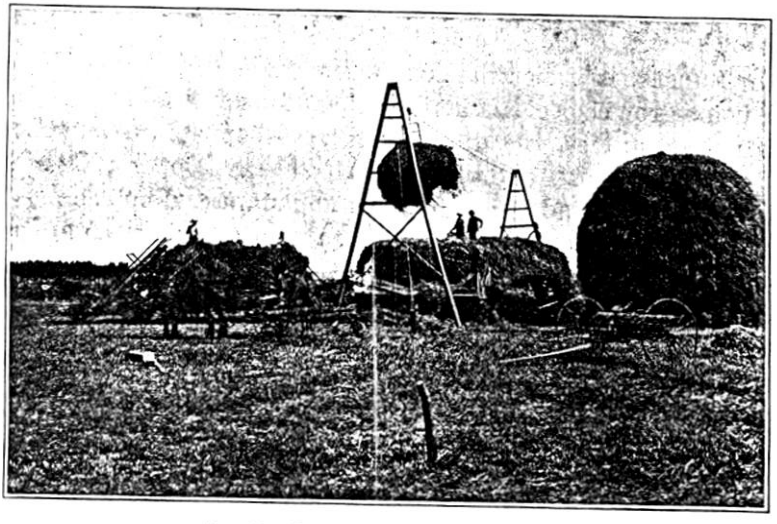

FIG. 16. Some modern haying machinery.