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COOPERATIVE EXTENSION WORK  
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STATE OF OKLAHOMA

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Methods of Producing  
High Quality  
Alfalfa and Prairie Hay

K. H. KLAGES AND L. E. HAZEN



**METHODS OF PRODUCING HIGH QUALITY  
ALFALFA AND PRAIRIE HAY**

K. H. KLAGES AND L. E. HAZEN<sup>(1)</sup>

**DEMAND FOR HIGH QUALITY HAY**

The more bulky a product the more valuable it must be per unit if it is to be shipped any distance to market and yield a profit to the producer or shipper. The value of a product over and above freight charges to move it to market, is in direct relationship to its quality. Highest prices are offered only for products of highest quality. This is true especially in a highly competitive market. The freight charges on a product such as hay are based not on the value but on the volume and weight of the material. It is evident then that the profits to be realized are dependent to a great degree on the price obtained above shipping costs.

The freight charge to move a product to market though very important is not the only item of cost entering into the price of producing and marketing of hay. The cost of harvesting is intimately associated with the yield, rather than with the quality of the hay. It costs less per ton to harvest a large than a small crop. On the other hand, it costs no more to harvest hay at a time when with the aid of proper climatic conditions it is possible to produce a high quality product than later at a time when too mature to be made into a high grade hay. In order to produce hay at a profit, it is necessary to grow maximum yields of high grade material.

Not infrequently the market is glutted with low quality hay selling below the cost of production and shipping at a time when there is an active demand for the higher and premium grades of hay at prices yielding substantial profits to producers. Such a condition is pointed out in the following letter from D. B. Tilson, president of the Kansas City Hay Dealers Association:

**KANSAS CITY HAY DEALERS ASSOCIATION**  
733-5-7 Livestock Exchange Bldg.,  
Kansas City, Mo.

Mr. Bradford Knapp, President,  
Oklahoma Agricultural and Mechanical College,  
Stillwater, Oklahoma.

Dear Sir:

As you are probably aware, the Kansas City Hay Dealers' Association adopted the official U. S. hay standards in November, 1927, as the official standards for the Association and on January 3, 1928, Federal hay inspection was inaugurated in the Kansas City market subject to the supervision of the Bureau of Agricultural Economics.

As a result of this act on our part and as a result of the publicity given to the inspection service by the Association and by the Bureau of Agricultural Economics among the dairy feeders of the east north central states and the southern states, an extensive demand has arisen for alfalfa hay of the grades U. S. No. 1 and No. 2 Extra Leafy Alfalfa, U. S. No. 1 Alfalfa, and U. S. No. 2 Leafy Alfalfa to be shipped subject to Federal inspection at Kansas City. During the winter just passed the members of our association have received hundreds of hay orders subject to Federal inspection which we have been unable to fill because of insufficient supplies of high grade alfalfa in our shipping territory. To a certain extent, our inability to originate sufficient supplies of high grade alfalfa to meet these orders is due to the unfavorable weather conditions which prevailed during the hay seasons of 1927.

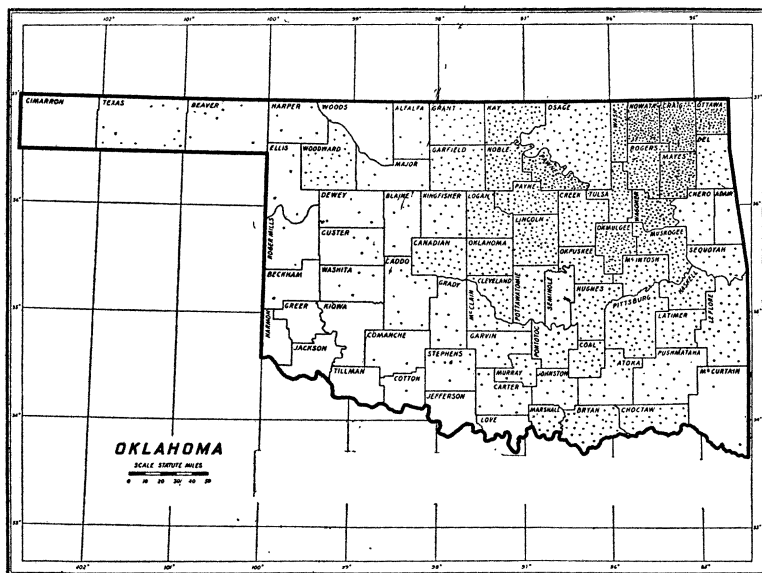
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<sup>(1)</sup> Assistant Professor of Agronomy in charge of Forage Crops and Professor of Agricultural Engineering, respectively.



The production of high grade hay should be of concern not only to producers of market hay but also to those who feed their own hay or to those who sell it to local feeders. The factors coming into play in the grading of hay according to the official United States hay standards are indicative of the actual feeding value. A U. S. No. 1 "Extra Green Alfalfa" hay will be of greater value to the local feeder than a U. S. No. 2 "Alfalfa" or a U. S. No. 3 "Coarse Alfalfa" hay. For that reason it is worth while for producers and shippers as well as feeders to familiarize themselves with the official U. S. hay standards.

Oklahoma produces approximately 400,000 tons of prairie hay on 500,000 acres and approximately the same amount of alfalfa on half the acreage or roughly 250,000 acres. The distribution of the prairie and alfalfa hay producing sections is shown in Figures 1 and 2. It will be noticed from these figures that prairie hay production is centered in the northeastern part of the state while alfalfa hay is produced mainly in the central and southwestern portions of Oklahoma.



Production of Prairie hay. Each dot represents 1000 tons.

### THE UNITED STATES HAY STANDARDS

The United States hay standards comprise standards for six major groups of hay: Group 1, Timothy and Clover Hay; Group 2, Alfalfa and Alfalfa Mixed Hay; Group 3, Prairie Hay; Group 4, Johnson and Johnson Mixed Hay; Group 5, Grass Hay; and Group 6, Mixed Hay. These groups with the exception of Grass Hay and Mixed Hay are based on combinations of hay commonly encountered in the various hay producing sections of the United States. Group 5, Grass Hay, is hay in which grasses other than timothy Johnson grass, upland and midland prairie grasses, or grain cut for hay strongly predominate. Such grass hays for Oklahoma would be hays singly or in combination of Bermuda, Orchard grass, Redtop, Crabgrass, etc. The "Mixed Hay" group comprise mixtures of hay not as common as those given in the various classes of hays in the first five groups. Hay mixtures

that come under the provisions of the group "Mixed Hay" must contain, either singly or in combination, 50 per cent or more of timothy, clover, alfalfa, Johnson grass, upland and midland grasses, or other grasses as defined in the United States standards for hay." There are at the present time no United States standards for such hays as grain hay, soybean, cowpea, peanuts or lespedeza hay.

Since alfalfa and prairie hay constitute the main market hays for the state, grade for them only are given. These grade requirements were taken from the handbook of "Official Hay Standards" prepared by Edward C. Parker, K. B. Seeds and W. H. Horsterman.

### Official United States Hay Standards for Group 2, Alfalfa and Alfalfa Mixed Hay

#### Definitions

For the purpose of the United States standards for alfalfa and alfalfa mixed hay:

Hay shall be the cured, unthreshed herbage which meets the requirements of the various classes in Group II, which has recognized feeding value, which is not coarse and woody, and which does not contain more than 35 per cent of foreign material.

Alfalfa may include not to exceed 10 per cent (of the total hay) of clover, vetches, and other legumes. Alfalfa, however, shall not have a percentage allowance of clover in the class Alfalfa Clover Mixed because in this class the percentage of clover is specifically stated.

Grasses shall be redbud, orchard grass, Kentucky bluegrass, crab-grass, quack-grass, Paspalum, Bermuda grass, wheat-grasses, early cut wild rye, early cut pigeon grass (sometimes called foxtail or wild millet), early cut wild brome grasses such as cheat, and such other cultivated and wild grasses, sedges, and rushes as occur in alfalfa meadows, and may include not to exceed 10 per cent (of the total hay) of timothy, Johnson grass, or early cut grain hay, singly or in combination.

Timothy may include not to exceed 10 per cent (of total hay) of other grasses.

Clover shall be red clover, alsike clover, and white clover.

Johnson grass may include not to exceed 10 per cent (of total hay) of other grasses.

Grain hay shall be early cut hay of the grains, oats, barley, wheat, rye, and wild oats, singly or in combination, and may include not to exceed 10 per cent (of total hay) of other grasses.

Foreign material shall be weeds, matured wild brome-grasses such as cheat, matured pigeon grass (sometimes called foxtail or wild millet), wire-grasses (*Aristida* spp.) and such sedges, rushes, and other plants as are coarse and woody or otherwise not suitable for feeding purposes; also corn-stalks, grain straw, stubble, chaff, and other objectionable matter which occurs naturally in hay.

Injurious foreign material shall be sand burs, poisonous plants, harsh bearded grasses such as matured squirreltail grass (*Hordeum jubatum*), matured wild barley (*Hordeum murinum*), and matured little barley (*Hordeum pusillum*), and other matter which is injurious when fed to livestock.

Green color.—The term "per cent green" employed in these standards represents the amount of green color (green appearance) in field-cured hay computed as a percentage of the 100 per cent green color of hay produced so as to have received no discoloration from maturity, sun bleach, dew, rain, or other damage.

Note.—Field-cured alfalfa hay which, on casual examination, appears to be of uniform green color, nearly always contains slight discolorations which materially lower the amount of green color from the perfect color standard.

## Group 2.—Alfalfa and Alfalfa Mixed Hay

CLASS REQUIREMENTS		GRADE REQUIREMENTS			
Class	Mixture Percentages	U. S. Grade No.	Leafiness of Alfalfa (per cent leaves)	Per Cent Green Color	Maximum per cent foreign material
Alfalfa	Alfalfa with not over 5 per cent grasses	1.....	40 or more .....	60 or more .....	5
		2.....	25 or more .....	35 or more .....	10
		3.....	Less than 25 <sup>1</sup> .....	Less than 35 <sup>1</sup> .....	15
Alfalfa Light Grass Mixed	A mixture of alfalfa and grasses with over 5 per cent but not over 20 per cent grasses.	1.....	40 or more .....	60 or more .....	5
		2.....	25 or more .....	35 or more .....	10
		3.....	Less than 25 <sup>1</sup> .....	Less than 35 <sup>1</sup> .....	15
Alfalfa Heavy Grass Mixed	A mixture of alfalfa and grasses with over 20 per cent but not over 60 per cent grasses.	1.....	.....	60 or more .....	5
		2.....	.....	35 or more .....	10
		3.....	.....	Less than 35 <sup>1</sup> .....	15
Alfalfa Light Timo- thy Mixed	A mixture of alfalfa and timothy with over 5 per cent but not over 30 per cent timothy.	1.....	40 or more .....	60 or more .....	5
		2.....	25 or more .....	35 or more .....	10
		3.....	Less than 25 <sup>1</sup> .....	Less than 35 <sup>1</sup> .....	15
Alfalfa Heavy Timo- thy Mixed	A mixture of alfalfa and timothy with over 30 per cent alfalfa and over 30 per cent timothy.	1.....	.....	60 or more .....	5
		2.....	.....	35 or more .....	10
		3.....	.....	Less than 35 <sup>1</sup> .....	15
Alfalfa Clover Mixed	A mixture of alfalfa and clover with over 10 per cent but not over 50 per cent clover and not over 10 per cent grasses.	1.....	40 or more .....	60 or more .....	5
		2.....	25 or more .....	35 or more .....	10
		3.....	Less than 25 <sup>1</sup> .....	Less than 35 <sup>1</sup> .....	15
Alfalfa Light Johnson Mixed	A mixture of alfalfa and Johnson grass with over 5 per cent but not over 30 per cent Johnson grass.	1.....	40 or more .....	60 or more .....	5
		2.....	25 or more .....	35 or more .....	10
		3.....	Less than 25 <sup>1</sup> .....	Less than 35 <sup>1</sup> .....	15
Alfalfa Heavy John- son Mixed	A mixture of alfalfa and Johnson grass with over 30 per cent alfalfa and over 30 per cent Johnson grass.	1.....	.....	60 or more .....	5
		2.....	.....	35 or more .....	10
		3.....	.....	Less than 35 <sup>1</sup> .....	15
Alfalfa Light Grain Mixed	A mixture of alfalfa and grain hay with over 5 per cent but not over 20 per cent grain hay.	1.....	40 or more .....	60 or more .....	5
		2.....	25 or more .....	35 or more .....	10
		3.....	Less than 25 <sup>1</sup> .....	Less than 35 <sup>1</sup> .....	15
Alfalfa Heavy Grain Mixed	A mixture of alfalfa and grain hay with over 40 per cent of alfalfa and over 20 per cent of grain hay.	1.....	.....	60 or more .....	5
		2.....	.....	35 or more .....	10
		3.....	.....	Less than 35 <sup>1</sup> .....	15
All Classes		Sample grade.	Hay of the above classes which contains more than 15 per cent foreign material, or which contains more than a trace of injurious foreign material, or which has any objectionable odor, or which is heating, hot, wet, moldy, musty, caked, badly weathered, badly overripe, or otherwise of distinctly low quality.		

<sup>1</sup> Does not apply to hay graded No. 3 on account of any other factor.

Thus the 60 per cent green color standard for No. 1 alfalfa represents an amount of color that is relatively high for field-cured hay.

Percentages.—The standards for mixture percentages and foreign material are based upon percentages by weight of the total hay. The standards for leafiness are based upon percentages by weight of the alfalfa. The standard for coarse hay is based upon percentage by count of the alfalfa plants. Measurements to determine diameters are made approximately 2 inches from the cut ends of the stalks. The standards for color are based upon color determinations ascertained by the method prescribed by the United States Department of Agriculture, which determinations are expressed in popular terms as "per cent green."

#### **Special Grades to Supplement Numerical Grades in Group 2.**

Grades for extra leafy hay.—Hay of any numerical grade of the classes Alfalfa, Alfalfa Light Grass Mixed, Alfalfa Light Timothy Mixed, Alfalfa Clover Mixed, Alfalfa Light Johnson Mixed, and Alfalfa Light Grain Mixed in Group II, in which the leafiness of the alfalfa is 50 per cent or more with most of the leaves clinging, and which does not contain more than 10 per cent foreign material, shall have the words "Extra Leafy" included in and made a part of the grade designation, as: "U. S. No. 1 Extra Leafy Alfalfa," "U. S. No. 2 Extra Leafy Alfalfa Light Grass Mixed."

Grades of leafy hay.—Hay of the grades 2 and 3 of the classes Alfalfa, Alfalfa Light Grass Mixed, Alfalfa Light Timothy Mixed, Alfalfa Clover Mixed, Alfalfa Light Johnson Mixed, and Alfalfa Light Grain Mixed in Group II, which has less than 60 per cent green color, in which the leafiness of the alfalfa is 40 per cent or more, and which does not contain more than 10 per cent foreign material, shall have the word "Leafy" included in and made a part of the grade designation, as "U. S. No. 2 Leafy Alfalfa," "U. S. No. 3 Leafy Alfalfa."

Grades for extra green hay.—Hay of any numerical grade of any of the classes in Group II which has 75 per cent or more green color, and which does not contain more than 10 per cent foreign material, shall have the words "Extra Green" included in and made a part of the grade designation, as "U. S. No. 1 Extra Green Alfalfa."

Grades for green hay.—Hay of the grades 2 and 3 of the classes Alfalfa, Alfalfa Light Grass Mixed, Alfalfa Light Timothy Mixed, Alfalfa Clover Mixed, Alfalfa Light Johnson Mixed, and Alfalfa Light Grain Mixed in Group II, in which the leafiness of the alfalfa is less than 40 per cent, which has 60 per cent or more green color, and which does not contain more than 10 per cent foreign material, shall have the word "Green" included in and made a part of the grade designation, as: "U. S. No. 2 Green Alfalfa," "U. S. No. 3 Green Alfalfa."

Grades for coarse hay.—Hay of any numerical grade of and of the classes in Group II, in which the alfalfa stalks are hard and round, and more than 30 per cent of the alfalfa stalks have diameters equal to and greater than the diameter of No. 11 steel wire (approximately twelve one-hundredths of an inch) by steel wire gage standards, shall have the word "Coarse" included in and made a part of the grade designation, as: "U. S. No. 2 Coarse Alfalfa," "U. S. No. 2 Coarse Alfalfa Heavy Timothy Mixed."

#### **Definitions**

For the purpose of the United States standards for prairie hay:

Hay shall be the cured herbage which meets the requirements of the various classes in Group III, which has recognized feeding value, which is not coarse and woody, and which does not contain more than 35 per cent of foreign material.



Upland grasses shall be bluestem (*Andropogon* spp.), grama grasses (*Bouteloua* spp.), Paspalum (*Paspalum* spp.), prairie June-grass (*Koeleria cristata*), Indian grass (*Sorghastrum nutans*), and other grasses which grow commonly in upland virgin prairie meadows. Upland grasses may include not to exceed 10 per cent (of the total hay), singly or in combination, of midland grasses or other grasses. Upland grasses, however, shall not have a percentage allowance of midland grasses in the classes Midland Prairie and Upland-Midland Prairie Mixed because in these classes the percentage of midland grasses is specifically stated.

Midland grasses shall be slough-grass (*Spartina michauxiana*), bluejoint (*Calamagrostis* spp.), sprangle top (*Fluminea fastucacea*), and reed canary-grass (*Phalaris arundinacea*).

Wheat-grass shall be that grass most commonly called western wheat-grass (*Agropyron smithii*) but occasionally known locally as bluestem, bluejoint, Colorado bluestem, alkali-grass, salt-grass, or western rye-grass.

Other grasses shall be rushes, sedges, and cultivated grasses such as timothy, redtop, and bluegrass.

Legumes shall be vetches, sweet clover, and other leguminous plants which occur in prairie meadows.

Foreign material shall be weeds, wire-grasses (*Aristida* spp.), and such sedges, rushes, and other plants as are coarse and woody or otherwise not suitable for feeding purposes; also other objectionable matter which occurs naturally in hay.

Injurious foreign material shall be sand burs, poisonous plants, harsh bearded grasses such as matured Stipa (*Stipa* spp.), with the needles attached, matured squirrel tail grass (*Hordeum jubatum*), and other matter which is injurious when fed to livestock.

Green color.—The term "per cent green" employed in these standards represents the amount of green color (green appearance) in field-cured hay computed as a percentage of the 100 per cent green color of hay produced so as to have received no discoloration from maturity, sun bleach, dew, rain, or other damage.

Percentages.—The standards for mixture percentages and foreign material are based upon percentages by weight of the total hay. The standard for coarse hay is based upon percentage by count of the grass plants. Measurements to determine diameters are made approximately 2 inches from the cut ends of the stalks. The standards for color are based upon color determinations ascertained by the method prescribed by the United States Department of Agriculture, which determinations are expressed in popular terms as "per cent green."

Grades for extra green hay.—Hay of the grades 1 and 2 of any of the classes in Group III which has 75 per cent or more green color shall have the words "Extra Green" included in and made a part of the grade designation, as: "U. S. No. 1 Extra Green Upland Prairie."

Grades for coarse hay.—Hay of any numerical grade of any of the classes in Group III in which more than 30 per cent of the grass stalks have diameters equal to and greater than the diameter of No. 11 steel wire (approximately twelve one-hundredths of an inch) by steel wire gage standards, shall have the word "Coarse" included in and made a part of the grade designation, as: "U. S. No. 2 Coarse Upland Prairie."

#### Prescribed Notations to Supplement Grade Designations

Ordinarily the grade designation is the only written evidence of the kind and quality of the hay which appears on a Federal certificate. The full meaning of the grade designation must be determined from the standards and the

Group 3—Prairie Hay

GRADE REQUIREMENTS <sup>1</sup>		CLASS REQUIREMENTS		
Class	Mixture Percentages	U. S. grade No.	PER CENT GREEN COLOR	Maximum per cent foreign material
Upland Prairie ...	Upland grasses with not over 10 per cent legumes.	1.....	60 or more .....	10
		2.....	35 or more .....	15
		3.....	Less than 35 <sup>2</sup> .....	20
Wheat-grass .....	Wheat-grass with not over 20 per cent upland grasses and 10 per cent legumes.	1.....	60 or more .....	10
		2.....	35 or more .....	15
		3.....	Less than 35 <sup>2</sup> .....	20
Midland Prairie ..	Midland grasses of a mixture of midland grasses with upland and or other grasses, with over 40 per cent midland grasses.	1.....	60 or more .....	10
		2.....	35 or more .....	20
Upland-Midland Prairie Mixed	A mixture of upland and midland grasses with over 10 per cent but not over 40 per cent midland grasses and not over 10 per cent legumes.	1.....	60 or more .....	10
		2.....	35 or more .....	20
		3.....	Less than 35 <sup>2</sup> .....	25
All classes .....		Sample grade.	Hay of the above classes which does not meet the requirements of the numerical grades, or which contains more than a trace of injurious foreign material, or which has any objectionable odor, or which is heating, hot, wet, moldy, musty, caked, badly stained, badly weathered, badly overripe, or otherwise of distinctly low quality.	

<sup>1</sup>Hay that is stained shall not be graded higher than No. 3.  
<sup>2</sup>Does not apply to hay graded No. 3 account of foreign material.

definitions accompanying the standards. Certain important exceptions are provided for, however, where explanatory statements are considered valuable to show the reasons why a certain grade was assigned, or, in some instances, to provide information that supplements the grade designation. For these purposes notations are prescribed which appear on Federal certificates with reference to foreign material and Sample grade.

Foreign material notations.—In the application of United States standards the grade of any lot of hay may be lowered on the basis of the percentage of foreign material irrespective of other grading factors. A lot of clover hay, for example, may meet the requirements of the No. 1 grade as to color yet be graded No. 2 on account of containing 15 per cent foreign material. Another lot of clover hay is graded No. 2 because it contains 15 per cent foreign material, also because it has No. 2 color. Both lots of hay are graded U. S. No. 2 Clover yet the first lot is of more value than the second.

In cases where hay is graded down on account of foreign material only, Federal inspectors are required to write a notation to that effect on the certificate. Thus for the first lot of clover hay previously described the certificate would read: "U. S. No. 2 Clover (Account foreign material)" thereby indicating that the grade was made only on account of the foreign material. Whenever a foreign material notation appears on a certificate, therefore, it indicates that the hay would be entitled to a higher grade but for the foreign material.

Sample grade notations.—In all United States standards hay is graded U. S. Sample grade that, for one reason or another, is not good enough for the numerical grades. It includes sound hay that contains excessive amounts of foreign material, sound hay that is badly overripe or badly weathered, and unsound hay that is musty or moldy. Thus the character and quality of U. S. Sample grade hay vary greatly and notations are prescribed to state the reasons for assigning this grade and such other facts as may be necessary to describe the quality of the hay.

When hay is graded U. S. Sample grade, Federal inspectors are required to show on certificates (1) that the hay is U. S. Sample grade, (2) the class of the hay; thereafter in parenthesis (3) the reasons for assigning Sample grade, and (4) the otherwise grade for all hay that is sound or that can be reconditioned. For example: U. S. Sample grade Clover (Account foreign material, otherwise U. S. No. 2); U. S. Sample grade Alfalfa (Heating, otherwise U. S. No. 1); U. S. Sample grade Timothy (Musty and moldy); U. S. Sample grade Timothy Light Grass Mixed (Badly overripe); U. S. Sample grade Timothy (Badly stained).

#### APPLICATION OF THE GRADES AND GRADING FACTORS

It will be noticed from the grade requirements that only two factors are employed to determine the numerical grade of prairie hay, namely, color and foreign material. In alfalfa hay an additional factor is employed, namely, leafiness. There are of course other factors as pointed out that may throw hay into sample grade. But for the determination of the numerical grade in alfalfa and alfalfa mixed hay only three factors are used to determine the numerical grade of the hay. These are leafiness, color, and foreign material. The class of the hay, that is, whether it is to be graded as alfalfa or alfalfa heavy Johnson mixed is determined by the particular mixture of which the hay is made up. Leafiness is not a grading factor in the classes Alfalfa heavy grass, timothy, Johnson or alfalfa heavy grain mixed hays.

There are three numerical grades for all classes of hay for the five respective groups of hay but for the class Midland Prairie for which there are but two numerical grades.

"U. S. No. 1 Alfalfa" must have at least 40 per cent, by weight of the alfalfa, of leaves, 60 per cent or more of green color and not in excess of 5 per cent of foreign material. If such a hay has only 35 per cent of leaves or less than 60 per cent of green color or 7 per cent of foreign material, it would grade "U. S. No. 2 Alfalfa." If it had 12 per cent of foreign material, it would grade "U. S. No. 3 Alfalfa."

Where the alfalfa has 50 per cent or more of leaves with most of the leaves clinging and does not have more than 10 per cent of foreign material, it is given the special grade "U. S. No. 1 Extra Leafy Alfalfa." If in this lot of alfalfa the color drops down below 60 per cent, it falls down to grade No. 2. Yet with other qualifications remaining as above, it would be designated as "U. S. No. 2 Extra Leafy Alfalfa."

The special grade "Extra Green" is applied when the per cent of green color comes up to or exceeds 75. In alfalfa, "U. S. No. 1 Extra Green Hay" or any grade of green alfalfa cannot contain more than 10 per cent of foreign material. The designation "U. S. No. 3 Green Alfalfa" implies that the hay has less than 25 per cent of leaves, therefore, grade No. 3; not in excess of 10 per cent of foreign material, that is, not in excess of the requirements for grade No. 2 but that it has 60 per cent or more of green color, the color is high enough for the requirements of grade 1.

Alfalfa hay having more than 30 per cent of round hard stems equal to and greater than the diameter of No. 11 steel wire (size of a 6 penny nail) has the word "Coarse" included in and made a part of the grade designation, as: "U. S. No. 1 Coarse Alfalfa." In cases where the stems of the alfalfa are flattened in baling, the special notation "Coarse" cannot be applied to the hay. Measurements of the stems are made two inches from the cut surface.

The following table gives examples of the application of the grading factors in alfalfa hay:

Number	Per Cent of Leafiness	Color of Alfalfa	MIXTURE PERCENTAGES					Foreign Material	GRADE AND CLASS
			Alfalfa	Other Grasses	Johnson Grass	Other Legumes	Foreign Material		
1	42	60	92	4			4	U. S. No. 1 Alfalfa	
2	30	50	82	1	4		8	U. S. No. 2 Alfalfa	
3	45	65	86	10			4	U. S. No. 1 Alfalfa Light Grass Mixed	
4	41	40	92	4			4	U. S. No. 2 Leafy Alfalfa	
5	50	20	90	2			8	U. S. No. 3 Extra Leafy Alfalfa	
6	25	35	65	5	15		14	U. S. No. 3 Alfalfa Light Johnson Mixed	
7	24	61	90	3			7	U. S. No. 3 Green Alfalfa	
8	40	76	97	1			2	U. S. No. 1 Extra Green Alfalfa	
9	35	60		20		5	5	U. S. No. 2 Alfalfa Heavy Grass Mixed	
10	40	50	80	4			1	U. S. No. 2 Mixed Hay	
11	41	60	81	2			17	U. S. Sample grade Alfalfa (Account foreign material, otherwise U. S. No. 1)	
12	35	40	92	4			4	U. S. Sample grade Alfalfa (Heating, otherwise U. S. No. 2)	

## CULTURAL METHODS FOR THE PRODUCTION OF HIGH GRADE ALFALFA HAY

The three grading factors employed in the grading of alfalfa hay are as has been pointed out, leafiness, color and foreign material. The last factor is especially influenced by the cultural methods employed as is also the amount of grass in the hay. It must be kept in mind that the class alfalfa as such has an allowance of only 5 per cent of grass. The first prerequisite for the production of a high grade hay is a good uniform and pure stand. Establishing and maintaining a good stand of alfalfa does much to keep the hay within the confines of the qualifications for foreign material for grade 1 and to keep the admixture of grasses down to a minimum so that the hay may be classified as alfalfa rather than alfalfa light grass or alfalfa heavy grass mixed.

Alfalfa may be sown either in late summer and early fall or else early in spring. On bottom lands inclined to be weedy fall seeding is more desirable than spring seeding. On the other hand, a considerable hazard in the form of winterkilling is encountered in the case of fall seeding on exposed uplands especially when such seeding is delayed till too late in the season.

The optimum time for the fall seeding of alfalfa is late in August or early in September. But unless conditions are such as to insure prompt germination at that time, it is best to wait till later in the season. If rains fail to come before the middle of September, it is best in the northern part of the state to delay seeding until the following spring. It is essential that the young seedlings be given an opportunity to establish themselves before the coming of cold weather. Unless the seedlings are able to make some growth during the warmer fall days, they are very likely to be killed during the winter. For that reason, fall seeding should not be delayed beyond the dates indicated. In the extreme southern part of the state alfalfa may be sown till late in September but even there early seedings are to be preferred.

The best time for the spring seeding of alfalfa is from the latter part of February in the southern part of the state to the end of March in the central and northern parts. In the northern part of the state, nothing is to be gained by planting before the middle of March. The young seedlings of alfalfa are very tender. A frost soon after they come up will do considerable damage. Seeding after the first week in April will not give the young plants sufficient time to properly establish themselves before the coming of dry hot weather in summer.

The usual rate of seeding is 15 pounds per acre.

Where alfalfa has not before been grown on the land, it is best to resort to artificial inoculation. Inoculating material may be obtained from most seed houses at a moderate cost.

It is advisable to seed alfalfa alone rather than with a nurse crop such as wheat or oats. Climatic conditions in the central and western parts of Oklahoma are often such as not to allow for the growth of two crops at the same time. The young alfalfa seedlings are at a marked disadvantage in competing for moisture with the ranker growing cereals. Even though stands of alfalfa may in favorable seasons be obtained with the use of a nurse crop, the yield the second season of alfalfa so started will be less than where started without a nurse crop. Such yields may be reduced as much as two tons per acre.

In the eastern part of the state, stands of alfalfa are more easily obtained with the use of a nurse crop than in the central and western parts. But,

even in this section, the young plants are weakened by having to compete for moisture and light. Too many producers are of the opinion that they will lose a whole crop by seeding alfalfa alone. This is not the case. Alfalfa, if planted alone, will under favorable conditions, yield a light crop of hay the first season. Young stands of alfalfa should, however, not be cut the first season till they reach the full flowering stage. At times the presence of weeds may make clipping necessary. In that event, the mower should be set high so as to do little damage to the alfalfa. The partial crop of hay from young alfalfa the first season together with the better growth obtained from these plants the second season more than makes up for the lack of a grain crop for the season that the alfalfa is started. But above all, the great advantage of seeding without a nurse crop is that a good uniform stand may be expected; if a nurse crop is made use of the hazards involved in securing a profitable stand are greatly increased.

If alfalfa is to be sown with a nurse crop, it is necessary to reduce the rate of seeding of that crop to one-half the usual rate. This will give the alfalfa seedlings some chance to survive.

Some of the soils in the central and western part of the state are too shallow to enable alfalfa to become an important crop on them. This same condition is found in some soils in the eastern portion of the state. Some of the soils in the eastern part of the state are too acid for the production of alfalfa. Samples of soil sent to the state Agronomy Department of the A. and M. College, Stillwater, for acidity tests will be tested free of charge. If the soil in question is found to be acid, recommendations can be made on the basis of the test as to the amount of ground limestone required to make it suitable for the production of alfalfa.

The main requirement of a good seedbed for alfalfa is firmness. A firm seedbed provides the necessary close contact between the small alfalfa seeds and the soil particles. This is essential for the absorption of water by the seed and for the proper establishment of the first roots produced by the young seedling. Early plowing will serve to bring about a proper connection between the surface and the subsurface soil which is necessary for the uninterrupted movement of moisture from the lower levels of the soil to the feeding zone of the young plants.

There is no substitute for early plowing in providing a firm, mellow seedbed. Fields to be sown to alfalfa in spring should be plowed in fall or winter. For fall seeding, also, the ground should be plowed for some time in advance of seeding. Where alfalfa follows such cultivated crops as soybeans or cowpeas, disking will, when the ground has been cultivated, serve to make a better seedbed than could be obtained by plowing since it will leave the soil in a firmer condition.

Alfalfa meadows in which the stand of alfalfa has become thin should be plowed up. The hay produced on such a meadow would at best classify as alfalfa light of heavy grass mixed. Considerable difficulty may be found in keeping the percentage of foreign material down so that the hay may be graded U. S. No. 1. After such a field has been plowed up, it should not be reseeded to alfalfa for several years. It is poor practice to keep the same area in alfalfa continually. It is good practice to plow up old alfalfa fields at times to grow some cash crop on them for several years and in that way realize on the fertility stored in the soil by the alfalfa.

The length of time that an alfalfa field may last and give profitable returns is dependent on local conditions. Thus, a field will last longer on good fertile bottomland well supplied with moisture than on shallower, drier

upland soils. In the eastern part of the state fields may become infested with grasses and weeds to the extent that it is not best to leave the field in alfalfa more than five years. In the western part of the state, stands of alfalfa may be maintained on fields with favorable soil conditions for longer periods. But even there it will be found profitable to grow alfalfa in a long time rotation.

### CULTURAL METHODS FOR THE PRODUCTION OF HIGH GRADE PRAIRIE HAY

The greatest difficulty encountered in the production of a high grade of prairie hay is that of keeping the percentage of foreign material within the confines set by grade No. 1. If the percentage of foreign material is to be kept down below 10 per cent it is above all necessary to have and to so manage the meadow as to retain a good uniform stand of the native grasses.

Before coming to the question of how to control weeds and undesirable plants on native grassland, it will be well worth while to consider the reasons responsible for the development of a weedy growth. Weeds grow in competition with the grass. Any condition serving to reduce the vitality of the grass places it at a disadvantage in the struggle with competitors. Weeds may be spoken of as accumulative plants. That is, after they once get a foothold they will keep on spreading and cause more and more damage unless they are kept down or unless conditions leading to their development are removed.

The development of a weedy growth on native grassland is a definite indication of faulty management. Under natural conditions, that is, where grasses are allowed to grow to maturity, to drop their seeds, and then to decay to add humus to the soil, weeds do not develop. The reason for that is that the grasses are under such conditions vigorous enough to hold the upper hand in the struggle for existence. It is evident then that one of the main essentials necessary to keep a native grassland meadow free from weeds and at a high state of production is to keep up the organic matter content of the soil. Any condition leading to a destruction of this most valuable material must be avoided.

One of the greatest agencies of destruction of organic matter is the yet altogether too common practice of burning off of native grasslands. The burning off of grassland is excusable only under special conditions. Where a meadow has not been cut the previous year there may be a considerable accumulation of dead stems and leaves which would serve to increase the percentage of foreign material and injure the color of the hay at the next harvest. If hay from such a meadow is to be sold under the U. S. standards it is necessary to remove the dead material in order to secure a high grade. Where the meadow has been cut the previous year even though some growth took place after the time of harvesting it should not be necessary to resort to burning. In cases where the hay is to be fed on the farm burning is never justifiable for under those conditions the remains of a previous season's growth would not interfere with the intrinsic value of the hay.

Where burning is resorted to it is by all means necessary to select a windy day so that the fire may sweep rapidly over the area, and if possible a day when the ground is moist. A slow fire on a dry soil results in great loss of organic matter in the soil.

### TIME FOR CUTTING ALFALFA HAY

Both leafiness and color in alfalfa is greatly influenced by the stage of maturity at which the hay is cut. Alfalfa hay to contain 40 per cent of leaves cannot be cut at too late a stage. On the other hand, alfalfa may be cut too early for the best of the stand. Experimental results have shown very definitely that cutting at the bud and early flowering stages has a detrimental effect on the alfalfa plants. Continual early cutting may lower the vitality of the plants to such an extent that it will render the stand unprofitable in a comparatively short period of time. The practice of cutting extremely late in the season is also detrimental. For best results, the alfalfa plants should be allowed to make a growth of several inches before the advent of low temperatures in the fall. Such a growth is essential to the maintenance of a strong and vigorous stand.

Alfalfa is best cut when one-tenth to one-fourth is in bloom. At that time the field will have a well defined blue to purple cast.

Alfalfa to produce hay of the special grade "Extra Leafy" must be cut at the bud or early flowering stages. Under favorable climatic conditions and with proper handling no difficulty should be encountered in the making of a "U. S. No. 1 Alfalfa" hay when cut at the one-fourth bloom stage. Alfalfa cut later than that stage loses its leaves and becomes woody. It must always be kept in mind that leafiness is the most important grading factor. The leaves of alfalfa contain approximately 70 per cent of the crude protein of the plant. Leafiness influences the actual feeding value of alfalfa more than any other factor. It is for that reason that the market is able to pay a premium for "Leafy" hay.

### TIME FOR CUTTING PRAIRIE HAY

Native grasses have the tendency to turn brown with the coming of maturity or from dry weather. The presence of brown and reddish-brown leaves at the base of the plants reduces the color of the hay greatly. The hay must for that reason be cut before this takes place. If such grasses as the bluestems are allowed to approach maturity, the stems become coarse. Hay made from such mature grasses would be likely to grade "Coarse" as well as lack of sufficient color for the No. 1 grade.

### CURING OF ALFALFA HAY

Two grading factors are greatly affected by the methods employed in the curing of alfalfa hay. These are leafiness and color. The leaves of alfalfa hay dry out more rapidly than the stems. As a result they become brittle and drop off when the hay is handled. This condition necessitates that most of the handling of the hay be done while the leaves are still flexible. A long period of exposure of hay in the swath will serve to reduce the color by bleaching.

Due to these factors alfalfa hay should be raked within a few hours of the time of cutting. It is well to have the leaves wilted but not brittle at the time of raking. The main problem in hay making is to reduce the water content of the cut material from around 75 per cent to about 15 per cent as rapidly as possible. The more rapidly this is done, the less are the climatic hazards. Allowing the hay to lay in the swath will accomplish this most rapidly but losses incident to such a practice are too great to allow its utilization. If some wilting is allowed to take place in the swath, the per cent of moisture in the cut material can be reduced rapidly. But the hay must be raked before the leaves become too dry. Where a side delivery rake



is used, the hay may be raked immediately after cutting. This is due to the fact that the hay is not closely packed as with the ordinary hay rake.

Allowing most of the curing of the hay to take place in the windrow or better yet in the cock, serves to reduce the surface exposed to the elements. Even in the windrows and in the cock there is danger of overcuring. The hay should not be allowed to dry to the extent that it becomes brittle and harsh. Operations must be planned so that either baling or stacking can be done at the time that the hay is dry enough.

### CURING OF PRAIRIE HAY

Since the loss of leaves is not a factor in prairie hay, it does not demand the degree of care as does alfalfa hay. The main source of loss with this type of hay is bleaching resulting from excessive exposure in the swath. Prairie hay for best results should be raked shortly after cutting.

### THE USE OF HAYING MACHINERY

There are three working factors in producing hay that enter primarily into both cost of production and quality of product. They are (a) speed, (b) manipulation, and (c) storage.

These three factors are matters of machinery and field methods and as such are discussed briefly from a mechanical and managerial standpoint. The time during which a plant is in the proper stage of maturity for the best hay is very short and the readiness with which cutting can be accomplished so as to arrest over-ripening determines quite largely the uniformity of the crop as a marketable product. For this reason mowing must be accomplished rapidly, and the gathering processes follow in swift succession in this race against time. The use of six and seven foot cutterbars on mowers, and the use of tractors as power units greatly accelerates this part of the work. It is best to cut hay in the morning and late in the afternoon rather than during the hottest portion of the day due to the fact that transpiration can continue removing water from the stem through unwilted leaves. If the leaves wilt quickly their ability to transpire moisture ceases and the stems retain a larger portion of sap than is desirable for the best quality hay. A quick wilting of the leaves also causes them to shatter more readily and under the influence of the sun to turn from a bright green to a brown or yellow color.

Now the curing of hay depends on the circulation of air past the leaves while they are yet in condition to transpire moisture, and it should be noted at this time that the handling of leafy crops such as alfalfa and peas is different from the grasses such as prairie grass or sudan. The loss of food material in the shattered leaves from alfalfa or peas represents a considerable per cent of the total, while such losses do not occur in the case of prairie hay. For this reason the description of the machine methods will be divided into those for leafy hay or clover and the other into the grassy hays such as sudan.

It is an adage often applied in the drier sections of our country that the sun should never touch a wilted leaf. For this reason rapid raking is advisable in order to minimize sun bleaching and loss of leaves. The leaves should be laid in windrows with the butts of the stems outward. For this purpose there is no implement surpassing the side delivery rake. It has no dumping action to retard its rapidity of movement as has the sulky rake so frequently used. The time during which the hay should lay in the windrows depends upon air currents, ground moisture, and temperature. In case of

rain it may be necessary to turn the windrows because of the moisture which will collect in the surface of the ground.

It should be noted at this time that there are two classes of hay loaders. The first lifts the hay from the windrows by means of one or two cylinders revolving so as to bring the teeth in gentle contact with the hay and lift it into an endless belt which conveys it to the wagon. This is the type best adapted to handling of leafy material which is easily shattered. The other type consists of rakes driven from cranks and the hay is gathered from the swath or windrow by these rakes and elevated by successive strokes. The rake type machine will handle much heavier material than will the former and is therefore well adapted to cane, sudan, and other rank growing, stemmy crops.

Field stacking of alfalfa, while sometimes resorted to, is usually fraught with considerable weather hazard, due to the fact that these hays "take" water very readily from rain. For this reason it is best to place the hay under shelter.

The methods of removing hay from the wagon at the barn fall into two classes. The most rapid being the use of slings, while the other method, the use of harpooned forks, is a favorite where light building construction makes the heavier track support out of the question.

We are illustrating four different steps in the process of putting up alfalfa. In the first the tractor mower equipped with an eight-foot cutter bar is illustrated. (Fig. 3). Such a tractor may be equipped with headlights and extra sickles so that work may continue uninterruptedly. The second illustration (Fig. 4) depicts the side-delivery rake which is, under most conditions, the easiest and most economical method of raking alfalfa hay. In the third is the hay loader (Fig. 5) taking hay from the windrows.

It is very important that all hand labor be reduced to a minimum. For this reason a very wide hay barn should be equipped with two tracks rather than one because of the difficulty in pitching the hay into the space near the walls.

The production of our native hay such as prairie involves a somewhat different method of procedure. Such hay is tougher cutting thus requiring a more frequent sharpening of sickles, but the quality of hay is not so dependent upon the time of cutting, the very dry nature of the stems making midday cutting entirely feasible. Prairie hay should be raked very quickly after the mower during the midday hours, usually within two hours after cutting, and probably not exceeding four hours, for the cuts made earlier or later. Such hay is somewhat difficult to handle with a side-delivery rake and in many cases it is best to resort to wide sulky rakes for putting the swathed material into windrows. The time that the hay remains in the windrows should be short. The bull rake or hay sweep may be used for bringing the windrows to the stack. Owing to the fact that most of these grass hays shed water quite readily, field stacking is feasible. The hay may be placed in stacks and temporarily protected by canvas covers in case of wet weather and as soon as the field processes have been completed baling from these stacks is in order. If it were not for the necessity of cutting, raking, and stacking within a very short period of time, baling could very well be done from the windrows, a practice used to good effect by farmers having small acreages. Where baling can be done in this way the cost of stacking can be eliminated. The quality of prairie hay depends not only on the time of cutting but upon the careful protection of the hay prior to baling. All of the grass hays are especially susceptible to white mold which gives a peculiar

and unpleasant odor. This is caused by rain entering the unprotected portions of the stack and seeping down in the center.

When hay is baled, care must be taken to exclude any weather damaged hay from the outside of the stack. Flakes of such damaged hay from the sides of the stack or from the bottom may injure the color materially.

A great deal of our baling is still done by horse power but the ready ease and rapidity with which the engine driven baler can turn out the work makes these machines entirely economical for all except very small growers.

There is a tendency to increase the size of the bales. The market showing a preference for from 90 to 110 pound bales as compared to the 70 to 80 size very generally produced. To the producer these larger bales are thoroughly desirable because they reduce the cost of wiring and the handling charge, requiring, however, a somewhat heavier baling equipment than is used for smaller bales. Bales are very readily stacked by the use of a horse or engine trolley and grapple, thus doing away with the old back breaking job of carrying them onto the pile. These grapples can be set up with a three pole derrick and moved from place to place in a few minutes time.

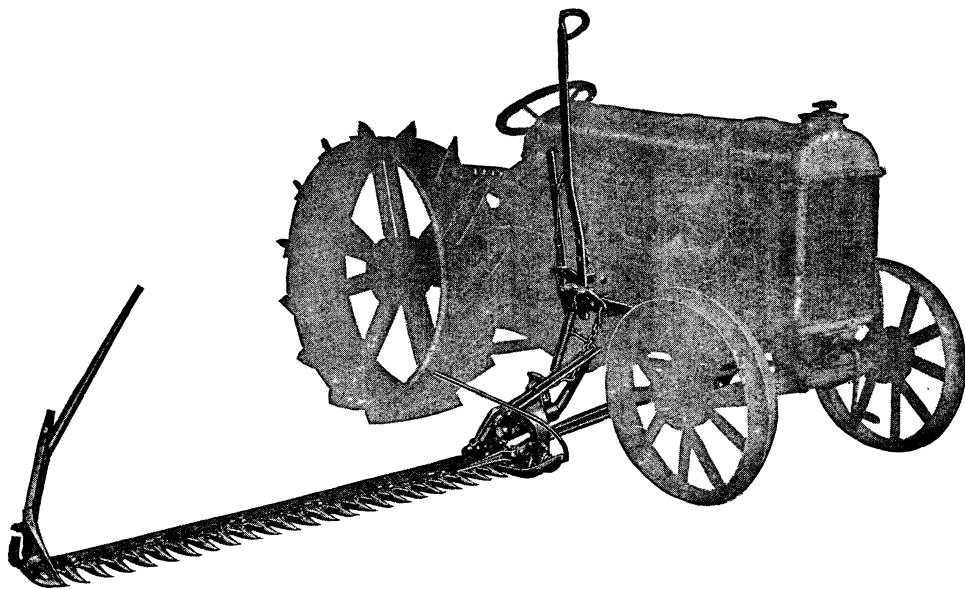


FIGURE 3.—Tractor mower equipped with an eight foot cutter bar. Equipment of this type will serve to speed up the cutting of the hay crop.



FIGURE 4.—Side delivery rake in action. This implement is especially adapted to handle alfalfa hay. Hay put into windrows by a side delivery rake has the cut stems on the outside. The leaves are protected and the hay is in open, well aerated rows where it can cure rapidly.

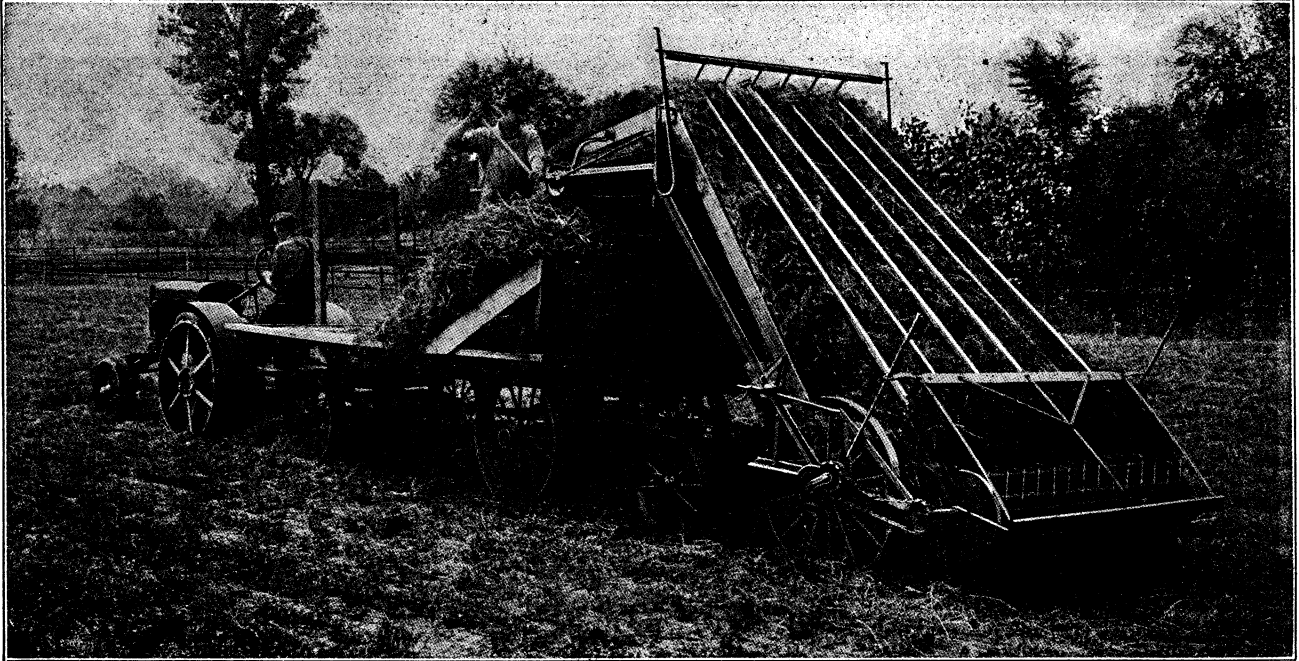


FIGURE 5.—Hay loader in action. The mechanical hay loader not only serves to speed up hay making but also eliminates a lot of hard work.



