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FORAGE HARVESTER OPERATION

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Operating efficiency and fuel consumption have always been important considerations in the purchases and operation of farm machinery. Recent rises in fuel prices and production costs have caused farmers to consider these factors more carefully than ever.

Some cattle farmers, who once fed their cattle baled hay, are now investigating more prod uctive systems. They are attracted to silage systems due to the ease of handling and better overall feed nutrient utilization. When converting to a silage system, familiarity with all aspects of the system is important, to get maximum benefit. This article deals with the operation of the forage harvester, the key machine in the operation.

THE FORAGE HARVESTER

The most common types of forage harvesters (APPENDIX I) use a cylindrical cutterhead. These harvesters are provided with adjustments to vary forage cut length by varying the speed of the feedrolls, relative to the cutterhead.* This permits the cutting of forage to suit specific requirements. Two variations of this type of harvester are in common use:

1. The **cut-and-blow** type of forage harvester is the more versatile in that it permits the mounting of a recutter screen to the cutterhead to provide a more consistent material size. The forage is then conveyed from the cutterhead to a separate fan which blows it to the wagon.

2. The **cut-and-throw** forage harvester cannot be fitted with a recutter screen since it relies on the cutterhead both to cut and to throw the forage to the wagon. This type of harvester does not have a separate fan.

An alternate method of adjusting cut length is by removing cutterhead knives.

OPERATING CONDITIONS

What should a farmer know about operating the forage harvester. What adjustments best suit his specific needs.

Machine Efficiency: The efficiency of the forage harvester may be expressed as specific capacity, (t/hp-h) defined as the mass of forage chopped per unit of energy supplied to the harvester. Forage refinement, achieved either by adjusting the machine to a shorter cut length setting or by installing a recutter screen, results in a reduction in machine efficiency.

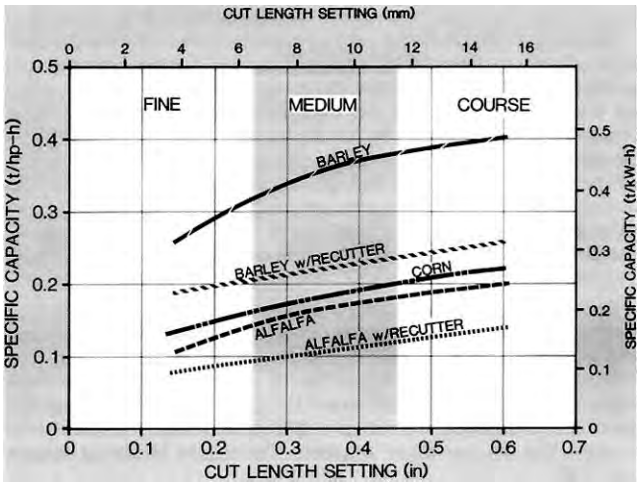


FIGURE 1. Specific Capacities (based on dry weight work rate) for a typical forage harvester.

FIGURE 1 shows the relationship between specific capacity and cut length setting, in some common crops, for a typical forage harvester. The effect of using a recutter screen is also shown. The values shown are typical and show average trends only. Actual values, for a specific harvester, may be significantly different. With this harvester, the average specific capacity in barley is about twice that in corn and alfalfa, indicating that barley requires about half as much energy to chop as corn or alfalfa.

Power Requirements*:* In general, reducing the cut length or adding a recutter screen lowers the specific capacity and increases the power requirements. At a specific workrate, reducing the cut length setting by one half usually results in a power increase of about 25%. Adding a recutter screen will have comparable effect. Tests show that specific capacity changes only slightly, with changes in crop moisture content from 40 to 70%.

The cutterhead and fan housing often gum up when harvesting low moisture legume crops, resulting in a consequent reduction in efficiency and increased power consumption.

Machine Maintenance: Cutterhead condition and shear plate adjustment significantly affect the specific capacity and quality of work. Too large a shear plate clearance, or dull knives (FIGURE 2), increase the power required. As well, the rate of wear will be accelerated if the cutting components are improperly adjusted. It is important to follow the manufacturer's instructions on clearance to provide maximum efficiency and to maintain the life of cutting components. If a recutter screen is used, the screen clearance must be adjusted precisely and regularly.

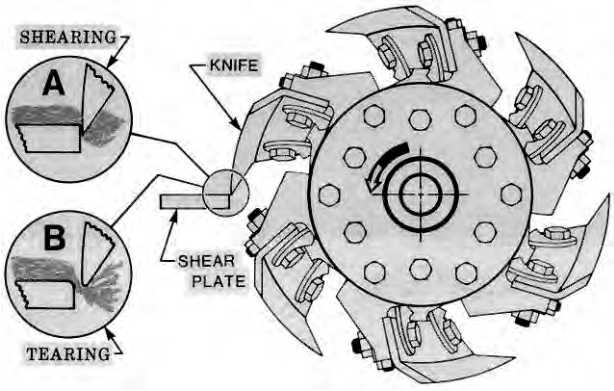


FIGURE 2. Wear on cutterhead knives and shear plate; (A) Sharp knife, new shear plate; (B) dull knife, worn shear plate.

WHICH SETTING IS BEST

There are four primary considerations when deciding on forage refinement: degree of forage uniformity, degree of refinement (cut length) of the forage, energy efficiency of the machine, and feed requirements of the cattle.

Uniformity: The uniformity can usually be judged by the percentage of long particles in the chopped forage. If there are potential problems with long particles plugging loading equipment, such as forage blowers, or if the livestock are not eating the long material, then reducing the percentage of long particles may be necessary. Shortening the cut length will decrease the work rate of the forage harvester, whereas installing a recutter screen will increase the power input, while having little effect on the workrate, provided the tractor is properly matched to the power requirements of the harvester. A reduction in the number of long particles is usually more significant when using a recutter screen.

Cut Length: When adjusting the cut length setting of the forage harvester, it is not the **nominal** cut length (machine setting), but the **actual** cut length and the uniformity (consistency) of the chopped material that should be of concern. Often, identical nominal settings on two different forage harvesters (even of the same manufacturer) will not give similar distributions of material length. The farmer must examine the actual chopped forage when deciding on the machine setting. FIGURE 3 shows charts of the forage length distribution for a harvester using twelve knives, six knives and a recutter screen. PAMI Evaluation Reports include test results that provide the operator with an indication of the expected forage refinement.

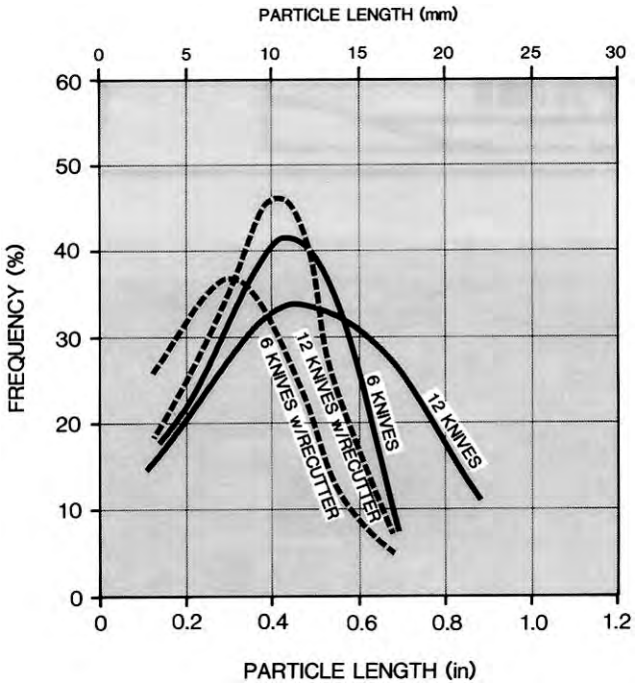


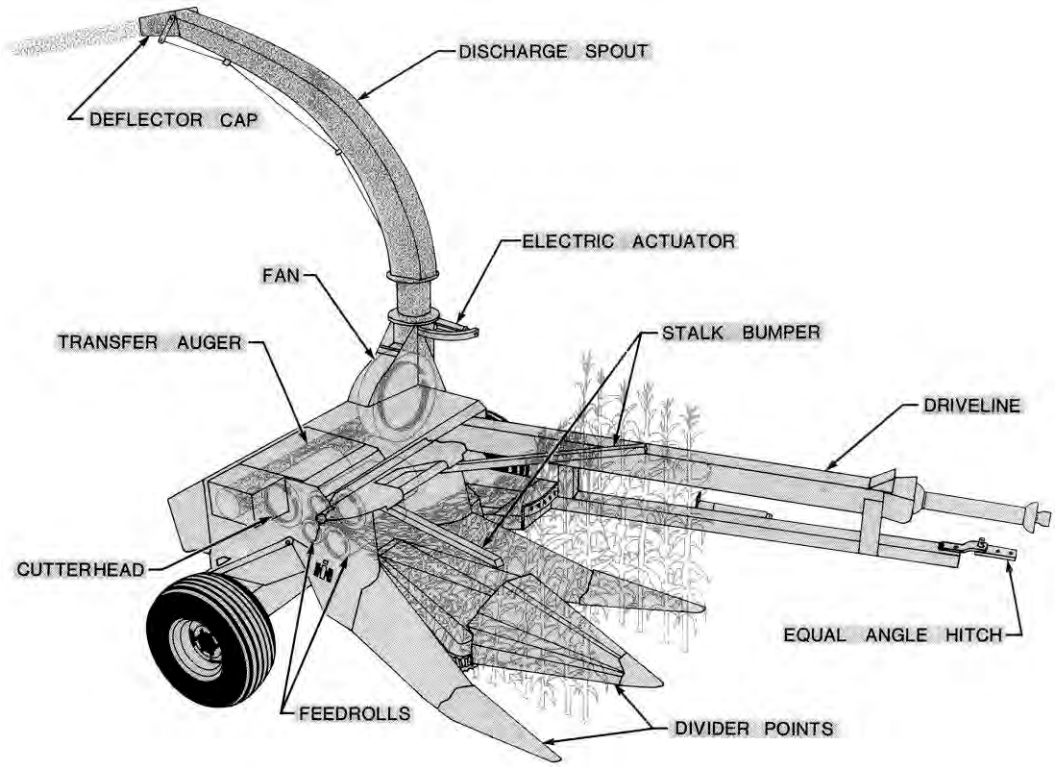
FIGURE 3. Typical particle length distributions for a 5 mm cut setting (with six knives removed and with recutter screen).

Energy Utilization*:* The ideal cut length setting for the machine in FIGURE 1, from an efficiency point of view, would be the long (coarse) cut setting. However, feed requirements, as discussed later, must also be regarded. Adequate tractor power is important when considering harvester size and cut setting. A forage harvester of a high power rating is best matched with a tractor of similar rating; too large a machine would be a poor investment. A good rule of thumb when matching a forage harvester to tractor in typical prairie crops is 8 hp per foot swath (20 kW/m) of alfalfa or 54 hp (40 kW) per row of corn. These figures will be influenced by machine setting and workrate.

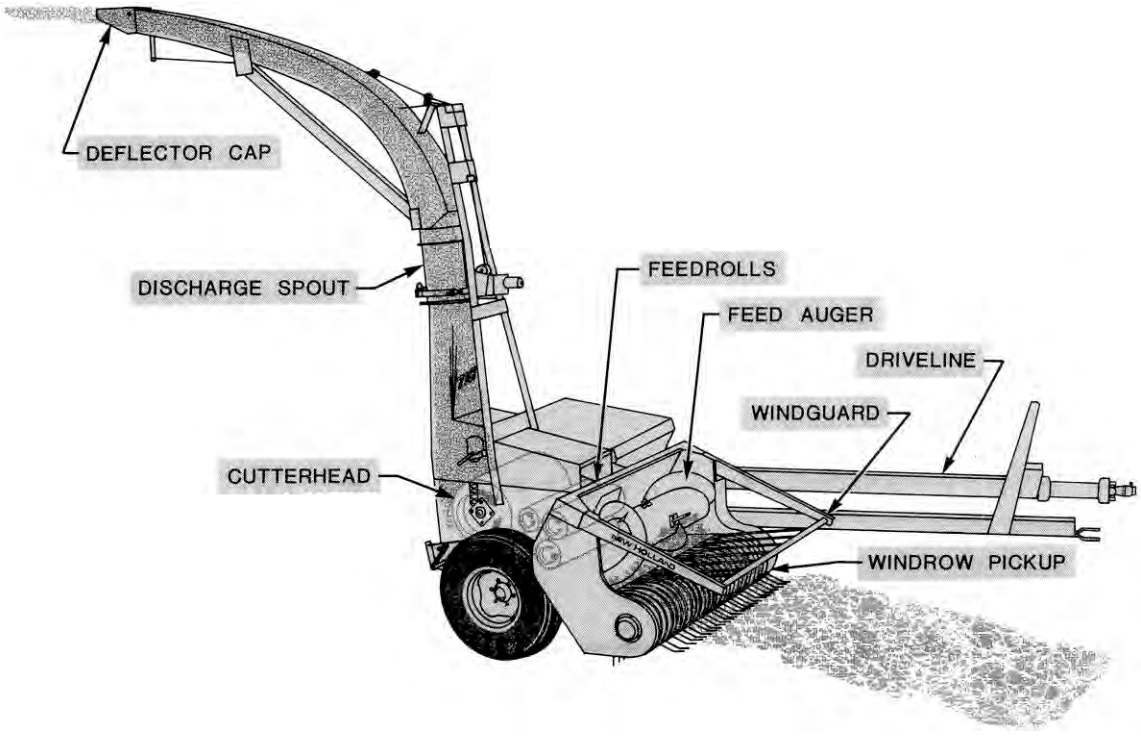
Feed Requirements: Feed requirements of dairy and beef cattle usually differ. Beef cattle need a finely chopped silage throughout the feeding period to encourage greater throughput, and consequent rapid weight gain. With dairy cattle, the emphasis is on nutrient intake, without weight gain, for much of the year, (this emphasis is especially important during the dry period), indicating that a medium cut length setting is best in the dairy operation. There is only a short period of time, just prior to the dry period, when it is desirable that dairy cattle gain weight, to recover from weight loss resulting immediately after calving. For dairy cattle, a medium forage length is generally recommended during the milking period while a coarse cut forage is fed during the dry period. The feed may be supplemented with baled hay during the dry period as an alternative to maintaining separate storages for silage cut at two different lengths.

If cut length uniformity is not good, the cattle may waste the long material. Use of a recutter screen will generally reduce this problem.

This article discusses some of the considerations when designing a specific silage system. The operator must consider aspects of both machine product and feeding requirements, to ensure the greatest benefit from the silage system.



a) Cut-and-Blow Forage Harvester with Row Crop Head.



b) Cut-and-Throw Forage Harvester with Windrow Pickup.

FIGURE 4. Forage Harvester Types.

Evaluation reports on forage harvesters available to date are:

120 New Holland 890 Forage Harvester
121 John Deere 3800 Forage Harvester
158 International Harvester 830 Forage Harvester
200 New Holland 718 Forage Harvester
201 Hesston 7160 Forage Harvester
202 John Deere 3960 Forage Harvester
330 New Holland 892 Forage Harvester
331 Gehl 1250 Forage Harvester

Individual reports are available on request.
Subscriptions to Machinery Institute evaluation reports are available on a one year basis, for a nominal fee.
For more information contact the Machinery Institute at the addresses listed at the bottom of this page.

Other related publications available are:

1. Friesen, O.H. **Economics of Forage Equipment and Feeding Systems**. Manitoba Agriculture.
2. Holt, Wayne. **Forage Harvesting and Hauling Comparisons.** Saskatchewan Agriculture.
3. Holt, Wayne. **Beef Cattle Feeding Systems Cost Comparison.** Saskatchewan Agriculture.
4. Holt, Wayne. **Chaff Collecting, Hauling, and Packing Costs.** Saskatchewan Agriculture.
5. Padbury, Ted. **Beef Cattle Feeding Systems**. Saskatchewan Agriculture.
6. Padbury, Ted. **Chaff Collecting and Handling,** Saskatchewan Agriculture.
7. Padbury, Ted, Wayne Holt. **Selecting a Beef Cattle Feeding System**. Canadian Society of Agricultural Engineers, Paper 84-400.

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