FEASIBILITY OF ROTARY CUT WINDROWERY IN ALFALFA PRODUCTION

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The rotary cutter most commonly known to us is the rotary cut lawn mower. For forage crop harvesting there are two basic types of rotary cutters available: the drum or top drive mower and the disc or bottom drive mower. Some experimentation is being done with various combinations of the two but as of now the combinations are not commonly avail able.

The top drive, drum mowers appear to have fewer parts but tend to have more maintenance problems. They are highly susceptible to run-in damage from field obstructions such as rocks, posts, badger holes, and ant hills. Drum mowers also have a tendency to scalp and scatter re-cuts in uneven fields due to their large diameter. At this time there are no drum type mowers available with roll type conditioners which are usually required in legume hay harvesting. As a result drum type mowers have been confined mainly to grass hay markets.

Disc or bottom drive mowers have smaller rotating discs or rotors than the drum mowers. The rotor of the disc mower is protected from run-in damage by a rock guard which extends under the rotor with only the cutting knife protruding. The disc mower also has its support bearings located in line with the radial knife load for better strength Disc mowers are suited for adaptation of roll type conditioners and can be fitted to transverse augers to make larger header units. There are two major manufacturers of the disc type mower. Kuhn, a French company, markets their product in the United States under the Kuhn S.A. name and is also sold by New Holland under the New Holland name. John Deere also offers a disc mower made in its French plant using the Kuhn cutter bar. Vicon, located in Holland, markets their product under the Vicon name with the same units also being sold by Gehl under the Gehl name. Lowe, the only manufacturer of self-propelled units, also uses Vicon components. Disc mowers, by virtue of their small rotor diameter, have more parts than drum mowers but tend to be more reliable and are better suited to legume hay harvesting.

The actual cutting with a rotary mower is accomplished with knife speed without having assistance from a shearing edge such as the guard on a sickle type machine. Disc mowers, such as the Vicon, with a 3000 R.P.M. speed will have a knife tip speed of about 180 M.P.H. Newer sickle type units with three and one-quarter (3¼) inch stroke and 1875 R.P.M. sickle action will have a knife speed of 11.5 M.P.H. The higher tip speed of rotarys allow for much higher cutting speeds. Some manufacturers have stated that theoretically, they could cut at thirty miles per hour. Our own self-propelled unit has a top speed of twenty-two miles per hour and has cut many acres at that speed. Field conditions, hay quality, and power unit selection will be a major factor in cutting rates but rotary disc mowers can easily double sickle cutting rates. The rotary, by nature of its continuous motion, is a smoother running unit than the reciprocating sickle, having less vibration and fewer stress points in the system.

There has been some question as to the performance of rotary cutters in down hay, as they have no reel. Several attempts have been made to use a reel in combination with rotary cutters but these have been unsuccessful. Reel speeds are too slow to work in conjunction with the high speed cutters. If the reel is placed in the rotary header in the same relative position it would have in the sickle header, the cutters

pull the hay through the reel, stripping leaves and double cutting the material. If the reel is placed far enough in front of the cutters to eliminate this problem, it is of little use in standing up the hay. The rotary cutters rely on air movement and knife contact with the plant stem for cutting. As there is no guard involved, there is nothing under the knife to rundown the hay before the knife has a chance to make contact with it. The high tip speed and knife formation are the keys to clean cutting. If the knife makes contact with the stem anywhere along its length, it will disorient the plant and cut it at the contact point. The disorientation generally allows the next knife to cut the plant cleanly at the set cutting height. This will create some double cutting but it should be minimal. The disorientation process carries through the plants far enough to eliminate double cutting. Air flow created by the curved knife also helps to lift down plants and carries them across the cutter bar.

Disc cutters do tend to display a strip pattern in severe conditions. This is a result of the counter-rotating discs. If the plant is laying extremely flat and directly away from the cutter, there will be a tendency for the cutters to strip where the knives come out from the bar as their direction of travel is in line with the stems. This same pattern can occur from every other rotor if the hay is laying extremely down and directly perpendicular to the path of cut as these rotors will be traveling primarily in that direction. Drum mowers, with their larger diameter and fewer overlaps, have less tendency to show stripping than do disc mowers. The knife created air flow and plant disorientation are, however, a suitable replacement for the convential reel. Our experience has shown us that the rotary cutter can perform equally to the sickle and reel combination in most conditions. The cutting speed of the rotary is not affected by down crop conditions. It is therefor possible to maintain cutting rates in conditions where it is customarily necessary to slow down with sickle type machines to allow the reel to pick up down material.

Rotary cutters have often been accused of retarding regrowth. The main reason usually given is that the cutting action pulls the plant out of the ground. In reality, we have found quite the opposite to be true. The high speed action of the rotary cutters do tend to tear the plant stem but this seems to allow the stem to seal faster and prevent plant bleeding. The rotary also eliminates the pinching action that can occure in the conventional sickle and result in plant pulling from machine overrun. This is particularly common if sickles or guards become worn.

Rotary cutters are not prone to the plugging that occurs with sickle units as a result of dirt build-up or grassy conditions. Rotary cutters have a great advantage in grassy hay and new hay, particularly that hay sown with a wheat cover crop. Rotarys are also not affected by loose hay piles or broken bales so commonly found in fields. These are simply swept through the cutters. The rotary cutters tend not to cut the shorter crown leaves as they have a tendency to be blown over. This phenomenon can be a problem in extremely light hay, half ton per acre or less, as the disc rotary tend to cut poorly.

At present only two manufacturers of rotary cutters provide roll type conditioner units. Vicon, which also includes units sold under the Gehl name, and Lowe. The fact that other manufacturers do not have conditioners has excluded them from most hay areas. Vicon units come in five and one-half (5½) foot (1.65 meter) and seven foot ten inches (7' 10")(2.4 meter) models. These are three point hitch, P.T.O. driven units and have full length rubber on rubber rolls. The Lowe self-propelled is available with thirteen (13) foot (4 meter), fifteen foot five inches (15' 5") (4.8 meter), and eighteen (18) foot (5.6 meter) headers. Lowe provides either steel on steel or steel on rubber rolls. The Lowe conditioner is hydraulically operated with chain and sprocket drive. This allows you to run both rollers at the same speed for legume hay or at different speeds for grass hay. The conditioning rolls, along with the header auger, are hydraulically reversible to back out any plugging that may occur.

Maintenance is a key factor in favor of the rotary. The Lowe self-propelled unit has only eleven grease zerks on the entire unit and only six of these require daily greasing. There is also no reel, sickle, guards or pitmans. The rotary units are much simpler and have fewer service parts The gear train that drives the disc rotors is an enclosed, sealed pan. If the oil level in the drive train is properly maintained and monitored, the drive components should give few problems. Too little oil in the drive train will cause premature bearing failure and excessive gear wear. Too much oil in the drive train will cause dramatic increases in horse power requirements and over heating. Most units have one piece construction of the top plate and pan. This type construction requires total teardown for drive train repair. This can be a time consuming job and thus makes drive train durability a vital factor. Lowe has been successful in its construction of a fully segmented bar top. If there is a bearing problem in this type bar, it is only necessary to pull up the problem section and not the entire top plate. We believe this is an important feature as it decreases the possible machine down time and adds greatly to unit reliability.

Knife wear on rotary units vary widely based on field conditions. Sand and gopher mounds are the two major culprits and will greatly accelerate knife wear. Average knife life has been around 1700 acres in alfalfa hay. This figure varies from a low of 400 acres in some gopher infested areas to a high of almost 6000 acres on some units run in Eastern Nebraska. The end rotor knives tend to wear more severly as they are subject to border and ditch run in. Individual knives may also break and need occasional replacement. The loss of one or two knives on the three knife Vicon or Lowe rotor will not be noticed until the unit is stopped for inspection as they do not tend to effect cutting quality. This is an advantage over sickles where section loss results in immediate problems. Knife costs vary for different makes but the Lowe or Vicon knives currently sell for $2.05 each which would collate to a fifteen and one-half (15½) foot sickle selling for $73.80. Knife replacement on rotary units is quite simple and most have reversible knives with two usable cutting edges.

Horse power requirements for rotary cutters are greater than comperable length sickle cutters. The Vicon seven foot ten inch (7' 10") KM240 requires fifty P.T.O. horsepower. The Lowe self-propelled units are avail able with engines from 127 to 170 horse power, more than twice that of sickle type units. We have found that with the 170 H.P. Detroit Diesel engine, we used 5.25 gallons of fuel per hour. This was done in one and one-quarter (1¼) ton per acre hay with a 4.8 meter header and average cutting rate of 15.4 acres per hour. Our per acre fuel consumption was .34 gallons per acre. Further tests have shown that fuel consumption appears to be fairly stable for crops up to one and three-quarter (1 3/4) ton per acre. Although the rotary cutters require more horse power, it is greatly offset by higher cutting rates and per acre fuel consumptions are only slightly higher.

European manufacturers have led the way in rotary design but have little or no market for large industrial machines. European acreages tend to be smaller and road transport laws discourage large machinery. The problems in making a larger cut rotary were combining an auger with the rotary cutters so single windrow formation could be accomplished and providing ample power to the longer cutters. A unique feature of the Lowe unit is the double hydraulic motor drive on the cutter bar. A motor is located behind the bar on each end of the header so that equal pressure is applied from each end of the drive train. Tall, end spinners are located on each end rotor to help move material cut by that rotor into the auger which is narrower than the cutting width. This drive system allows for doubleing the cutting width of any P.T.O. driven unit. The cutters are also hydrostatically driven to provide variable cutter speeds. This unique cutter arrangement actually makes the cutting width wider than the header itself.

Lowe also builds an end delivery header. This unit allows for double windrowing and is ideally suited for insilage and dehydrating operations

where total plant drydown is not required. It also allows the unique feature of stems up or leaf up windrows. The rotary cutters deliver the plant to the auger stem first. This alignment can be maintained across the header with a varible speed auger. The discharge gate, which is hydraulically controlled, can then be located so as to roll the windrow with stems up or lay it back with leaves up. The end delivery header is not available with conditioner but the stems up windrowing can compare quite favorably with conditioned hay in some areas. This windrow formation also allows less leaf bleach and promotes more even drying of stems and leaves. End delivery headers do not tend to work well in bordered ground as the header is offset and does not perform well cutting on borders.

Although rotary cutters are not yet generally considered for cutting alfalfa, I feel they will take an increasing part of the market, as more manufacturers add roll type conditioners. The increased cutting rates of rotarys will mean fewer total units for large operations. Their greater reliability will mean smaller repair bills for all. As most manufacturers sell under more than one name, parts should be available from several sources.

Manufacturers need to keep on top of farm service requirements. Some things to look for in a rotary are: segmented bar top for easy teardown, magnets in the drive train to trap gear wear particles, bar flushing system to periodically clean out bars without teardown, oil temperature indicators in bar oil for early detection of problems, and improved knife design to eliminate stripping problems in light material.

Farmers may need to use different field preperation practices to fully use the advantages of the rotary cutters. This includes seed bed leveling and gopher control. Hitting a cross-check at twenty (20) M.P.H. can be quite an experience.

Rotaries are coming. With parts and labor costs ever rising, they may be the way to cut costs as well as hay.