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RE-ESTABLISHING NATIVE GRASSES BY THE HAY METHOD[1]

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Spreading mature hay with a manure spreader—a highly effective method of providing uniform distribution of hay and seed.

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INTRODUCTION

The need for economical and dependable methods of regrassing rough, erosive and unproductive cultivated land in western Kansas has been assuming importance for several years. The recent drought years, with their accompanying high winds, dust storms and high temperatures accentuated this need and extended it to thousands of acres of pasture land. Many land owners are tempted to let nature take its course in reestablishing a cover on this type of land. Others, however, who have tried the method over a longer period of time, have found it very slow and costly as generally it requires anywhere from 25 to 40 years for complete and satisfactory natural regrassing to occur. With proper assistance the establishment of a permanent grass cover on these areas is not only greatly hastened but returns from grazing are increased and the destructive processes of erosion are retarded.

Native grasses, as has been determined by long experience and testing, are vastly superior to any of the perennial grasses now available from other parts of the world for use in this reestablishment work. Most native grasses are, however, poorly suited to commercial handling and propagation from seed and it was for this reason the hay method of seeding was developed. Buffalo grass, for example, normally produces its seed so close to the ground that it is seldom possible to obtain as much as one-half of the total crop with the machinery now available. Other grasses such as blue grama and the bluestems, produce seed which is readily harvested in ample quantities, but their seed, unless especially processed, is difficult to clean and drill because of its light, fuzzy character.

Aside from these physical characteristics which make native grasses more-or-less difficult to handle, the problem of low seed germinability must be overcome. Likewise, trouble from erosion is often encountered because these native grass seedlings are slow in emerging and becoming established. Thus, a method to be practical must not only overcome these handicaps but must be useable on rolling and unproductive land such as will be first chosen for reseeding.

The hay method, as developed in 1937 and since used at the Fort Hays Branch Experiment Station, has proved a practical method of reestablishing the native grasses in that territory and recent work at other Kansas Stations and at numerous locations in the Great Plains region indicate the method has possibilities over a wide range of soil and climatic conditions.

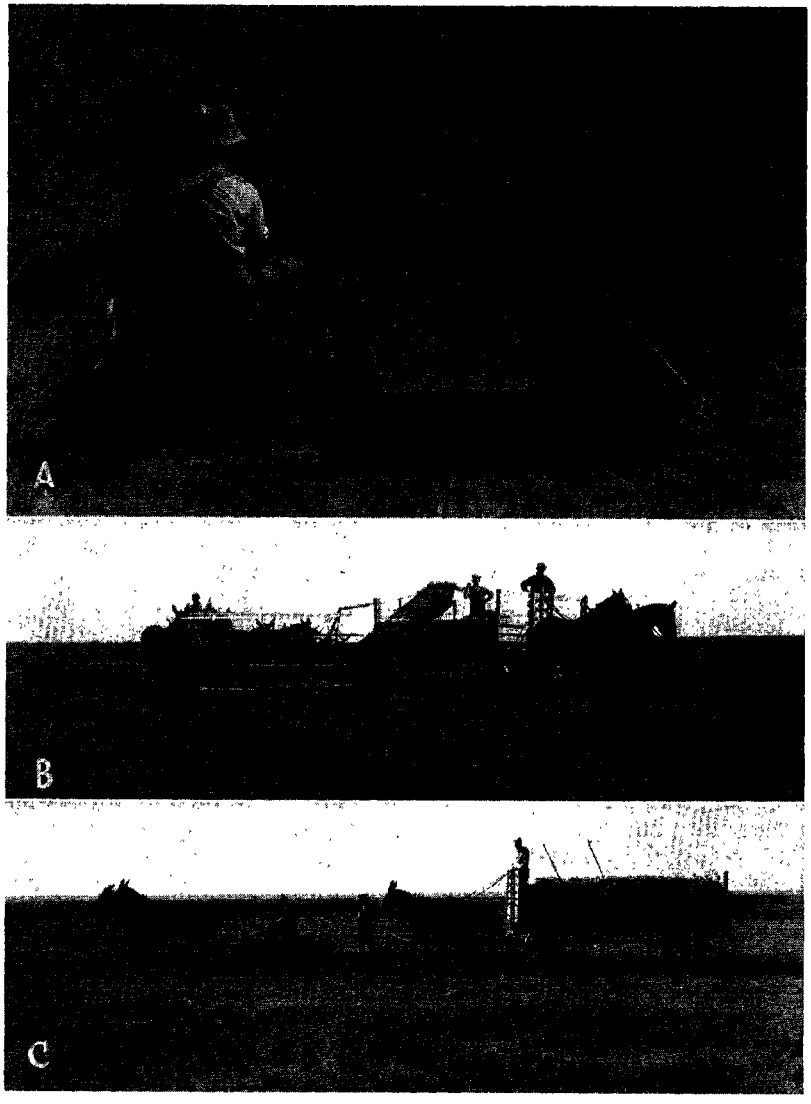

FIG. 1.—(A) Harvesting mature hay from a native short grass pasture with a metal pan attached to the sicklebar. The pan is necessary to catch the shattered buffalo grass seed. (B) Harvesting blue grama grass with a wheat header. This machine is considered inferior to the mower for harvesting the short grasses, it generally being necessary to mix clean straw or prairie hay with the headed material to make the seed cover a larger area. (C) Harvesting buffalo—blue grama grass hay with an alfalfa buncher. This method will obtain a fair percentage of the buffalo grass seed. Other native grasses ripe at this time are obtained, thus resulting in a natural mixture of adapted grasses.

Explanation of the Hay Method

The hay method of planting native grasses consists of spreading mature hay containing ripe seed over a prepared seedbed with a manure spreader and providing some kind of tillage that will cover the seed and anchor the hay.

The hay crop is harvested and stored when the bulk of the seed is ripe but before excessive shattering occurs. After at least one winter in the stack, most grasses may be planted with assurance of good germination. Planting is done in the late spring months on a well prepared seedbed, preferably fallow or on surface tilled cropland stubble. Distributing the hay material over an area from one to three times as great as that from which the hay was harvested represents the normal planting range, depending upon such factors as season, method of harvest and section of the country.

Immediately after spreading, the hay material is anchored by packing with a subsurface packer or covered with a disk-drill set to run shallow. The packing operation, aside from anchoring the hay so that it cannot be blown about by wind or carried off by water, covers the seed at various depths, some one of which generally is suitable under the prevailing climatic conditions.

General Excellence of the Hay Method

This method of seeding combines several principles of selection and use of good seed in providing locally grown seed of nature's best adapted grasses.

The chances of severe damage from environmental extremes are lessened by planting a natural mixture of native grasses adapted to the area. This is true in that some grasses are damaged more by overgrazing than others; likewise certain grasses may be more subject to injury by insects and climatic extremes than others. Mixtures of grasses also provide better opportunities for obtaining and maintaining stands. Once they are established they provide a greater variety of forage and a longer grazing season by supplying grazing at different periods of the year.

Experience with the hay method indicates that it is adaptable to a wide variety of conditions and that it may be employed almost anywhere in Kansas where native grasses are available. This method is limited only in areas where extreme conditions have reduced the number of good native grass pastures from which suitable seed material can be harvested.

The hay material spread with the seed prevents wind erosion, retards runoff and reduces water erosion. It also helps prevent soil crusting and reduces the damage from covering by torrential rains, thereby assuring better emergence and greater protection to the newly emerged seedlings. The process of anchoring the hay which covers the seed at varying depths also has an advantage over drilling at uniform depths or broadcasting. This is particularly true if wind, temperature and rainfall conditions are not favorable to germina-

tion. With seed placed at various depths some one of these depths likely will be favorable for germination regardless of the kind of weather following planting.

The fact that this method requires no cash outlay for seed or equipment will enable many farmers to plant native grass who otherwise would be forced to wait until more economical methods of harvesting, processing and drilling are perfected.

Protecting the Native Pasture to Permit Seed Production

The first requisite in obtaining mature hay seeding material is that livestock be removed from the pasture from which hay is desired. Native pastures do not seed abundantly every year, and where continuously grazed seldom produce seed at all. Therefore, if a maximum seed crop is to be obtained grazing must be discontinued after July 1, as most native grasses seed best in the fall of the year. Supplemental pastures of Sudan grass and volunteer wheat may be used temporarily to replace the native pasture while seeding material is being produced.

If the native pasture acreage of the farm does not permit the necessary deferment, it is frequently possible to lease a native pasture for the express purpose of harvesting seed therefrom. Removing a seed crop in the form of hay does not injure native pasture grasses but tends to benefit the stand through providing protection from grazing.

When and How to Harvest the Ripe Hay

The mature hay should be harvested when the seed is ripe but before any great loss of seed from shattering has occurred. The proper condition for harvesting can readily be determined by watching the important grass in the mixture as it matures. Usually one or two days after shattering is observed the material is in the proper stage for harvesting. Various implements have been used for this purpose, all of which have their advantages and disadvantages, depending upon the type of grass, weather conditions, stage of ripeness, and the amount of growth and seed produced.

The common field mower is preferred for harvesting the short grasses, primarily because it will cut closer to the ground than other implements thereby obtaining more stem and leaf material which is of special value in the spreading operation and in obtaining a stand. When buffalo grass makes a good seed crop, a satisfactory amount of the seed can be obtained by using a mower equipped with a metal pan attached to the sickle bar, as illustrated in figure 1a.

Some buffalo grass seed can be obtained simply by mowing and raking immediately, but the loss by this method is too great to warrant its use in harvesting such valuable seed. Where only blue grama is of interest, raking immediately after cutting will save a fair percentage of the seed if the hay is harvested before shattering takes place.

Where the wheat header is available it may be used to harvest blue grama and some of the tall grasses (figure 1b). This method is

more rapid and economical than the mowing machine but less material is obtained, Prairie hay or straw which is free from grain will need to be mixed with the headed material to enable spreading at a uniform and satisfactory rate, as experience has shown that it is difficult to spread less than 500 pounds of cured hay material per acre. This amount is generally more than the yield of headed material obtained from an acre of native pasture.

Where the headed material is spread without the addition of some bulky material, the light rate of spreading generally results in uneven distribution, spotted stands, and insufficient mulch protection against wind and water erosion. The latter condition is particularly important where plantings are made on clean fallow. Another disadvantage of the header method of harvesting lies in the fact that buffalo grass seed is produced so close to the ground that it cannot be obtained with the header. Where the possibility of obtaining buffalo grass seed in the hay mixture exists, every effort should be made to secure it even though it requires harvesting with a mower with pan attached.

A grain binder may be used for convenient harvesting and handling of the tall grasses on areas where the topography is such as to permit its use. Usually buffalo grass does not constitute an important part of the mixture under these conditions and since larger yields of hay are to be expected there is little necessity for cutting close. Where the binder is used precaution should be taken to dry the bound material thoroughly before stacking or storing.

Regardles of the method employed in harvesting the native grass hay, it is a good practice to leave strips of unharvested material at frequent intervals to catch and retain winter snow. By harvesting in an east and west direction taking from two to four swaths and leaving a narrow strip, the pasture can readily be protected.

Native short grass material cut with a mowing machine or header can usually be stored immediately as there is not enough moisture remaining in the plants at this time to cause heating or molding. The tall grasses, regardless of how they are harvested, should be allowed to cure well before stacking or storing inside.

Storing the Cured Hay

In western Kansas stacking the cured hay outside in small well topped stacks is sufficient protection if shed room is not available (Fig. 2). The stacked material should pass at least one winter in the stack before being planted because the germination of newly harvested seed is very low. If buffalo grass constitutes a large portion of the grass mixture, it is advisable to leave in the stack for at least two years before seeding as more time is required for this grass seed to improve in germination. Under proper methods of handling and storing the viability of the seed will remain good for several years. This fact permits the harvesting of enough seeding material in good years to carry through the poor years.

Land Preparation for Seeding by the Hay Method

The section of the state, the character of the soil and the slope of the field to be seeded will determine quite largely the best method of land preparation.

Under conditions at Hays, seedings on fallow have been more successful and the grass has been better able to establish itself than on cropped land. In the southwest part of the state, where the soil is quite sandy and extremely susceptible to blowing, the protective

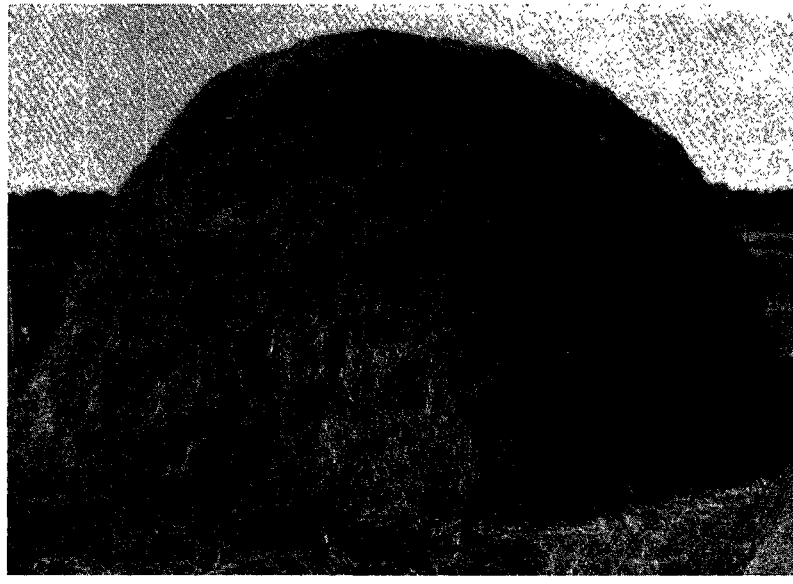

FIG. 2.—A well made stack of native grass hay. Short grass hay is usually sufficiently dry at harvest time to permit immediate stacking. Seed in well made stacks like this will retain its viability for several years.

value of the hay mulch applied with the seed may not be sufficient protection at economical spreading rates. Under such conditions Sudan grass or sorghum cover would have definite advantages in overcoming the blow hazard. Where sorghums are grown as preparatory crops it is advisable to cut them high at flowering time and allow the growth to fall to the ground for additional protection. Clipping the sorghums prevents the grain from maturing and creating a serious volunteer problem in the grass planting the next year. Costs of the latter method of seedbed preparation are not much different than fallow. However, where the preparatory crop is harvested as forage the net costs are generally lower than for fallow.

On hard land under the light rainfall conditions in the western part of the state, fallow is to be preferred over cropped land where seedings by the hay method can be made. If the area to be seeded

is extremely large it may be advisable to plant strips of sorghum at intervals to help protect the fallow against wind erosion. These strips can be seeded to grass after the grassed sections afford satisfactory protection.

In the intermediate rainfall area in the west-central part of the state, seasonal conditions and slope may determine whether it is advisable to seed on fallow or on some type of cropped land. In using a preparatory crop its handling should be devoted primarily to protecting the land from erosion. For this purpose Sudan grass has many advantages.

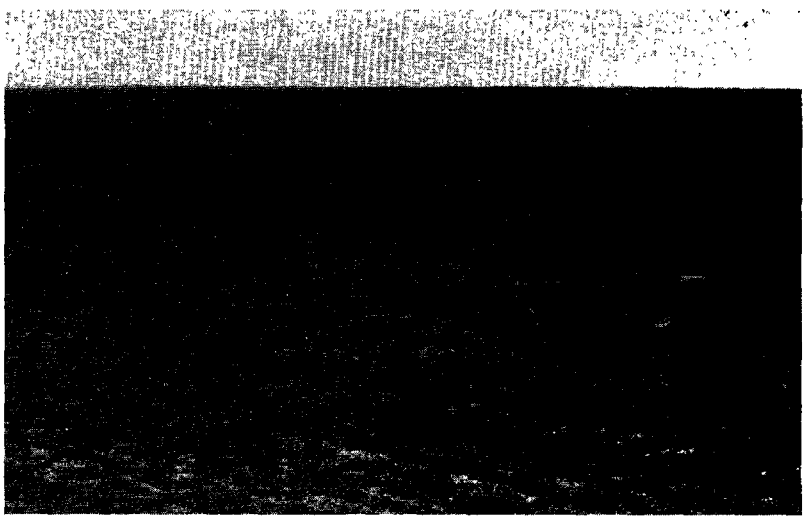

FIG. 3.—One of the fields of native grass established by the hay method in 1940. This field was seeded June 15 with a hay mixture consisting of 320 pounds each of blue grama heads and sand dropseed hay. This planting showed an average of 251 blue grama plants and 607 sand dropseed plants per square yard at the close of the season. One hundred fifty well-spaced plants per square yard is considered an excellent stand.

Under conditions of higher rainfall farther east, fallow is not necessary. Sudan or cane hay cut higher than usual to leave a good stubble will provide a satisfactory medium for the protection of the soil from erosion and the grass seedlings from the elements until they have become well established.

Regardless of the territory or the seedbed preparation used, there are a few necessary prerequisites to the successful use of the hay method. To permit proper anchoring of the hay and covering of the seed it is necessary to provide a seedbed which is fairly loose on the surface but firm underneath. Such a condition enables the packer to push the hay into the soil sufficiently to anchor it against wind and water erosion and yet not cover the seed too deeply. The seedbed must also be free of weeds. The springtooth harrow and duckfoot are good implements for preparing fallow while the one-way

plow and disk harrow are satisfactory implements for preparing most croplands. Where trouble from either wind or water erosion may be expected, every effort should be made to leave as much undisturbed crop residue on the surface as possible. For this reason the disk harrow has definite advantages in preparing fields having a thick stubble cover.

A comparison of the results obtained by spreading blue grama hay on fallow and various croplands prepared by plowing and disking is presented in Table 1. A photograph of the results is presented in figure 3.

TABLE 1. *Stands obtained in the spring of 1940 by spreading blue grama hay on fallow and various crop lands prepared by different methods*

Crop grown in 1939 previous to seeding grass May 7, 1940.	Number of blue grama plants per square yard obtained where the land was	
	Plowed March 20, spring-toothed and packed twice May 3.	Double-disked and packed once May 3.
Fallow	663	769
Barley	333	556
Corn	499	512
Kafir	459	436
Sudan in 21-in. rows	346	433
Sudan in 7-in. drills	292	396
Weeds	297	298

NOTE.—Spreading rate was same on all areas. Approximately one acre of pasture required to seed one acre of land.

Attempts at thickening stands in denuded and depleted native pastures require that the surface be worked shallow prior to spreading, otherwise the hay and seed cannot be efficiently held and covered. A light disking or preparation with a disk-type wheat drill will produce a suitable seedbed condition and yet will not destroy the remaining pasture plants.

When and How to Plant the Hay Material

Most native grasses are warm season plants, consequently will not germinate until warm weather regardless of when planted. Thus, there is nothing to be gained and often considerable to be lost by planting before late April or during May after a crop or two of weeds have been killed. The only occasion for planting earlier than this being in undisturbed cropland stubble and in depleted pastures where a partial stand of grass furnishes considerable competition.

Fall or early spring seedings are not to be recommended with any of the common native grasses except western wheat grass which, because of its cool weather growing habit, may best be seeded at these

times. The native species other than western wheat grass seldom produce enough growth after fall seeding to enable them to withstand the winter cold. If seedings are made in late winter or early spring, weeds emerge ahead of the grass giving the slower growing grasses little chance for survival. Plantings made during these seasons are also subject to the fall and spring windy periods which may eventually break down the resistance of the grass mulch and permit the soil to blow.

The results of planting blue grama and sand dropseed during different months of the year are shown in Table 2. From these results it will be observed that early spring and fall plantings are

TABLE 2. *Results of spreading blue grama grass and sand dropseed hay at different times of the year*

Date seeded, month and year.	Blue grama.			Sand dropseed.		
	Number of plots.	Seedling stand.	Av. percent ground cover or no. plants per sq. yd.	Number of plots.	Seedling stand.	Av. percent ground cover or no. plants per sq. yd.
March, 1938	2	Excellent	37.84	2	Good	18.57
March, 1939	1	Very poor	Failure	.....	.....	.....
March, 1940	1	Very poor	Failure	.....	.....	.....
April, 1938	2	Excellent	33.99	2	Very good	23.58
April, 1939	1	Very poor	Failure	.....	.....	.....
April, 1940	8	Very poor	25 plants	.....	.....	.....
May, 1938	4	Excellent	35.56	2	Very good	20.79
May, 1939	1	Good	22.84	.....	.....	.....
May, 1940	18	Excellent	439 plants	2	Very good	162 plants
June, 1937	1	Excellent	33.79	.....	.....	.....
June, 1938	2	Excellent	37.04	3	Excellent	27.73
June, 1940	1	Excellent	251 plants	1	Excellent	607 plants
August, 1938	1	Very good	Failure	.....	.....	.....
August, 1939	1	Very poor	4 plants	.....	.....	.....

NOTE—Well-managed native grass pasture showed an average ground cover of 32.0 percent in the fall of 1940. Two- and three-year-old seedings with 25.0 percent are considered satisfactory. First-year seedings should have about 150 plants per square yard to be considered satisfactory.

not dependable. The spring of 1938 was an exception in that March and April were so warm that both grass and weeds were well established by the first of May. A late freeze on May 8 killed most of the weeds without harming the grass, thereby permitting the early planting to succeed.

The ordinary manure spreader has proven the most effective implement for distributing the ripe hay and seed on the land to be seeded. A man standing in the rear of the spreader can aid greatly in regulating the feeding of the hay to the cylinder by weighting the hay down and forcing the cylinder to pull it out at a uniform rate. This action shatters much of the seed and effects more uniform spreading. A similar effect could be obtained by placing a weighted roller of at least 18 inches in diameter in position immediately in front of the spreader cylinder so the hay would be tightly compressed as it was fed into the revolving cylinder.

Spreadings have been made by hand and with a specially constructed straw mulcher but these methods have their disadvantages in that they require more material and the coverage is seldom as uniform. However, where a spreader is not available on the farm and one cannot be obtained, hand spreadings may be resorted to and expected to produce quite satisfactory results.

Rate of Spreading Hay

The rate of spreading is dependent upon several factors but principally upon the amount of hay and seed produced during the year of harvest. The kind of grass, section of country, type of soil

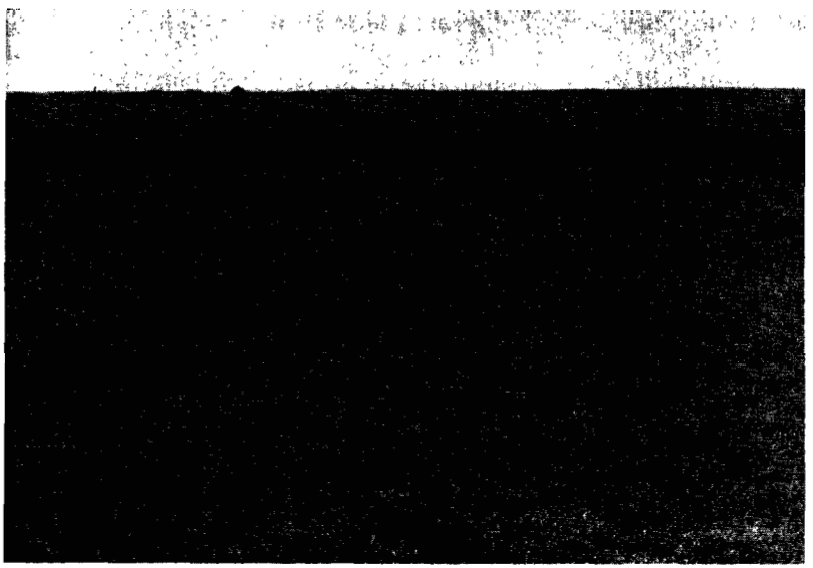

FIG. 4.—A typical area showing the results of spreading blue grama hay as a seeding method in the spring of 1938, as it appeared at the close of the 1940 season. This area measures 37.84 percent ground cover. The native pasture in the background averages about 32 percent.

to be seeded, and the method employed in harvesting are other factors affecting the proper rate of spreading. In dry seasons one acre of protected short grass pasture will usually furnish enough seeding material to cover an equal area of cultivated land. A favorable season will permit a larger area to be spread. For example, in 1937 native short grass pastures produced enough seed material to replant three times the harvested area. In 1938 one acre of pasture material would barely plant an acre of cultivated land, while the 1939 season, one of the driest in history at Hays, did not produce sufficient material to justify harvesting. The pasture yield in 1940 was sufficient to plant an area equal to that harvested.

Areas producing sand dropseed, western wheat grass and most of the taller grasses will generally yield sufficient material to seed at least twice the amount of land that has been harvested.

Experience in seeding has demonstrated that it is difficult to obtain a uniform spreading of less than 500 pounds of material per acre with the manure spreader. This amount is also about the minimum that can be expected to protect the average field from blowing. It is better to overspread than to underspread because stands of most native grasses thicken slowly when there are already nearly enough plants on the area to utilize the moisture that is received.

A comparison of different rates of spreading blue grama hay harvested in 1937 is given in Table 3. Figure 4 shows a two-year-old field started from blue grama hay in 1938.

TABLE 3. *Rate-of-spreading trials with blue grama hay in May, 1938*

Pounds of material spread per acre.	Method of harvesting seed material in 1937.	Seedling stand first year.	Stand expressed in percentage of ground cover at end of 1940.
1,000	Mowing machine	Excellent	33.13
800	Mowing machine	Excellent	36.77
750	Mowing machine	Excellent	36.13
650	Mowing machine	Excellent	32.56
500	Mowing machine	Very good	29.79
250	Mowing machine	Good	21.80
400	Wheat header	Excellent	35.75

NOTE.—Approximately 750 pounds of hay material were harvested from one acre of protected pasture in 1937. 400 pounds of headed material contained the same amount of seed as 1,000 pounds of hay cut with the mower. A ground cover of 25.0 percent is considered satisfactory.

Supplementing With Buffalo Sod

In territories where buffalo grass is adapted but where it seems impractical to obtain seed, sodding at wide intervals in connection with spreading the hay of other short grasses is a satisfactory method of obtaining a pasture representing all of the desirable grasses. (See fig. 5.) This method involves dropping six-inch squares of buffalo sod at uniform intervals over the seedbed before spreading the hay. Following the spreading operation the field should be rolled once with a surface packer to push the sod pieces into the soil and to firm the seedbed before the hay is anchored in the usual manner. This first surface packing prevents the seed from being covered too deeply by the second subsurface packing.

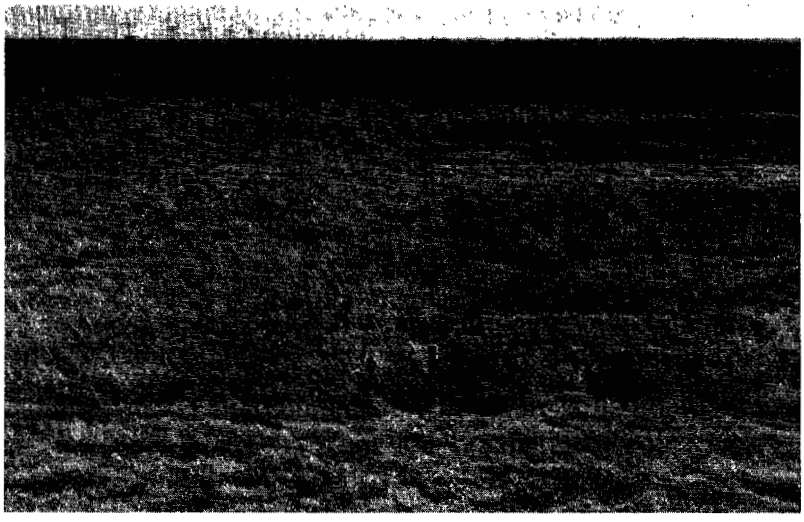

FIG. 5.—Obtaining the desirable qualities of buffalo grass in a pasture by dropping pieces of sod at various intervals previous to spreading blue grama hay (left) and drilling blue grama seed (right). The close-spaced sods spread completely together in three years. Blue grama measures 39.59 percent ground cover where the hay was spread and 20.49 percent where the seed was drilled shallow.

Packing-in or Covering the Hay

Following the spreading operation it is essential that the hay be pushed into the ground and the seed covered. This operation is especially necessary to anchor the hay so that it cannot be blown about by wind or be carried off by water.

The Campbell packer has been found the most effective implement for use in this packing-in or covering operation. (Fig 6.) Its narrow and rather blunt wheels will push the hay sufficiently deep into the soil and yet not cut it, thereby firmly anchoring the hay and at the same time covering the seed at various depths. In the event a packer of this type cannot be obtained a dull disk-type drill or disk harrow set straight and run very shallow may be used somewhat less effectively. Precaution is always necessary in using either of the two latter implements lest the seed be covered too deeply.

The packing-in operation is an important step toward the success of this method of planting. If it properly anchors the mulch, the young tender seedlings will be afforded maximum protection against the cutting action of blowing soil and will be greatly protected against covering or washing out by heavy rains. Thedepth of seed coverage varies from being broadcast on the surface to being covered several inches deep. This condition greatly enhances the opportunities of securing satisfactory emergence regardless of the type of weather following planting. The direct value of the mulch to the establishment of the grass has been consistently shown by the fact that seedlings are most numerous in the packer wheel tracks and under small bunches of litter. In addition to preventing ero-

sion, soil crusting and covering from torrential rains, the mulch may have some value in reducing evaporation and consequently in retarding the loss of surface moisture. None of the hay plantings made at the Hays station have permitted soil blowing, and in several instances sufficient protection was afforded to hold drifting soil from adjoining fields. Water erosion and runoff are noticeably retarded by the hay material left on the surface by this method of seeding.

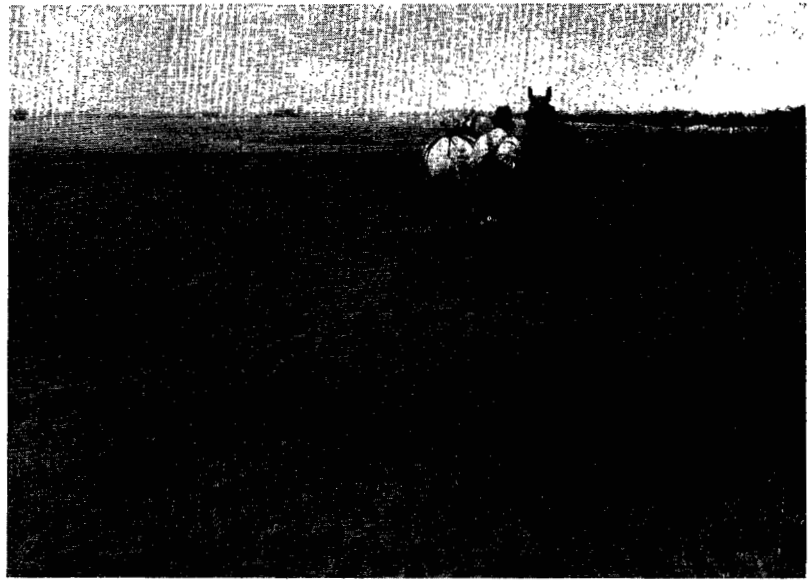

FIG. 6.—Packing in the hay material with a Campbell subsurface packer. This implement has proven the most successful for this operation. It anchors the hay and covers the seed at various depths. The mulch thus prevents wind and water erosion, lessens soil crusting and prevents covering of the small seedlings from torrential rains.

Treatment After Planting

Every precaution should be taken to save the young grass stand once it is obtained. Weeds are invariably a problem on new grass seedings and since they grow so much faster than native grasses, clipping is generally necessary to prevent them from reducing the stand.

The number of mowings necessary to keep the weeds under proper control will be in direct proportion to the earliness of planting. Plantings made during May will generally require from two to three clippings, depending upon the amount of rainfall received and the prevalence of weeds. Earlier plantings will require at least one more mowing the first season. Clipping at a height of from two to three inches as often as the weeds attain a height of eight inches or when it is observed they are unduly shading and crowding the grass, will remove most of the weed growth without injuring the grass stand.

Grazing Pastures Seeded by the Hay Method

Grazing should not be expected the first season because native grasses grow and root so slowly that the trampling and pulling effects of grazing are almost certain to injure or destroy the stand. However, by the latter part of the second season livestock may be permitted to graze the new seeding. In event weeds become serious the early part of the second season they may either be grazed off hurriedly or clipped. In this case grazing is not practiced for more than a few days and the grass is generally sufficiently established to withstand this short treatment.

Advantages of the Hay Method Over Drilling

In territories where native pastures permit the obtaining of mature grass hay for planting material, this method has the following advantages over drilling:

1. There is no cash outla for seed.
2. A natural mixture of adapted native grasses is obtained.
3. The hay mulch applied with the seed provides both wind and water erosion protection for the tender grass seedlings while they are becoming established.
4. No special native grass seed-processing or drilling equipment is necessary.
5. Better stands, with fewer failures, have resulted. (See Table 4).

TABLE 4. *Comparisons of spreading hay and drilling seed of blue grama grass and sand dropseed*

Year and month.	Grass.	Preparatory cropping and tillage.	Stands at the end of 1940 in percent ground cover or number of plants per square yard obtained by—	
			Drilling seed.	Spreading hay.
June, 1937	Blue grama	Fallow	Failure	33.79
April, 1938	Blue grama	Fallow	7.0*	33.99
April, 1938	Sand dropseed	Fallow	12.5*	23.58
May, 1938	Blue grama	Fallow	20.63	36.77
May, 1938	Blue grama	In partial stand of grass	20. 9	39.59
May, 1938	Sand dropseed	Fallow	15.5*	20.79
May, 1939	Blue grama	Cane stubble	7.83	22.84
May, 1940	Blue grama	Fallow	66 plants	769 plants
May, 1940	Blue grama	Barley	56 plants	556 plants
May, 1940	Blue grama	Corn	53 plants	512 plants
May, 1940	Blue grama	Kafir	44 plants	436 plants
May, 1940	Blue grama	Sudan 21-inch	25 plants	433 plants
May, 1940	Blue grama	Sudan drilled	38 plants	396 plants
May, 1940	Blue grama	Weeds	19 plants	298 plants

* These plots were plowed in fall of 1939, consequently ground cover had to be calculated from stand present at time of plowing.

Twenty-five percent ground cover is considered satisfactory, while 150 plants per square yard is considered a satisfactory stand.

Most of these advantages will continue to be evident until methods of producing, harvesting, processing and drilling native grass seeds are perfected and demonstrated to be of practical use on a farm scale.

Summary

Native grasses are better adapted than other available species for revegetating land in the drier sections of Kansas.

Spreading the mature hay of native grasses on a shallow tilled seedbed with a manure spreader and packing this material in with a subsurface packer has been demonstrated a practical method for revegetating areas in any section of Kansas where native grass pastures will furnish seed material. This method is not well suited to reclaiming large areas of sub-marginal land in southwestern Kansas where transportation of the hay material for long distances is necessary.

This method requires that the native pasture be protected from grazing for at least 75 days prior to the normal date of seed maturity which for most grasses is during the month of September.

Mowing at an optimum stage of maturity, raking and stacking immediately and spreading after at least one winter in the stack has proved the best method of handling the seed hay.

Spreading with a manure spreader late in April or during May on firm fallow or disked stubble land is the most successful method with the common species except western wheat grass, which should be spread in the fall or early spring months.

Spreading the mature hay harvested from one acre of protected native pasture over from one to three acres of cultivated land represents the normal planting range varying for species, favorableness of season, section of country, type of soil, method of harvest and manner of spreading.

Packing with a Campbell type subsurface packer or similar implement immediately after spreading not only anchors the hay material to effect protection against wind and water erosion, but covers the seed at various depths leaving the mulch material in close contact with the seed thereby reducing soil crusting and covering that may result from torrential rains.

Weed growth should be clipped at intervals during the first summer to admit light and to reduce the competition for moisture.

Pasturage must not be expected the first summer after seeding but, if rainfall conditions permit, grazing may usually be practiced after the middle of the second season.

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