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FORAGE CROPS FOR THE SAND-HILL SECTION OF NEBRASKA.

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FORAGE CROPS FOR THE SAND-HILL SECTION OF NEBRASKA.

INTRODUCTION.

The passage of the Kinkaid homestead law[1] caused a considerable influx of settlers into the sand-hill section of Nebraska. Many of those who filed claims on tracts of 640 acres of this land were entirely unacquainted with agricultural practices and, besides, lacked the funds properly to stock and equip their farms. The result has been that a number were forced to abandon their homesteads before obtaining title, while a great many others stayed only long enough to secure a deed to the land so they could sell it; then they, too, gave up the struggle. Not only were the settlers themselves unacquainted with the agricultural conditions in the sand hills, but there was practically no source from which information was available.

It was with a view of obtaining a basis for recommendations in connection with the growing of forage crops that investigations consisting of cooperative experiments and a study of the practices of the more successful farmers were inaugurated. In the spring of 1908 a series of tests of forage crops was started in cooperation with farmers located under various conditions that were typical of the sand-hill section. These experiments were arranged not only to determine the comparative adaptability and value of various crops, but also to determine the best methods of culture. In the dry-valley region alfalfa (including several varieties), sweet clover, awnless brome-grass, slender wheat-grass, western wheat-grass, orchard grass, tall oat-grass, millet, and sorghum were tested extensively. Alfalfa, sweet clover, red clover, alsike clover, awnless brome-grass, timothy,

[1] This law, known as the Kinkaid Act, amended the Federal homestead laws, making it possible throughout the region indicated on the map (fig. 1) for settlers to file claims on 640 acres of land instead of 160. There were excluded from this act only such lands in the indicated district as the Secretary of the Interior might deem reasonably practicable to irrigate. It was also provided that settlers who had previously filed on a homestead in the region affected should have, for 90 days after the passage of the act, preferential right to make entry on sufficient additional land to increase their holdings to 640 acres, the stipulation in regard to final proof being that the entryman must prove affirmatively that he has placed upon the lands entered permanent improvements of the value of not less than $1.25 for each acre included in his entry.

redtop, Italian rye-grass, and perennial rye-grass were among the most important crops tested in the wet-valley region.

In the years 1909 and 1910 the tests were continued, in many cases with the same cooperators, but on a larger scale than in 1908. The plats varied from one-fourth of an acre to an acre in area, except where reseeding experiments were conducted, in which case they were usually much larger. The tests were inspected during the growing season each year, so that the behavior of the various crops was studied at the most favorable time for determining their value.

The results of these experiments, together with the data obtained from the most successful farmers, have made it possible to make some suggestions of a rather specific nature regarding the best methods of improving forage-crop conditions in the sand-hill section. While the suggestions and recommendations contained in this circular must in a measure be considered as tentative on account of

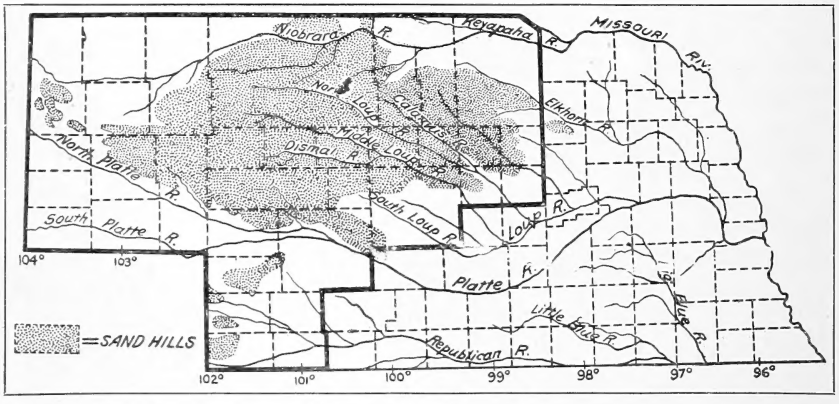

FIG. 1.—Map of Nebraska, showing the sand-hill section as indicated by Prof. Erwin Hinckley Barbour in his geological map of that State. The space inclosed by the heavy line shows the district affected by the Kinkaid homestead law.

the newness of the problems, it is hoped that they will be of considerable benefit to the farmers already in the sand hills and also to prospective settlers.

LOCATION OF THE SAND HILLS.

The sand-hill section of Nebraska, as shown in the geological map prepared by Prof. Erwin Hinckley Barbour, lies between 98° and 103° west longitude, and is bounded on the north by the Niobrara River and on the southwest by the North Platte River. (Fig. 1.) It includes practically all of the counties of Cherry, Garfield, Loup, Blaine, Thomas, Hooker, Grant, McPherson, and Garden; about half of Sheridan, Wheeler, Brown, Rock, and Logan; and considerable areas in Holt, Greeley, Valley, Custer, Lincoln, Keith, Morrill, Sioux, Perkins, Chase, and Dundy Counties. The space designated covers nearly 20,000 square miles, or about one-fourth the total area of the State.

TOPOGRAPHY OF THE SAND-HILL AREA.

The northern and western parts of this sand-hill area, lying in the counties of Holt, Rock, Brown, Cherry, Sheridan, Morrill, Garden, and Grant, are characterized as the "wet-valley region." In this region the valleys follow a general east-and-west direction and are usually quite broad and flat at the eastern or lowest end, which in most cases contains a shallow lake of varying dimensions, the largest of these being Dad's Lake, which is 4 to 6 miles long and 1 to 2 miles broad. In wet seasons the lakes increase in size and in dry seasons the smaller ones disappear entirely. Although in periods of extreme drought, like that of 1894, very few of the large lakes dry up completely, their varying size renders the area of the hay meadows which surround them inconstant.

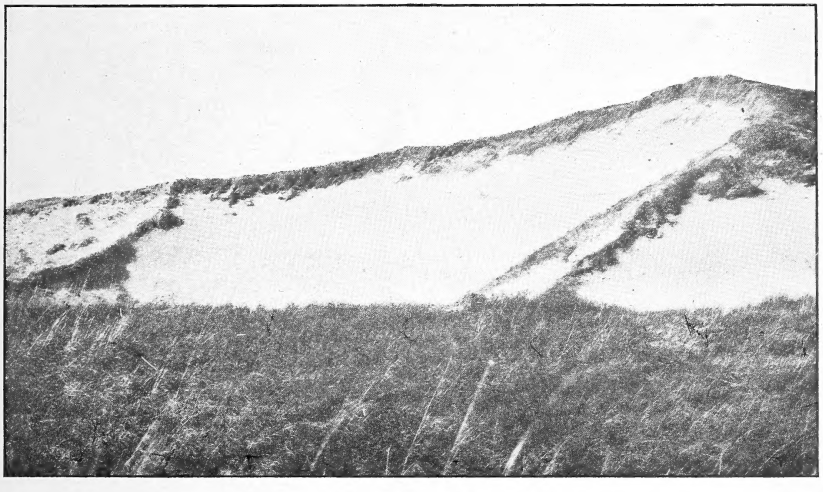

FIG. 2.—A blow-out near Alliance, Nebr.

The dry-valley region occupies most of the sand-hill section outside of the counties just named. It lies south of the former, and its distinguishing characteristic is its more abrupt and narrower valleys interspersed with ridges of sand hills. These valleys also are inclined in a general east-and-west direction, contain some fairly good soil in the bottoms, and have underground drainage sufficient to remove the surplus water. This dry-valley region grades insensibly into more irregular and choppy sand hills, which have no well-defined valleys between them and which contain little or no soil suitable for agricultural purposes. These choppy sand hills are found south of Thedford and Halsey in Thomas County, between the Middle Loup and Dismal Rivers. They are entirely useless for agricultural purposes other than grazing. On the tops of many of the hills are irregular conical depressions in the loose, shifting sand, locally known as "blow-outs." These depressions, swept out and kept clear of vegeta-

tion through the action of the wind, vary in depth from 15 to 50 feet and present the most difficult problem to deal with in the improvement of the sand hills. (Fig. 2.)

CLIMATE OF THE SAND-HILL AREA.

The forty-second parallel of latitude passes through about the middle of the sand-hill district. The temperatures in the hills are about the same as those along this parallel in eastern Nebraska and Iowa, except that the rapid radiation of heat at night from the sandy soil and the higher altitude make the nights cooler and bring the fall frosts somewhat earlier. In the western portion of the sand hills the climate is also more variable and the changes in temperature more sudden. The rainfall varies from 23 inches in the eastern part

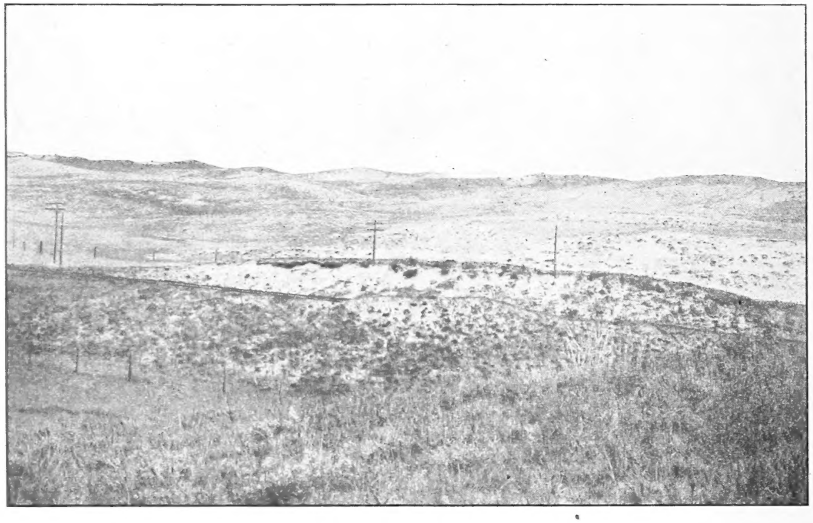

FIG. 3.—View between Seneca and Mullen, Nebr., showing the character of the native vegetation.

of Holt County to 16 inches in Sheridan and Morrill Counties. As a rule this rain comes at a seasonable time, being most abundant during the growing season of crops, from the middle of April to the first of August.

NATIVE VEGETATION.

The entire sand-hill district is fairly well covered at the present time with grasses. (Fig. 3.) Among the most common species[1] are the following:

On the tops and sides of the sand-hill ridges: Long-leafed reedgrass (*Calamovilfa longifolia*), redfieldia (*Redfieldia flexuosa*),

[1] Rydberg, P. A. Flora of the Sand Hills of Nebraska. Contributions from the United States National Herbarium, vol. 3, pp. 139–143. Also Pound, Roscoe, and Clements, F. E. The Phytogeography of Nebraska, vol. 1, pp. 345–347 and 352–368.

prairie muhlenbergia (*Muhlenbergia pungens*), Hall's beard-grass (*Andropogon hallii*), little bluestem (*Andropogon scoparius*), western stipa (*Stipa comata*), hairlike eragrostis (*Eragrostis trichoides*), and *Oryzopsis hymenoides*. These are common on the ridges of both the wet-valley and the dry-valley regions. Besides these grasses two species of Psoralea and two of Euphorbia are common. The sand cherry (*Prunus besseyi*) is also widely distributed and is a prominent feature of the sand-hill flora.

In the hay meadows of the wet-valley region the most valuable grasses are the following: Big bluestem (*Andropogon furcatus*), switch-grass (*Panicum virgatum*), western wheat-grass (*Agropyron smithii*), Indian grass (*Sorghastrum nutans*), wild timothy (*Muhlenbergia racemosa*), slender wheat-grass (*Agropyron tenerum*), porcupine grass (*Stipa spartea*), and nodding wild rye (*Elymus canadensis*).

In the moist soils adjacent to the lakes these better grasses are mixed with or superseded by sedges (*Carex* spp.) and rushes (*Juncus* spp.), several species of each being prominent. Where the ground is marshy in such situations, the tall marsh-grass (*Spartina cynosuroides*) and several species of Equisetum are also abundant. In the better soils of the dry valleys are found, besides a great many of the hay grasses named, patches of the side oats and blue gramas (*Bouteloua curtipendula* and *Bouteloua oligostachya*) and sometimes buffalo grass (*Bulbilis dactyloides*).

The sand-hill vegetation is very rich in species of grasses, and no attempt will be made to enumerate them further. During the spring and summer months these grasses are quite succulent and are efficient in producing both beef and milk, but in the fall and winter, with the exception of the buffalo and grama grasses, they are killed by frost and are not equal to the pasturage on the hard soils farther south, where the percentage of the last-named grasses is larger.

The hay secured in the wet-valley region is abundant and if cured properly makes a good roughage for cattle and horses, but it lacks the protein element necessary to sustain strength and produce growth when fed without grain.

CROP LIMITATIONS.

The extremely sandy character of the soil precludes any extensive system of small-grain or corn farming, such as is carried on in the eastern and southern parts of the State. This region is, therefore, and doubtless will remain essentially a stock-growing section. Prospective settlers should understand this point and make their plans accordingly.

Where a settler can obtain a large body of land, including some hay flats, he may profitably engage in the production of beef cattle

or of horses and mules. If he has only a limited area, like 640 acres, and is in reach of a shipping point, he had better substitute for the beef cattle a dairy herd.

IMPORTANCE OF A LEGUMINOUS FORAGE CROP.

None of these sandy lands should be farmed more than two years successively to corn or any other intertilled crop. The stockman must have grain or some substitute for it to feed his animals during the winter in order to maintain their strength and enable the females to enter the spring season strong enough to produce and care for their young. A feed is desirable which will also prevent the usual shrinkage during the winter of the young cattle. To supplement the native hay with grain shipped in and hauled long distances over sandy roads would be too expensive. This feed must be grown on the ranch. What crop will fill this need? Obviously it must be one that can be grown without clean cultivation and which in itself does not markedly deplete the fertility of the soil. For such a crop we must look among the legumes.

COMPARISON OF BROADCASTED AND CULTIVATED CROPS.

Continuous clean cultivation of a sandy soil destroys the vegetable matter remaining in it from the grass roots, and in a short time, generally three years, the soil begins to blow. Soon, if such methods are continued, a large percentage of the crop will be cut off by the drifting sand each year just as it is coming up, and when the field is abandoned the wind will continue to remove the soil until the surface is lowered to a depth of 6 or 7 feet and the land becomes practically worthless, even for grazing purposes. Such experiences as these have induced the sand-hill farmer to look about for some crop which does not need cultivation, and preferably a perennial one for which the soil does not need to be plowed each year.

PRESENT CROPPING SYSTEM.

Most farmers are depending at the present time on growing corn and rye with a small acreage of oats and supplementing this with large quantities of native hay. This hay, if cut at the right time and cured properly, would be fairly efficient in carrying stock through the winter, but most of it is put up under contract and little care is used either to cut it at the proper time or to get it baled or stacked while it is bright and sweet smelling. On account of the scarcity of grain, this indifferently handled hay becomes the principal reliance of the ranchman for his cattle during the winter. Feeding it as the sole diet usually results in the cattle going on the grass in a very weak condition in the spring. If there are many bad storms, great

numbers will be lost; and even if the older ones succeed in weathering the storms, a large percentage of calves will be lost on account of the weak condition of their mothers.

A small quantity of grain fed with the native hay daily would improve conditions a great deal, but the planting of most of the farm land to corn for a few years would be ruinious. Even sorghum, which would be some improvement on the native hay, presents the same difficulty on account of the necessity for its cultivation. Sorghum is a slightiy stronger feed than native hay, but there is the same objection to its culture that there is to corn when planted in rows and cultivated on truly sandy soils. On the harder soil at the edge of the sand-hill region sorghum can be utilized profitably on account of its drought resistance. Settlers will find it useful on the newly turned sod in the sand hills, but it can not be utilized as a permanent crop on account of its effect on the soil.

IMPROVEMENT OF GRAZING CONDITIONS ON THE SAND RIDGES.

In the spring of 1908 tests with various grasses, including brome-grass, orchard grass, tall oat-grass, slender wheat-grass, and western wheat-grass, were conducted to determine whether a cultivated grass more palatable than native vegetation might be found that could be grown more successfully on the tops and sides of the sand ridges. Brome-grass proved more promising than any of the other grasses under such conditions, but it does not flourish in the loose sand. Most of the seedings, except those on land heavily manured, have been failures so far as practical results are concerned. No suggestions for the improvement of these grazing conditions can be made at the present time except that the blow-outs may be remedied somewhat by seeding them to sweet clover or brome-grass and then scattering manure or straw over the loose sand to prevent it from blowing. (Fig. 4.) It is hoped that in time a grass may be found which will prove sufficiently aggressive to thrive on the loose, sandy ridges.

USE OF CLOVER IN THE WET-VALLEY REGION.

As nearly every farmer knows, clover hay carries a high percentage of protein, and for putting on flesh and inducing growth it is much better than even timothy hay. One of the ways, then, of filling the need for protein is to mix a good percentage of clover with the native hay. It is strongly urged that this be done, as all the clovers grow naturally on the moist lands of the hay flats. In fact, no part of the United States seems able to produce clover with less care or attention than this wet-valley region, and its use here is strongly urged. Red clover seeded in 1895 near Chambers, Nebr., in meadow sod, without plowing or other cultivation, has reseeded

itself from year to year in haying and is to-day in better condition and shows a better stand than ever before.

Where the meadow is inclined to be wet, alsike clover is best, but in all other locations common red clover is preferable. It is better than alsike clover on account of its larger growth, and especially its larger leaves, and better than mammoth because it is earlier and will make two cuttings in one season.

The advisability of seeding white clover under any circumstances is questioned. It grows readily, but does not make a hay crop, and in pastures where it is too abundant it induces the "slobbers" in horses.

FIG. 4.—Field showing sweet clover seeded in a blow-out near Ainsworth, Nebr.

TIME OF SEEDING.

In the tests previously mentioned, good results were obtained from both fall and spring seeding of clover, but as yet there are not sufficient data to warrant definite recommendations. On account of the severity of the winter, however, spring seeding would seem to have the advantage. When seeding on uncultivated land, the earlier it can be done the better, as the clover will then start at a time when the grass is not growing rapidly. On cultivated land it can be sown with a grain crop, such as oats or barley. A better stand is usually secured, however, where no nurse crop is used.

RATE OF SEEDING.

It is advisable to use sufficient seed to insure a stand even when sowing on meadowland. Many disappointments have arisen from a half-hearted scattering of a few pounds of clover seed over a 40-acre

meadow. Twelve pounds of red clover to the acre or 8 pounds of alsike are usually the quantities recommended and are sufficient to give a complete stand when proper methods of seeding are used. It is better to have a good stand of clover over 5 acres of the meadow, where one can see exactly how beneficial it is, than to have a spot here and there over 80 or 100 acres. Some reckon that if only a bunch here and there is started in a meadow the seed will gradually be scattered by the sweep rake in haying and will cover the entire meadow. It will do so if the clover is allowed to get fairly ripe before the haying is done, but it will take years. The farmer might have been cutting good clover crops from it much sooner if a smaller area had been given the proper quantity of seed and a field kept on cultivated ground to furnish the seed necessary for a gradual extension of his meadow. A field of pure clover on cultivated land is of great service for this purpose, as that produced in the meadows is so mixed with grass leaves that it is difficult to thrash. If the farmer has some source of seed on his own farm he will ordinarily use a larger quantity than if forced to purchase it.

METHOD OF SEEDING.

Many scatter clover seed on the surface of the ground and count on the rains covering it. When sown with oats on cultivated ground the soil should be plowed and thoroughly prepared with disk and harrow before seeding. Then the clover can be seeded at the same time as the oats and harrowed in with a drag harrow if no drill is available, or the oats can be disked or drilled in first and then the clover seed scattered on and harrowed in lightly. On these light soils it is always better to cover the seed in some way.

Where clover is sown without a grain crop, land that was in corn the previous year is preferable, because it is firm and solid. If the corn was cut for fodder, it only remains to sow the seed broadcast and harrow or drill it in the following spring. The field should be one which was kept free from weeds the preceding year, otherwise the young clover plants are likely to be choked out.

Most of this paper has been written with the present equipment of the sand-hill farmer in mind. As soon as possible every farmer should supply himself with a drill which will sow clover and alfalfa seed. A disk drill having a press attachment which is removable will pay for itself in one season in the saving of seed if any considerable area of land is seeded. The press wheels are very essential on cultivated ground, since it is always loose and needs to be compacted after the seed is sown. When seeding clover on meadowland these wheels can be removed and the seed left in the little furrows made by the disks. Succeeding rains will pack the soil sufficiently to insure an

even germination, and the slight loosening of the turf will give the young clover plants a better chance.

Where this method of seeding has been followed the meadow takes on the appearance of a clover field. (Fig. 5.) The resultant stand is so certain when clover is seeded on meadowland with a disk drill that a few trials would convince the most skeptical that wonderful possibilities exist in the improvement of a native moist meadow by seeding it to red clover.

RESEEDING CLOVER FIELDS.

Clover seeded on cultivated fields and regularly harvested for seed will, of course, need reseeding every other year, but the clover stand

FIG. 5.—Field showing common red clover seeded with a disk drill in the native meadow grass.

in native meadows can be preserved indefinitely without putting on any additional seed if handled properly.

A remarkable point noticeable in clover production in this region is that the first cutting of clover can be depended upon to produce seed, usually a full crop. In the East the first cutting very seldom produces seed. The presence of seed in the first cutting is of immense advantage to the man who has it in his meadows, as it comes on early in the spring, and by the time the native grass is ready to cut much of the clover has matured seed. During the haying operation a great deal of this seed is shattered out by the rakes, and thus the ground is reseeded without any additional trouble, and a good crop of new clover is assured each succeeding year. The second cutting comes on more uniformly and can be cut when it is in better condition for hay.

Alsike is handled in very much the same way and seeds as freely as the red clover. In the meadows, however, it of course is not so important that the alsike mature seed, since it is a perennial and does not need to be reseeded often.

CLOVER SEED PRODUCTION.

Since clover seeds so freely in this region, an exceedingly profitable system of farming is opened up to the sand-hill settler who owns a tract of moist meadowland. There is always a ready market for prime red or alsike clover seed at from $4 to $6 a bushel, and there seems little doubt that with proper treatment a good field of clover should return in this region 4 bushels per acre. Yields much exceeding this have been reported. The seed is not bulky, and the farmer could therefore afford to haul it a considerable distance to a shipping point. If properly developed, this region should become one of the principal sections of the United States for producing clover seed.

USE OF REDTOP AND TIMOTHY IN HAY FLATS.

Both redtop and timothy will endure considerable moisture and thrive well when seeded on the hay flats. Timothy is no doubt a considerable improvement over the native grasses, and tests show that a more extensive use of it is justifiable. When one seeds redtop on his meadowland, however, it scatters quickly over adjoining territory, and in a few years the meadow has the appearance of a field of redtop. This is due to some extent to the fact that the redtop comes on early and produces seed before the regular haying season of the native grasses has arrived. Thus, like the clover, it is spread broadcast over the entire meadow.

Redtop is not much of an improvement in quality over the native grass for hay, although if cut early, before it is too nearly mature, it makes first-class hay. It lacks the vitalizing, strength-giving quality of the clover, however, and should be used only on land too wet for either alsike or red clover, and there are few places too wet for alsike clover. Most farmers regret having redtop on their farms.

WEED PESTS IN MEADOWS.

Until recently the hay meadows of this region have been remarkably free from weeds. Sedges and rushes occupy much of the very wet land, but the presence of these in the hay is not considered sufficient cause for its refusal; in fact, a considerable percentage of the hay from some points is made up of these two plants.

There has appeared, however, the squirrel-tail grass (*Hordeum jubatum*), which has proved such a nuisance in the hay meadows of

Wyoming, Montana, and other Western States. It has spread rapidly, and unless radical measures are taken to check it there will soon be little first-class hay shipped from this region. The farmers and stockmen should understand that its presence in hay not only means the refusal of the hay by buyers, but also makes it dangerous to feed at home. The lodging of numerous beards, or awns, in the animal's mouth makes it unable to eat. Much good can be accomplished by cutting this grass off before it produces seed. It is considered an annual, and although some of the roots may live over winter, a few years of conscientious clipping will do much to rid the meadows of this dangerous pest. The time to act is now, before it secures too extensive a foothold. The farmer in a case of this kind is too apt to plead lack of time, but the man who desires to succeed will find time for such work and do it at the right time.

SWEET CLOVER.

The value of sweet clover (*Melilotus alba*), a much maligned plant, for forage and soil improvement in the sand hills is emphasized by the results of tests and also by finding it in use and giving complete satisfaction in several localities. Not only do stock eat it readily when accustomed to it, but it grows freely and inoculates naturally in situations where no other cultivated legume yet found, unless it be vetch, will thrive. As a means of preparing a field for the seeding of alfalfa it has no equal. The bacteria that produce nodules on the roots of sweet clover are effective in producing inoculation on alfalfa, which ordinarily is slow to become inoculated in the poorer sandy soils. Fields which have grown sweet clover for two years will usually be abundantly supplied with the needed bacteria. A much wider use of this plant as a forage crop is therefore advised.

FEEDING VALUE.

Tests in feeding sweet clover to sheep were conducted at the Wyoming Agricultural Experiment Station,[1] and in both quality of meat and amount of gain it proved to be nearly equal to alfalfa and much superior to native hay. Even though a poor grade of sweet clover hay was used in the test, "the lambs exhibited a steady appetite for it."

Numerous farmers report it as of equal value to alfalfa in feeding dairy cows, which means that it is as good as the best. For pasture it is available for cattle, horses, and hogs while the plants are small and not bitter, but live stock usually refuse to eat it after it becomes more mature and attains its characteristic bitter taste. Animals unused to sweet clover are apt to refuse even to taste it, probably on account of the odor, but once they are induced to eat a small quan-

[1] Bulletins 78 and 79, Wyoming Agricultural Experiment Station.

tity there is no further trouble. They seem to relish it afterwards and will select it in preference to native and even tame grass hay.

SEEDING.

Although numerous tests have been conducted with sweet clover, there has not been sufficient experience with it as yet to warrant definite recommendations in regard to the proper time for seeding. So far the best results have been obtained by sowing it early in the spring on a well-prepared seed bed, which should be firmed as in the case of clover and alfalfa. In other sections, seeding it in grain, either oats, barley, or spring wheat, has been successful and perhaps could be followed out in this region wherever the moisture is fairly abundant. Usually it is simply sown broadcast on the field after the grain has been drilled in, and it is then allowed to be covered by the weather. On sandy land, however, it is preferable to give the soil a light harrowing after sowing the sweet clover so that the seed will be covered. On the drier soils it is best to seed it without a grain crop.

Most sweet clover seed germinates very poorly; hence it is advisable to sow 25 pounds per acre. This low germination is not caused entirely by poor seed, but also by the large quantity of "hard seed" usually present in commercial sweet clover seed. In some cases the proportion of hard seed has run as high as 90 per cent, and this means that a large part of the quantity sown will lie dormant in the soil and germinate the following year.

A tabulation of the results obtained by the Seed Laboratory of the Bureau of Plant Industry in germination tests of sweet clover seed was made in order to determine whether the source of the seed has any effect on the germination or on the percentage of the hard seed it contains. This tabulation showed that in 22 samples of seed from the southern United States the average germination was 14.3 per cent and the average percentage of hard seed, 60.13. In 22 samples of seed from the northern United States, the average germination was 36.6 per cent and the average percentage of hard seed was 43.22. In the 28 samples of imported seed the average germination was 56.48 per cent and the average percentage of hard seed, 12.33. This would seem to indicate that the imported sweet clover seed is the most reliable, and that seed from the southern United States is likely to contain more hard seed and germinate less than that from any other section. These results confirm the observations which have been made on field tests of these samples.

TIME TO CUT FOR HAY.

Sweet clover should be cut for hay early, before its stems have become large and woody. The proper time to cut seems to be just as

the blossom buds are forming on the ends of the shoots. This will give about the maximum growth of leaf and stem. There will be at this time a large percentage of water in the green matter and considerable time will be necessary to cure it properly, but the hay when cured will be more palatable than if it had been allowed to reach full bloom.

TREATMENT OF SWEET CLOVER FIELDS.

If a good, strong germination of the seed is obtained early in May, sufficient growth should be made by August 1 to give a cutting of hay. The following year the growth will start very early and another good cutting can usually be secured between June 1 and 15. The second growth should then be allowed to go to seed, if it is desired to continue sweet clover on the field. There is usually no necessity of harrowing or disking the field after it has seeded, but such treatment would probably assist in getting an even germination.

Where the soil is poor the plowing under of a crop of sweet clover greatly benefits it; and even where the clover is cut for hay the decay of the roots, which in a good growth has been estimated at 20 tons green weight per acre, will add large quantities of humus to the soil.

ALFALFA.

DIFFICULTY OF CULTIVATION.

The crop which will eventually be of the most importance in both the wet and dry valley regions is undoubtedly alfalfa, and it is hoped that a more consistent effort to establish it will follow the publication of this circular. A great deal of it has already been sown throughout this territory and many discouragements encountered. Most of these have arisen from a lack of understanding regarding the requirements of this crop.

In the wet-valley region much of the alfalfa was sown where the water was near the surface, and during a wet time the crop was drowned out. In other cases, both in the wet and the dry valley regions, fields were sown with insufficient preparation of the ground. They lacked inoculation and on account of the poor character of the soil failed to secure it, and so, after making an indifferent growth for a number of years, the alfalfa was crowded out by weeds and grasses. In nearly all such fields a few plants became inoculated and are still fighting with the grasses, ever-present evidence of the hardy character and adaptability of the alfalfa plant.

Successful fields of alfalfa are to be found on sandy soils at Whitman, Hyannis, Seneca, Halsey, Anselmo, Chambers, Atkinson,

Stuart, Bassett, and Ainsworth. (Fig. 6.) This wide distribution of successful fields growing under nearly every condition of moisture and in widely varying situations is sufficient evidence that alfalfa can and will be grown in practically every part of this region. There are sure to be numerous failures in seeding alfalfa on account of the uncertainty of the climate, and it is advised that discretion be used in limiting expenditures on the first trials. Success will be more general as the people become better acquainted with the crop and as hardier strains, suited to this locality, are developed.

FIG. 6.—Alfalfa field near Atkinson, Nebr.

SEED STRAINS ADAPTED TO SAND-HILL CONDITIONS.

NATIVE DRY-LAND STRAINS.

Seed of native dry-land strains of alfalfa is secured from nonirrigated fields in the semiarid sections of the West. It is usually ordinary alfalfa which has been grown for years under dry-land conditions. In this way the drought-resistant plants alone have survived, and such seed is preferable if it can be obtained.[1]

TURKESTAN ALFALFA.

Turkestan alfalfa was secured originally from Turkestan and has been found, as a rule, more drought resistant than the ordinary alfalfa. It is not recommended, however, under irrigation, or in sections with sufficient rainfall for full crops of ordinary alfalfa. In the sand-hill region ordinary alfalfa usually gives a better yield.[2]

[1] Westgate, J. M. Alfalfa. Farmers' Bulletin 339, U. S. Dept. of Agriculture, 1908, p. 38.
[2] Westgate, J. M. Op. cit., p. 37.

SAND LUCERN.

Sand lucern is a hardy, drought-resistant strain which originated from a cross between ordinary alfalfa and the yellow-flowered species, *Medicago falcata*. It is adapted to a wider range of soil types than ordinary alfalfa and is proving equal or superior to many of the strains now being grown for drought and cold resistance.[1]

GRIMM ALFALFA.

Grimm alfalfa[2] is a local strain developed in Minnesota, which on account of its superior hardiness is well adapted to localities where trying conditions are to be met.[3]

LOCATING THE FIELD.

The best soil obtainable should be chosen for the alfalfa field. Except in the wet-valley region, the best location will invariably be in the bottom of the valley, where the soil contains the most humus and the moisture supply is the most constant. In the wet valleys the prospective alfalfa field should be located where the water table will be at least 4 feet under the surface of the ground. There have been successful fields where the distance to water was less in wet seasons, but the chances are very much against such a field. A well-drained piece of land with the water 8 to 12 feet beneath the surface is best. Too much water is as ruinous to alfalfa as too little.

TIME OF SEEDING.

Numerous tests of alfalfa have been conducted in this region. The results of these tests demonstrate quite thoroughly that the best time for seeding is about the middle of June. There are several reasons for this: (1) The winds, which are likely to be quite frequent and rather destructive through March, April, and the early part of May, usually cease by the first of June. (2) It gives the weed seeds which may have remained in the ground from the year before a chance to germinate and be destroyed by cultivation before the alfalfa is sown. (3) The ground is warm, the rains are more abundant at this time, and the alfalfa has time to make a good growth before frost, so that it can withstand the winter. With all these points of advantage, however, judgment will have to be exercised in seeding, as this date might happen to be just the wrong time to seed. If no rains have fallen for some time and the surface soil is dry to a depth of 3 or 4 inches, it is best to retain the seed until it does rain or, in case the

[1] Westgate, J. M. Variegated Alfalfa. Bulletin 169, Bureau of Plant Industry, U. S. Dept. of Agriculture, 1910.

[2] Brand, Charles J. Grimm Alfalfa and Its Utilization in the Northwest. Bulletin 209, Bureau of Plant Industry, U. S. Dept. of Agriculture, 1911.

[3] Brand, C. J., and Waldron, L. R. Cold Resistance of Alfalfa and Some Factors Influencing It. Bulletin 185, Bureau of Plant Industry, U. S. Dept. of Agriculture, 1910.

drought continues until after the middle of July, to carry the seed over until the following year. It avails little to put the seed in the ground at any time of the year when conditions are not favorable for its germination and continued growth.

Should the spring come on early and conditions be such at the middle of May as usually obtain at the middle of June, then it is well to sow the seed at that time, securing a stronger root system and larger top growth for protection during the winter.

RATE OF SEEDING.

The mortality among the young plants on sandy soil is very high, owing to the fact that the surface of the soil becomes extremely hot and many plants are wilted and burned off before the third leaf is formed. Such wholesale destruction of the young seedlings means that an oversupply of seed must be used. From 9 to 12 pounds of good seed should be ample, but on account of the conditions just mentioned it is usually best to sow 16 to 20 pounds per acre. If conditions are favorable and too thick a stand is secured, it can be thinned out much easier than a poor stand can be patched up. If the ground is too fully occupied by the young plants, a good harrowing or a light disking when the plants are only 3 or 4 inches high will not only reduce the number of plants but will leave the surface of the soil in good condition to retain the moisture.

PREPARATION OF SEED BED.

Wherever possible, ground that has been cropped to corn or potatoes the preceding year should be used for alfalfa. Such ground is best on account of its freedom from weeds and the firm seed bed it affords the alfalfa. The addition of manure to the soil several years in advance of its use for alfalfa is very beneficial, but manure should never be plowed under at the time of seeding, as it cuts off capillary action from below and generally leaves the upper soil loose and very dry, the rain water passing through rapidly but never returning past the layer of manure to benefit the young plants.

If corn or potato ground is used, it should be disked in the spring as soon as the first crop of weeds starts, then allowed to lie in a rough condition until a second crop germinates, when this can be killed by another disking or harrowing. It is advisable to kill out the weeds thoroughly before seeding, and this may require the third disking. If the soil is inclined to blow after such treatment, it may be better to give but one working. It will be found, though, that if the ground is disked crosswise to the direction of the prevailing winds the trouble from blowing will be less than if the ground were allowed to lie smooth and hard.

Where grain stubble is used it can be plowed in the spring after the first crop of weeds has started, left rough until the second crop germinates, and the latter killed by harrowing with a drag harrow or by disking.

Every effort should be made to get the seed bed as solid as possible, either by repeated harrowings, if the ground has been spring-plowed, or by the use of a roller. The frequency of the cultivations in the spring, especially with the harrow, must be determined to a great extent by the judgment of the man on the ground. Experience will show how much it is safe to work the soil with this implement. It must be remembered, however, that the weeds must be removed from the soil.

INOCULATION.

Throughout central and eastern Nebraska no trouble is experienced in getting a field of alfalfa inoculated. In the sand-hill country, however, many fields were noted which seemed to lack this very essential aid to growth. Numerous cases of winter injury would have been avoided if the field had been inoculated promptly and the growth during the late summer and fall had been more vigorous.

Lack of inoculation is shown by weak, spindling plants of a yellowish-green color in the field. The addition of barnyard manure or vegetable matter of any kind always assists greatly in procuring inoculation. It is well, however, to take other precautions besides the addition of manure. Ordinary sweet clover, which is very plentiful farther east in the State, and is found growing in many localities throughout the sand hills, is inoculated with bacteria usually understood to be the same as those which produce nodules on the roots of alfalfa. It is known that if a crop of sweet clover is grown on the soil prior to the seeding of alfalfa, the ground will be thoroughly inoculated. Sweet clover is more adaptable to different soil and climatic conditions than alfalfa and not only supplies the ground with bacteria but also adds a large quantity of vegetable matter in the shape of roots which decay very promptly when the plant dies. It would therefore be advisable to use sweet clover as an aid to the establishment of alfalfa fields throughout the sand hills.

When beginning a field on ground which has not been inoculated by the method just described, it is highly important and usually very profitable to secure soil from an old alfalfa field which is already inoculated, or from a patch of sweet clover, and scatter this soil at the rate of 500 pounds per acre over the ground which is to be sown to alfalfa.

The soil is best applied through a fertilizer drill, but as very few farmers in the sand hills possess a drill of this kind the application must generally be made by broadcasting the soil with the hands and

then covering it immediately with a disk or ordinary spike-toothed harrow, as bright sunlight is very quickly fatal to the bacteria.

When this inoculated soil can not be obtained near at hand, it is best to go to the trouble of shipping it even from considerable distances rather than sow the seed without inoculation. In this event 200 or 300 pounds of the inoculated soil may be mixed with an equal quantity of loose soil or sand in order to facilitate the scattering of it evenly over the field.

METHOD OF SEEDING.

Before seeding, it is always profitable to spend sufficient time and money on the preparation of the ground to get it in perfect condition. Alfalfa seed is quite expensive, and a poor stand of alfalfa means that weeds will enter the field in the vacant spaces and in time ruin the field entirely.

When the ground has been thoroughly prepared, as previously indicated, the best results should come from seeding with a press drill, but extreme care must be taken to prevent the seed from being covered too deeply, as the press wheels sink in the loose soil to a considerable depth and the wind later fills these furrows. One can also broadcast the seed, but the germination is never as good when the seed is broadcasted and harrowed in as when it is put in the ground with a press drill. This arises largely from the fact that the soil is pressed down on the seed in the drill track and capillary action supplies the germinating seed with moisture, even though no rain falls for some time after the seed is sown.

In the case of broadcasted seed where it lies in the loose soil, the seed is very apt to suffer from lack of moisture directly after it has germinated. It is better to seed half the required quantity of seed one way and then cross-seed with the remaining half than to sow it all one way, as a more even stand is usually secured in this manner.

If the press drill is not available one can obtain about the same condition of soil by rolling the ground after it is seeded and then following the roller with a light harrowing. If the soil is unusually sandy and liable to blow badly, it is necessary to do something to keep the moving sand from cutting the young plants off as they appear above the surface of the ground. Some growers accomplish this by using a light dressing of barnyard manure. If such manure is free from weed seed it will not only keep the sand from blowing badly, but will supply the ground with additional plant food.

The following is one of the best ways noted in which to hold the sand and give the alfalfa a chance to start: After the alfalfa has been seeded, a very light dressing of native hay taken from old stack bottoms is scattered over the field. This dressing of hay should be quite thin and evenly distributed. The next process is to go on the field

with a disk set very nearly straight and weighted, so that while it does not tear up the ground it will cut the hay into the soil and leave it standing over the field somewhat like stubble. (Fig. 7.) Splendid results have followed this method of seeding.

SUBSEQUENT TREATMENT.

If it should ever seem advisable to make a cutting the first season, care should be taken to set the cutter bar of the mower high. If cut low, the plants are slow to recover from the shock of cutting, and sufficient growth is not left on the field to protect the roots of the alfalfa through the winter. Present data indicate that clipping is warranted only as a protection against weeds, and that the common

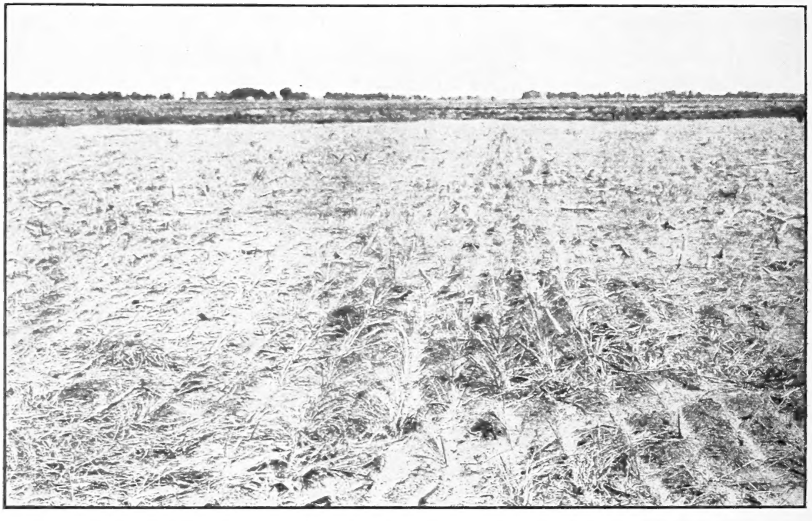

FIG. 7.—Field showing the method used for preventing the movement of sand by the use of old hay from stack bottoms.

practice of clipping new fields of alfalfa retards rather than strengthens the root growth.

When the stand of alfalfa is weedy it has been found advisable to disk the field each spring, and in some cases, where the moisture supply is adequate, after each cutting. The disk should be followed by a drag harrow to level off the soil for the mower. Even in fields which are not weedy it is best to disk each spring unless the ground is extremely dry, as it loosens up the surface soil and induces a heavier growth.

Ordinarily it is safe to cut three crops of hay each year, especially if the cutting is done at the proper season, when about one-tenth of the plants are in bloom. If the second crop is allowed to go to seed, the third growth had better be pastured back, since the cutting would

necessarily be late, and in that case the field would be left without winter protection, which often means disaster.

SUMMARY.

The sand-hill section of Nebraska comprises nearly 20,000 square miles, or about one-fourth the total area of the State.

Stock raising is, and doubtless will continue to be, the main industry of this section.

Native hay is at present the chief dependence of the stockmen for their winter feed.

No tame grass has been found which appears more valuable on the loose, sandy ridges than the native vegetation.

Crops which require clean cultivation should be discontinued as far as possible.

The most dependable source of livelihood for the small landowner is dairying.

The clovers are well suited to the wet-valley region, and this division of the sand hills should become in time one of the important clover-producing sections of the United States.

The improvement of the native, moist meadowlands by the introduction of timothy is advised, but the use of redtop for this purpose should be discouraged.

The growing of sweet clover as a forage crop and in preparing land for alfalfa is recommended.

The most dangerous weed of the wet-valley region is the squirreltail grass (*Hordeum jubatum*), now quite common.

Alfalfa promises to become the most valuable cultivated crop of the sand hills.

The use of a hardy strain, good judgment in locating the field, inoculation of the soil, and careful attention to the details of seeding are necessary for success with alfalfa.

Approved:

JAMES WILSON,
Secretary of Agriculture.

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