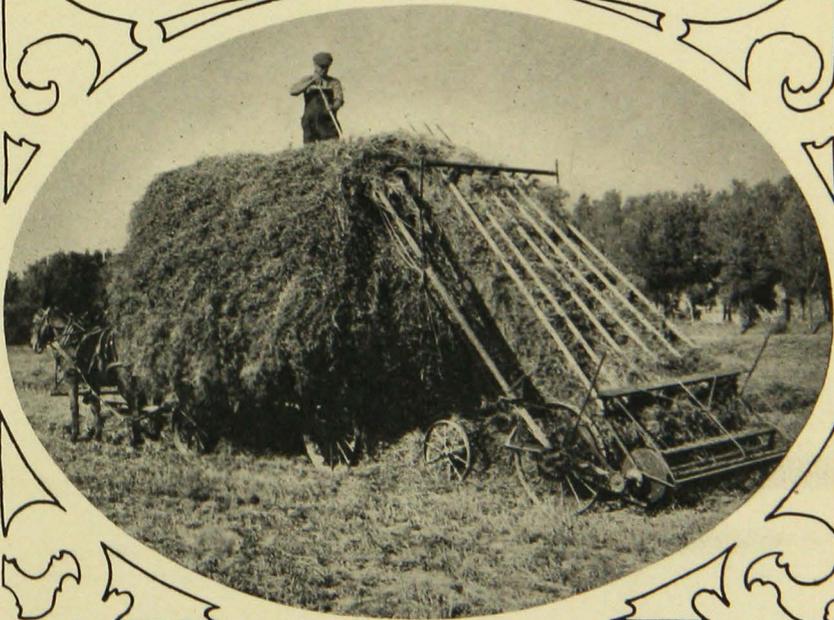


HAY MAKING IN MINNESOTA

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IN 1925 4,429,000 acres of land in Minnesota were devoted to the production of hay. The hay crop, valued at approximately \$64,579,000, is the most valuable crop in the state except corn. Considering the condition and quality of hay, especially that which passes through the market, it is evident that the value of the hay crop may be greatly enhanced with more efficient management in production. As relatively little hay is sold as a cash crop, little attention has been given to securing the maximum feeding value.

Hay that is fine in texture, cured so that it retains a high percentage of the original green color, and without the loss of leaves, and which is free from foreign material, is of high quality. Conditions which cause it to lose its natural color cause, also, a loss of palatability, desirable odor, and digestible feed constituents. Hay that is coarse, badly bleached, musty, moldy, or full of rubbish is of low quality. No easily applied method for measuring the feeding value of hay has been known to the producer and serious losses are often sustained without his knowledge.

CUT AT BLOOMING STAGE OR BEFORE

The best time to cut hay is when the greatest amount of digestible nutrients per acre will be obtained. Young plants are most palatable, and their digestibility is generally greatest at the blooming stage or before. If cut later than the blooming period, plants have lost palatability and can not be made into high quality hay regardless of attention during the curing process. Coarse stems, loss of leaves, and loss of green color can not be overcome. Too often the producer cuts his crop when the greatest amount per acre can be had, even tho it is not equal in feeding value to younger plants.

Alfalfa should be cut when the field is one-tenth to one-half in bloom. This is before the leaves fall and the stems become coarse and woody. At this stage the greatest amount of digestible feed is obtained. Approximately 50 per cent of the alfalfa plant is leaf, and the leaves contain about 60 per cent of the total feed constituents. When cut at one-tenth bloom it is more than twice as efficient for making gains in beef steers as when cut in the seed stage. When the crop lodges or becomes frosted it should be cut immediately, thus preventing the loss of leaves.

Red clover is best cut when it is in full bloom. After this, not only the yield becomes lower but the digestibility of the feed constituents falls rapidly. At later stages the leaves fall off readily, the stems become woody, and the green color rapidly disappears.

Timothy, and timothy and clover.—Timothy alone should be cut not later than full bloom. A mixture of timothy and medium red

clover is best cut when the clover is in full bloom. This is ordinarily about a week or ten days before the timothy has reached that stage. Alsike clover is about ten days later than medium red clover, so alsike and timothy mixed are both cut at approximately full bloom.

Prairie grasses should be cut before the plants begin to turn brown from dry weather or maturity. Bluestem becomes stemmy at maturity and if cut at this stage the hay is coarse and may not grade high because of lack of green color.

OBJECT OF CURING IS TO REDUCE MOISTURE

As cut, hay contains from 65 to 75 per cent moisture. This must be reduced to between 15 and 20 per cent to insure the best hay. As soon as the crop becomes wilted, but while still tough and sappy, in order not to lose the leaves, it should be raked into windrows to reduce the area exposed to sunlight. The greater part of the field curing should take place in windrows or cocks. Hay should not be cut when it is wet from rain or dew. External moisture causes bleaching and loss of soluble material.

Windrowing Reduces Cost of Curing

Owing to the high cost of labor it is economical to cure hay in the windrow and haul it directly to the barn or stack, and the kind of windrow is important.

This side delivery rake with straight teeth, or the dump rake, has a tendency to "rope" or pack the windrow. The hay is pushed into the windrow, not pitched. Loose fluffy windrows may be made by using the side delivery rake with curved teeth. This rake hastens the curing process with little loss of leaves and little bleaching. The leaves are usually well wilted when hay is taken from the swath and are more rapidly dried in the windrow than the stems.



Fig. 1. Turning the Windrow in an Alfalfa Field with the Side Delivery Rake

Cocking Saves Leaves, Reduces Bleaching

Hay cured in the cock is usually of higher quality than that cured in the swath or windrow because a smaller proportion of leaves is lost and less bleaching occurs. This method involves more labor, however, especially when it becomes necessary to recondition hay which has been wet by rain. Hay should be put into cocks only when free from external moisture. Moisture encourages the development of molds and bacteria, the hay subsequently heating and spoiling. Cocks should be carefully made to shed rain. Except in wet weather, three or four days in the cock will complete the curing of hay.



Fig. 2. Heavy Yield of Timothy and Clover on Peat Soil in Poorly Made Cocks

Good Equipment, Insurance Against Rain

If it were not for rainfall after the hay is down, curing hay to retain the maximum feeding value would be easy. Rain not only causes loss of color but a large percentage of the feed constituents may be washed away. Damage from prolonged rains can not be avoided but it can be minimized. The best insurance against damage from rain in Minnesota is such equipment as the side delivery rake, the hay loader, the sweep rake, or sufficient hand labor to move the hay rapidly from the field into storage.

Method of Loading and Hauling Depends on Conditions

If hay is cured in the windrow, the hay loader makes it possible to handle the crop economically, and to store it in a short time. If the windrow is produced with the side delivery rake and the hay has not become brittle from drying, the double cylinder hay loader, properly operated, takes it up with little loss. A hay loader is necessary on all large farms where the hay is put into the barn. If the hay is stacked, it may be taken to the stack by sweep rakes. If the hay crop is not

large enough to justify an extensive investment in machinery, and labor is available, cocking and handling by hand, altho expensive, is the most practical method.

Sweep Rake Good on Large Meadows

The sweep rake is most commonly used on large meadows where the hay is stacked or baled from the windrow. It is the most rapid and economical method of getting hay from the windrow to the stack or baler, but is usually not practical where the hay is put into the mow. Hay sheds centrally located, if equipped with a fork, may be filled from the sweep rake. In this method the hay is handled entirely by machinery and the labor cost is low.



Fig. 3. Sweep Rakes Taking Timothy and Clover Hay from Windrow

Storage of Hay Requires Careful Attention

The quality and condition of hay that comes out of the stack or mow depends very largely upon its condition as it goes into storage. If hay is cut at the proper time and cured with little damage, especially if the moisture content is reduced to about 20 per cent, there is little danger of the quality being reduced in storage. Ordinarily, hay is in the best condition to store when it is still tough and will not break readily or exude moisture if tightly twisted.

Hay in this condition goes through a "sweat," the extent of which is largely determined by the moisture content. "Sweating" is a slow fermentation process which results in the production of heat, loss of moisture, and some loss of weight, but is desirable for the production of aroma and palatability. Hay that is not thoroly field cured or is damp from dew or rain should not be stored. Too much moisture causes heating and a heavy loss in weight. Wet hay has been known to heat to the point of spontaneous combustion, causing the stack or mow to take fire.

Stacks Should Contain from 10 to 15 Tons

Hay stacks should hold from 10 to 15 tons. Stacks holding only 2 to 4 tons will suffer relatively large losses from weathering.

The stack should be compact, symmetrical, and drawn to a peak at the top to keep out moisture; full in the center and built to turn rain. Covering with slough grass is a practical way of making the stack more or less waterproof.

If the sweep rake is used, hay is put into the stack with the over-shot stacker. Special care should be taken to have the stack well built.

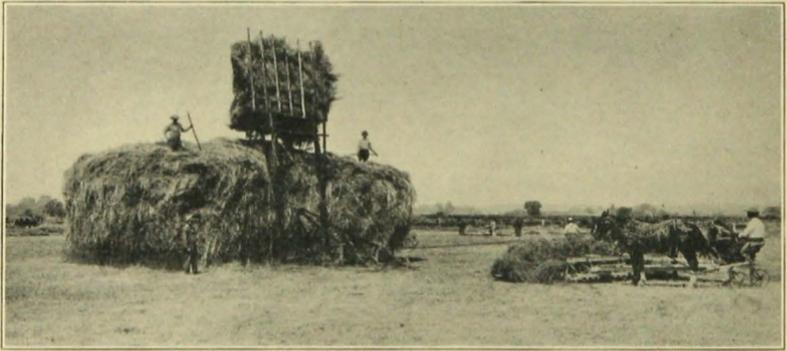


Fig. 4. Over-Shot Stacker and Sweep Rake

How Stacks of Hay Are Measured

Where hay is produced for market it is customary to estimate the tonnage in the stack and buy on that basis. It is difficult to estimate the volume, or the weight of a known volume of hay. The number of cubic feet of hay required to weigh a ton is affected by (1) length of time the hay has remained in the stack, (2) height of the stack, (3) kind of plants from which hay is made, (4) stage of development, and (5) moisture content when stacked.

The United States Department of Agriculture measured 92 stacks of timothy and clover hay. The cubic feet required to equal one ton of hay, when allowed different periods of time to settle, are shown as follows:

Age of stack	Average cubic feet per ton
Under 30 days	589.6
30 to 60 days	581.5
74 to 155 days	514.9

The number of cubic feet in the stack is calculated as volume (V) = FOWL. Multiply "over" (O) by "width" (W) and by "length" (L) and this by a "factor" (F) which varies from 0.25 to 0.37, according

to the height and fullness of the cross-section of the stack. "Over" (O) is the contour of the stack cross-section. (See Fig. 5.) Example: A hay stack 40 feet long, 30 feet wide and 20 feet high, with an "over" of 56 feet, and a shape similar to No. 4 in the diagram and standing 45 days would contain about 32.35 tons of hay.

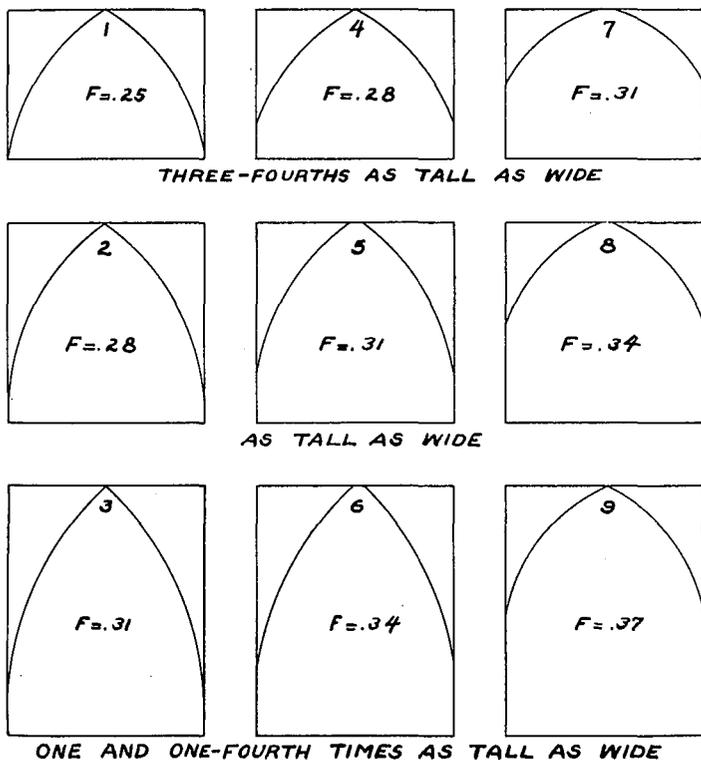


Fig. 5. Cross-Section of Haystacks of Different Shapes (U.S.D.A. Yearbook, 1924)

Thoro Curing Should Precede Baling

Ordinarily, when hay is baled it is intended for the market. The most satisfactory results are obtained in baling hay which is thoroly cured in the stack or mow. "Sweating" lowers the moisture content to a point which does not cause injury when hay is tightly compressed. All weathered, moldy or undesirable hay should be removed before baling, as the market grade may be lowered by a comparatively small amount of unsound hay. Large quantities of hay which is heating, and in some cases moldy as a result of baling it when wet, come on the market. The baler should not be operated during a flurry of snow

or during showers. Hay baled from the windrow has not gone through the sweat and is not thoroly cured. The moisture content is often higher than it appears to be and the tightly compressed bales ferment, produce heat, and become sour and moldy. Hay dried in the swath or windrow until it becomes brittle loses color and leafiness. This reduces its feeding value and lowers the grade on the market.

Labor Requirements Vary with Methods

A study of haying operations on 235 corn-belt farms shows that four distinct methods of handling hay are in common use. From the standpoint of time consumed and the amount of labor used, these methods, which are based upon the first cutting of alfalfa hay yielding $1\frac{1}{2}$ tons per acre, vary greatly, as shown in Figure 6.

Method 1 is the most common, and requires more time and labor than Methods 2, 3, and 4 because of the great amount of hand labor for cocking and for pitching the hay on the wagons. Method 2 is practically the same as Method 1 with cocking omitted, thus decreasing the amount of labor. The use of the side delivery rake and the hay loader, as indicated by Method 3, reduces the time and much of the hand labor. The method of handling the hay preparatory to the use of the sweep rake varies greatly. In most cases the crop is cured and raked into windrows with the side delivery rake or the ordinary dump rake. It is then taken directly from the windrow with the sweep rake. This, Method 4, requires less labor than any of the others. The principal difference in labor required per acre between this method and Method 3 is due to the difference in time required to load, haul, and unload the hay.

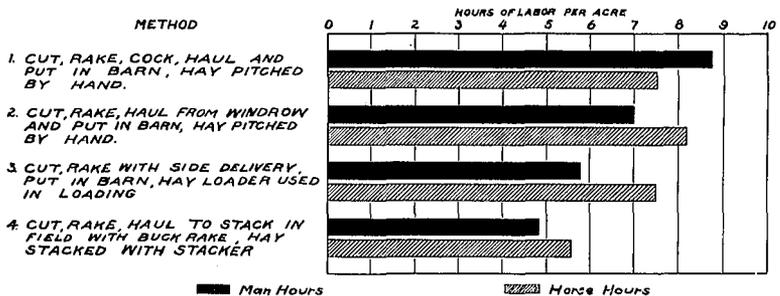


Fig. 6. Time and Labor Required in Harvesting Alfalfa Hay by Different Methods (U.S.D.A. Yearbook, 1924)

GOVERNMENT HAS ESTABLISHED GRADES

Until recently there have been no uniform standards of quality, or grades of hay for the markets of the United States. Grade designations assigned for local use do not define hays identical in quality or nearly so to the trade in all other markets. Local grades which are not understood or easily interpreted have caused hay marketing to be a hazardous business in some localities. The United States Department of Agriculture has established standards for grading hay which are well defined, are easily understood and applied by trained inspectors, and are applicable in all markets where they have been adopted.

The fundamental principle upon which the federal grades are established is the identification and arrangement of hay into classes and the designation of grades which represent the quality and condition of the classes. This standardization expresses the value of the hay definitely, as the kind of hay and its quality and condition are independently determined. The following extracts from the Hand Book of Official Hay Standards, under the timothy, clover, and grass hay group illustrate the principle.

"Classes

- "1. **Timothy**—Timothy with not over 10 per cent clover.
- "2. **Timothy light clover mixed**—A mixture of timothy and clover with over 10 per cent but not over 30 per cent clover.
- "3. **Timothy medium clover mixed**—A mixture of timothy and clover with over 30 per cent but not over 50 per cent clover.
- "4. **Timothy light grass mixed**—A mixture of timothy and other grasses with over 10 per cent but not over 30 per cent of other grasses and not over 10 per cent clover.
- "5. **Timothy grass mixed**—A mixture of timothy and other grasses with over 30 per cent but not over 60 per cent other grasses and not over 10 per cent clover."

Grades.—Each of these classes is divided into numerical grades based upon the percentage of green color and foreign material as follows:

"U. S. Grade No.	Required percentage of green color	Maximum percentage of foreign material
1	50 or more	10
2	30 or more	15
3	Less than 30	20

"Sample grade.—Hay of the above classes which has been threshed or headed, or which contains more than 20 per cent of 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 or otherwise of distinctly low quality."

Supplementary grading factors, high green color, leafiness, fineness, coarseness, are employed to indicate as nearly as possible the condition of the hay. Under the federal standards all classes, grades, grading factors, and supplementary grading factors are accurately defined and easily understood, and can be accurately applied by thoroly trained inspectors.

Minnesota State Hay Grades

Under the Minnesota state hay grades the classification of hay is incorporated as a part of the grade designation. The kinds of hay in mixtures are not classified and a grade which represents the quality applies to the classes. To illustrate:

No. 1 Timothy.—"Shall be timothy with not more than one quarter (25%) mixed with clover or other tame grasses, may contain some brown blades, properly cured, good color, sound and well baled."

There is considerable latitude in mixtures tolerated in this grade designation. Any of the classes of hay indicated under the federal standards with the exception of No. 3, may pass through the market as No. 1 timothy hay under the Minnesota state grades. Class No. 3 can not be graded as No. 1 timothy but may be passed as No. 2 timothy on account of the presence of more than 25 per cent of clover.

Under the Minnesota grading system the factors which determine quality and condition of hay are not defined or measured. Their significance and application are matters of the inspector's opinion which may or may not be based upon facts. There is no system by which inspectors using Minnesota hay grades are trained or their ideas standardized on the factors which determine quality in hay.

MARKET REQUIRES ATTENTION TO DETAILS

The producer who ships hay to the market is able to have high grades that command the highest prices only when the crop is taken from clean meadows, cut at the proper time, cured properly, and baled without weather damage. The bulk of hay which passes through the Minnesota markets is purchased by dairymen, cattle feeders, and the Stock Yards Company of South St. Paul. Some is used in the Twin Cities for horses. These dealers demand palatable hay that gives value in accordance with the price they pay. Hay that is coarse, full of foreign material, badly bleached, unsound, or otherwise of low quality, is too prevalent on the markets. Owing to high freight rates, low grade hay should be fed on the farm and not shipped to market.

A hay baler should be used that will put out bales of the size and weight most commonly found in the market where the hay is to be

shipped. Minnesota hay can be marketed most satisfactorily in bales 17 x 22 inches or 14 x 18 inches and which weigh from 80 to 90 pounds. The shipper will do well to cater to the established market preferences in baling hay for shipment. Bales should be neatly tied, those that are unevenly or loosely tied break easily in handling and cause a serious loss. Low bids are sometimes offered because bales are unattractive. Shippers should protect baled hay from rain or snow, as if it is damp on the surface it will heat in a short time when put into a car or hay shed. Very little rain or snow will cause it to become hot and musty. Baled hay should be sorted and graded prior to shipment so that a car can be filled with hay of one class and grade. If the shipper does not have enough hay of uniform grade to fill a car, it is good policy to separate the classes or grades, putting each in a different part of the car. When different classes and grades are loaded systematically in the same car, it is not difficult for an inspector to grade the entire carload. The shipper's invoice should designate the number of bales of each class and grade. Accurately listing the contents of the car to the consignees and inspectors in terminal markets is a policy which if consistently followed serves as the most valuable "trade mark" for the producer in building up a reputation for reliability.