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Research Report 633

Pulse Crop Cutting Equipment

A Co-operative Program Between
ALBERTA FARM MACHINERY RESEARCH CENTRE
PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

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PULSE CROP CUTTING EQUIPMENT

INTRODUCTION

The following research resulted from a field study by PAMI under the sponsorship of the Saskatchewan Pulse Crop Development Board and Saskatchewan Agriculture Development Fund. The intent of the study was to provide farmers with an independent assessment of conventional and specialty cutterbar components used for windrowing prairie lentil and pea crops.

Four commercial knife systems were alternately installed on a 21 ft (6.4 m) Westward 7000 self-propelled windrower equipped with a MacDon model 2000 pickup reel. Each knife system was assessed in various pea and lentil crops for rate of work, cutting ability, shatter loss, ability to operate as crop adhesion occurred, power requirements, ease of installation, adjusting, cleaning and servicing, operator safety, and the suitability of written instructions. Mechanical failures and problems were recorded. Eight different vine lifter attachments were also assessed, along with a polyethylene skid shoe cover.

TERMINOLOGY

COMPONENTS

The knife system consists of the various components, which are responsible for the cutting process. The components, which are in direct contact with crop while cutting are referred to as the cutterbar. The cutterbar includes the knife and guards. The knife consists of knife or sickle sections riveted or bolted to a backing bar. The backing bar is connected to the knife drive by a knife head. The knife or sickle sections may have grooves along the cutting edges, these are known as serrations. When these serrations face upward, the knife is often called over serrated or top serrated. If the grooves are on the bottom, it is called under serrated or bottom serrated.

The reciprocating knife is carried by the guards bolted along the front edge of the windrower platform or table. The guards not only serve as a guide for the knife but also provide stationary cutting edges for the knife sections to shear the crop against. To keep the knife properly positioned for effective cutting hold-down clips or wear plates are normally used. These hold-down clips or plates often have shims or spacers to allow proper adjustment.

To aid in cutting pulse crops, other specialty equipment is often used. The specialty equipment includes a pickup or finger reel to replace the bat reel and vine lifters, which attach to the cutterbar to help lift the crop over the cutterbar. As well, polyethylene skid shoe covers are used to help reduce soil sticking to the cutterbar and platform surfaces, which skid on the ground when cutting low. Comments on the performance of these attachments used during the test are included in this report.

CUTTING

The purpose of a knife system is to cut the crop stems cleanly at a uniform height. In peas and lentils, it is usually necessary to cut as close to the ground as possible. Cutting loss consists of the seeds or pods on vines, which were not cut due to the cutterbar riding over them because the vines were not lifted or the pods grew below the cutting height. In this report cutting loss was measured for the knife systems both with and without vine lifters. The seeds on missed, uncut plants were counted and expressed as a percentage of the total estimated crop yield. Quality of cut was also assessed according to the stubble condition. A uniform stubble height with the plants cleanly cut denoted effective cutting while varying stubble height with jagged cut stems and plants pulled from the ground indicated a reduction in cutting effectiveness.

SHATTER LOSS

Shatter loss is defined as seeds or pods, which have been shaken loose from the plant during the cutting process. Some seeds are shattered upon contact with reel, lifters or cutterbar and drop to the ground. However, the majority shattered during the cutting process land on the conveyors and are deposited with the windrow. It is this loss, which was measured in this study. Shattering is highly dependent on crop variety and maturity at time of cutting and upon machine adjustment. For these reasons, the shatter loss tests for the four knife systems were done in the same field on the same day, using the same windrower and operator. By keeping these variables constant, the difference in shatter loss could then be attributed to the knife systems.

NATURAL LOSS

Natural or shedding loss can also be a major loss in pea and lentil crops. This loss is caused by nature's forces of wind, sun and rain as well as the crops natural tendency to shed mature seeds. In some fields, natural loss accounted for as much as 30% of the total crop yield. It is important to recognize this when comparing differences between knife systems and to put that into perspective with the savings possible through timely harvest.

CROP ADHESION

Crop adhesion or gumming refers to the buildup on the cutterbar resulting from the combination of plant juice, soil and shredded plant material. Pea and lentil crops are often very conducive to gumming due to the excessive plant juice associated with cutting green plants and weeds and the presence of dirt from cutting close to the ground. Gumming is a negative factor that can increase the clearance between the cutting surfaces of the knife and guards. This may reduce cutting effectiveness and/or add resistance to knife movement thus increasing the power required. As well, removing the buildup is inconvenient and time consuming.

The knife systems were assessed for their ability to operate as gumming occurred and the effects of gumming on cutting and power. Ease of cleaning and mechanical durability were also monitored during the test.

Senior Engineer: J.D. Wassermann

Project Engineer: M.E. Jorgenson

Project Technologist: D.H. Kelly

MACDON CONVENTIONAL KNIFE SYSTEM

MANUFACTURER:

MacDon Industries Ltd.
680 Moray Street
Winnipeg, Manitoba
R3J 3S3

DISTRIBUTOR:

Westward Parts Services Ltd.
6517 - 67th Street
Red Deer, Alberta
T4P 1A3
Phone: (403) 342-5510

RETAIL PRICE:

$948.00 [July, 1989, f.o.b. Humboldt, Sask. for a complete 21 ft (6.4 m) knife with knife hold-downs, hardware and guards].

SUMMARY AND CONCLUSIONS

Rate of Work: The MacDon Conventional knife system cut smoothly and effectively up to about 6 mph (10 km/h) in lentils and peas when rigid vine lifters were used. Without lifters, speed had to be reduced for better operator control.

Quality of Work: Quality of cut was very good with rigid lifters and fair without lifters. Lifters reduced cutting toss from 5% of the total crop yield to less than 1%. With a clean cutterbar, and sharp knife, the stubble was a uniform height and cut cleanly, but as gumming occurred cutting effectiveness decreased. The ability to cut without shattering was fair. About 2 to 2.5% of total crop yield was lost due to shattering in mature lentils. The ability to operate effectively as crop adhesion or gumming occurred was fair. Gumming usually became severe enough that the cutterbar had to be cleaned about every 10 hours.

Power: About 1.7 to 2.6 hp (1.3 to 1.9 kW) was needed to drive the 21 ft (6.4 m) knife.

Ease of Operation and Adjustment: Ease of installation was very good. It took two people about 1 hour to install the guards and an assembled knife. Ease of adjustment was good. No shims or wear plates were required. Ease of cleaning was good. The knife was easily removed if the hold-downs were loosened. Ease of servicing was good. It took about 15 minutes to change one knife section when using a rivet tool.

Operator Safety: As with all cutterbars, extreme caution was required when servicing or repairing the knife.

Operator's Manual: The operator's manual was fair. No separate manual on the knife system was available. Discussion in the Westward 7000 windrower manual was limited.

Mechanical History: A total of 23 knife sections and 9 guards had to be replaced during 33 hours of cutting.

GENERAL DESCRIPTION

The MacDon Conventional knife system (FIGURE 1) was the standard factory installed knife on the Westward 7000 self-propelled windrower used in the test. The knife consists of 3.0 in (76 mm) wide, top serrated, knife sections riveted on top of a continuous length of backing bar. The forged steel guards are 6.0 in (150 mm) wide with points spaced every 3.0 in (76 mm). Steel hold-down clips are spaced every 12 in (305 mm) along the knife to hold the knife and guard cutting surfaces together.

SCOPE OF TEST

The MacDon Conventional knife system was operated for 33 hours while cutting about 270 ac (110 ha) of lentils and peas. The knife was operated with and without various vine lifters. Half moon rigid lifters were used for all cutting and shatter loss measurements.

RESULTS AND DISCUSSION

RATE OF WORK

The MacDon Conventional knife system cut effectively at speeds up to 6 mph (10 km/h) when rigid vine lifters were used. Without vine lifters, the pea or lentil vines had to be aggressively pulled up and over the cutterbar with the pickup reel. This increased crop losses and generally cutting speed had to be reduced to give the operator better control over crop feeding.

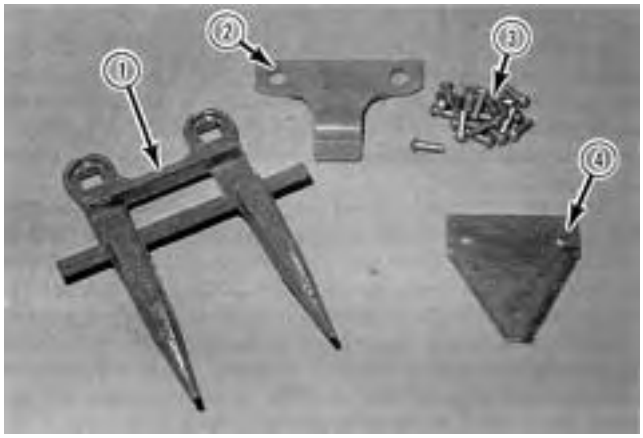


FIGURE 1. MacDon Conventional: 1) Guard, 2) Hold-down Clip, 3) Rivets, 4) Knife Section (typically pre-assembled on bar).

QUALITY OF WORK

Cutting: Cutting was very good when using rigid vine lifters but was reduced to fair without vine lifters.

The minimum cutting height for the MacDon Conventional knife system on the Westward 7000 windrower was about 2.7 in (69 mm). In some crops, the knife cut above the very low growing vines. In lentils, this loss amounted to as much as 5% of the total crop yield. Installing rigid vine lifters (FIGURE 2) helped lift the low vines and cutting losses were greatly reduced. With the rigid lifters spaced 9 or 12 in (230 or 305 mm) along the cutterbar, cutting loss was less than 1% of the total crop yield.

Stubble was usually cut cleanly at a uniform height when using a sharp, clean knife. As gumming occurred, the knife was lifted off the guards and cutting effectiveness was reduced with the stubble becoming ragged. In green or weedy pulse crops, the knife had to be cleaned about every 10 hours to maintain effective cutting.

Shattering: The ability to cut without shattering was fair.

In the test crop of mature lentils, approximately 2 to 2.5% of the total yield was shatter loss caused by the mechanical action of the MacDon Conventional knife system. This loss was attributed to the 3 in (76 mm) cutting intervals which were believed to have caused considerable sideways movement of the plants during cutting.

In general, shatter loss was highly dependant on crop ripeness, moisture conditions, and weather. As well, natural or shedding loss in some pea crops was in excess of 30% of the yield before windrowing. It should be recognized that in such conditions, the shatter loss caused by the MacDon Conventional knife system would be insignificant compared to losses due to weather. For any knife system, shatter and natural losses often can be appreciably reduced by harvesting the crop at an earlier stage, or by cutting during cool, moist weather.

Crop Adhesion: The ability to operate when gumming occurred was fair.

Gumming occurred on all parts of the knife system (FIGURE 2). Material built up in the channel under the knife bar and was especially detrimental as it lifted the knife away from the guards. This reduced the cutting effectiveness and resulted in mechanical damage as knife sections contacted the top lips of the guards.

Gumming was especially severe in immature crops and weed infested areas. In most pea and lentil crops encountered during the test, the knife had to be removed and cleaned after about every 10 hours of cutting to maintain cutting effectiveness and avoid knife damage.

POWER

In pea and lentil crops, 1.7 to 2.6 hp (1.3 to 1.9 kW) was required to drive the 21 ft (6.4 m) knife. Power requirements increased proportionally to travel speed and crop yield, but power was not affected by gumming.

FIGURE 2. Crop Material Adhesion and Buildup.

SPECIFICATIONS	
MAKE AND MODEL:	MacDon Conventional
MANUFACTURER:	MacDon Industries Ltd. 680 Moray Street Winnipeg, Manitoba R3J 3S3
KNIFE SECTION:	
-- length	3.25 in (83 mm)
-- width	3.00 in (76 mm)
-- thickness	0.11 in (2.7 mm)
-- serration	0.30 in (7.6 mm) parallel to stroke
-- point spacing	3.00 in (76 mm)
-- fasteners	7/32 x 5/8 in (5.6 x 16 mm) rivets
GUARD:	
-- length	7.00 in (178 mm)
-- width	5.90 in (150 mm)
-- height	1.35 in (34 mm)
-- bolt size	7/16 UNC
-- point spacing	3.00 in (76 mm)
KNIFE ALIGNMENT:	steel hold-down clips spaced 12 in (300 mm) along top of knife

EASE OF OPERATION AND ADJUSTMENT

Installation: Ease of installing was very good.

No installation instructions were available, and the operator's manual made no mention of knife installation.

The complete installation of the assembled knife, guards and hold-down clips on a 21 ft (6.4 m) windrower took two people about 1 hour. Since this knife was factory installed on the test windrower, all hardware was supplied and no alterations or adjustments were necessary. Although not sold specifically for after market installation on other windrowers, the parts could also be obtained separately for such use.

Adjusting: Ease of adjusting was good.

Only one adjustment was necessary. As gumming occurred the clips were bent upward and wear increased. After cleaning, the hold-down clips had to be bent down to maintain firm contact between the cutting surfaces. No other adjustments were necessary. The MacDon Conventional knife system did not require the use of any shims or wear plates.

Cleaning: Ease of cleaning was good.

The knife had to be removed to thoroughly clean the material from beneath the knife backing bar. To remove the knife, the hold-down clips had to be loosened and the knife head disconnected from the wobble drive. The material buildup was removed with scrapers such as a wide blade screwdriver or putty knife. It is possible that a high pressure washer may also remove the buildup more quickly although this was not tried.

Servicing: Ease of servicing was good.

Changing one riveted knife section took about 15 minutes. A hammer, chisel, and rivet tool were required. It was usually necessary to remove a guard to improve access to the broken or dull knife section. Bolt-on knife sections were not available.

Guards and hold-down clips were very easy to change, requiring only one wrench. The knife was easy to remove by sliding it out the drive end of the cutterbar.

OPERATOR SAFETY

All knife systems present a hazard both when cutting and if not handled safely during service. Extreme care should be exercised at all times. The MacDon Conventional knife system did not pose any danger uncommon to other knife systems.

OPERATOR'S MANUAL

The operator's manual was fair.

No separate manual on the knife system was available since the knife was factory installed with the windrower. The windrower manual provided very little information on the knife, discussing only briefly the safety and operating concerns.

MECHANICAL HISTORY

A total of 23 knife sections and 9 guards had to be replaced during 33 hours of cutting in a variety of soil and crop conditions. The knife sections usually broke loose at the rivets due to contact with small stones up to 2 in (50 mm) in diameter. The guards were usually damaged when crop material built up under the knife, raising the knife section into contact with the top lip of the guard. The cutting edges of the knife sections were beginning to dull after the 33 hours of use.

SCHUMACHER EASY-CUT KNIFE SYSTEM

MANUFACTURER:

Gebr. Schumacher Gmbh
D-5231 Eichelhardt
Westerwald, West Germany

DISTRIBUTOR:

Honey Bee Manufacturing Ltd.
P.O. Box 120
Frontier, Saskatchewan
S0N 0W0
Phone: (306) 296-2297

RETAIL PRICE:

$1,062.00 [July, 1989, f.o.b. Humboldt, Sask. for a complete 21 ft (6.4 m) knife with knife sections, bar, hardware and guards].

SUMMARY AND CONCLUSIONS

Rate of Work: The Schumacher Easy-Cut knife system cut smoothly and effectively up to about 6 mph (10 km/h) in lentils and peas when rigid vine lifters were used. Without lifters, speed had to be reduced for better operator control.

Quality of Work: Quality of cut was very good with rigid lifters, and fair without lifters. Lifters reduced cutting loss from 5% of total crop yield to less than 1%. Under all conditions with a sharp knife, the stubble was a uniform height and cut cleanly. The ability to cut without shattering was fair. About 2 to 2.5% of total crop yield was lost due to shattering in mature lentils. The ability to operate effectively as crop adhesion or gumming occurred was good. Although cutting effectiveness was not reduced, gumming did cause knife power requirements to increase greatly.

Power: About 1.6 to 2.5 hp (1.2 to 1.9 kW) was typically needed to drive the 21 ft (6.4 m) knife when clean. As gumming occurred, up to 14 hp (10 kW) was needed.

Ease of Operation and Adjustment: Ease of installation was very good. It took two people about 1.5 hours to install the guards and assembled knife. The 3/8 in (10 mm) guard bolts in the 7/16 in (11 mm) holes on the windrower made guard alignment awkward. Ease of adjusting was excellent. No adjustments were needed at any time. Ease of cleaning was fair. The knife was difficult to remove. Ease of servicing was very good. It took about 5 minutes to change one bolt-on knife section.

Operator Safety: As with alt cutterbars, extreme caution was required when servicing or repairing the knife.

Operators Manual: The operator's manual was very good. It contained thorough and well illustrated instructions on installing and maintaining the knife system.

Mechanical History: A total of 8 knife sections and 1 guard had to be replaced during 32 hours of cutting.

GENERAL DESCRIPTION

The Schumacher Easy-Cut knife system (FIGURE 3) consists of 3.0 in (76 mm) wide, top serrated, knife sections bolted on top of a continuous length of backing bar. Every second knife section is inverted, giving cutting surfaces on the tops and bottoms of every guard point. The high carbon steel guards are 6.0 in (150 mm) wide with points spaced every 3.0 in (76 mm). The guards wrap completely around the knife, holding the knife in place and eliminating the need for hold-down clips. Spacer bars are required to position the knife.

SCOPE OF TEST

The Schumacher Easy-Cut knife system was operated for 32 hours while cutting about 280 ac (113 ha) of lentils and peas. The knife was operated with and without various vine lifters. Half moon rigid lifters were used for all cutting and shatter loss measurements.

RESULTS AND DISCUSSION

RATE OF WORK

The Schumacher Easy-Cut knife system cut effectively at speeds up to 6 mph (10 km/h) when rigid vine lifters were used. Without vine lifters, the pea or lentil vines had to be aggressively pulled up and over the cutterbar with the pickup reel. This increased crop losses and generally cutting speed had to be reduced to give the operator better control over crop feeding.

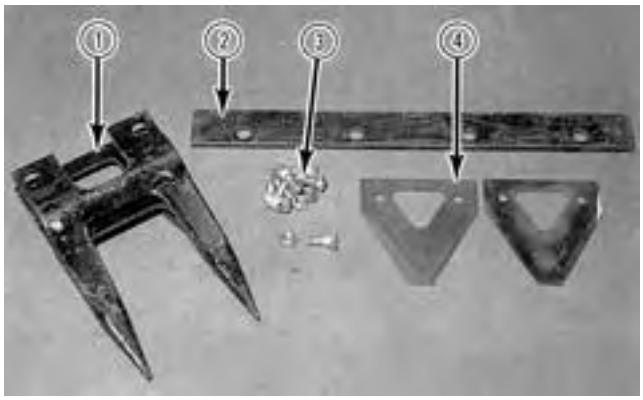


FIGURE 3. Schumacher Easy-Cut: 1) Guard, 2) Spacer Bar, 3) Bolts, 4) Knife Sections.

QUALITY OF WORK

Cutting: Cutting was very good when using rigid vine lifters but was reduced to fair without vine lifters.

With the Schumacher Easy-Cut knife system, the minimum cutting height for the Westward 7000 windrower was about 2.7 in (69 mm). In some crops, the knife cut above the low growing vines. In lentils, this loss amounted to as much as 5% of the total crop yield. The manufacturer supplied a set of skid type lifters, but they did not work as well as rigid types, especially in lentils. Installing rigid vine lifters (FIGURE 4) helped lift the low vines and cutting losses were greatly reduced. With the rigid lifters spaced at 9 or 12 in (230 or 305 mm) along the cutterbar, cutting loss was less than 1% of the total crop yield.

Stubble was cut cleanly at a uniform height when using a sharp knife even when gumming occurred. The wraparound guards maintained contact between cutting surfaces for effective cutting. As long as the windrower drive could maintain proper knife speed for the additional power requirements, cutting was not affected.

FIGURE 4. Crop Material Adhesion and Buildup.

Shattering: The ability to cut without shattering was fair.

In the test crop of mature lentils, approximately 2 to 2.5% of the total crop yield was shatter loss caused by the mechanical action of the Schumacher Easy-Cut knife system. This loss was attributed to the 3 in (76 mm) cutting intervals, which were believed to have caused considerable sideways movement of the plants during cutting.

In general, shatter loss was highly dependent on crop ripeness, moisture conditions, and weather. Natural or shedding loss in some pea crops was in excess of 30% of the crop yield before windrowing. It should be recognized that in such conditions, the shatter loss caused by the Schumacher Easy-Cut knife system would be insignificant compared to losses due to weather. For any knife system shatter and natural losses often can be appreciably reduced by harvesting the crop at an earlier stage, or by cutting during cool, moist weather.

Crop Adhesion: The ability to operate when gumming occurred was good.

Gumming occurred on all parts of the knife system (FIGURE 4). Material built up on the knife sections and knife backing bar, but the wrap-around guard ensured that cutting surfaces remained in close contact. As gumming occurred, the tight fit between the knife and guards greatly increased the power requirements.

Gumming was especially severe in immature crops and green weed infested areas. In most pea and lentil crops the knife had to be removed and cleaned after about every 10 hours of cutting to prevent excessive cutting power demands.

POWER

In pea and lentil crops, 1.6 to 2.5 hp (1.2 to 1.9 kW) was required to drive the 21 ft (6.4 m) knife. Power requirements increased slightly in proportion to travel speed and crop yield. However, as gumming occurred power requirements increased to as high as 14 hp (10 kW). It is possible that some windrower drives may not be able to meet these requirements and knife stalling could occur.

EASE OF OPERATION AND ADJUSTMENT

Installation: Ease of installing was very good. Installation instructions were clear, thorough and well illustrated. Complete installation of the knife, guards and spacer bars on a 21 ft (6.4 m) windrower took two people about 1.5 hours. The 3/8 in (10 mm) guard bolts fit loosely in the 7/16 in (11 mm) holes on the windrower frame. Each guard had to be manually aligned as the knife was slid in from the drive end. This made installation slow and tedious. On other makes of windrowers, with 3/8 in (10 mm) frame holes, installation would have been easier and quicker.

Adjusting: Ease of adjusting was excellent.

No adjustments were necessary once the knife was installed. Contact between upper and lower cutting surfaces was maintained without any need for shims or hold-down clips.

Cleaning: Ease of cleaning was fair.

The knife had to be removed to thoroughly clean the material from the knife and guards. This was difficult because the knife fit very tightly in the guards after gumming had occurred. The material buildup was removed with scrapers such as a wide blade screwdriver, or putty knife. It is possible that a high pressure washer may have removed the build up more easily although this was not tried.

Servicing: Ease of servicing was very good.

The bolt-on knife sections were easily changed with hand tools in about 5 minutes. One or two guards had to be removed to access the knife section bolts.

Guards were very easy to change. The knife was easy to remove by sliding it out the drive end of the cutterbar.

OPERATOR SAFETY

All knife systems present a hazard both when cutting and if not handled safely during service. Extreme care should be exercised at all times. The Schumacher Easy-Cut knife system did not pose any danger uncommon to other knife systems.

OPERATOR'S MANUAL

The operator's manual was very good. It contained a thorough explanation of installation procedures. Several sketches helped clarify the knife system.

MECHANICAL HISTORY

A total of 8 knife sections and 1 guard had to be replaced during 32 hours of cutting in a variety of soil and crop conditions. The knife sections usually broke due to contact with small stones up to 2 in (50 mm) in diameter. The guard failed apparently from a poor weld. The guards were generally very tough.

Cutting surfaces showed minimal wear after 32 hours of cutting.

SPECIFICATIONS

MAKE AND MODEL:	Schumacher Easy-Cut
MANUFACTURER:	Gebr. Schumacher GMbh D-5231 Eichelhardt Westerwaid, West Germany
KNIFE SECTION:	
-- length	3.20 in (81 mm)
-- width	3.00 in (76 mm)
-- thickness	0.10 in (2.5 mm)
-- serration	0.32 in (76 mm) parallel to stroke
-- point spacing	3.00 in (76 mm)
-- fasteners	6 x 16 mm hex head spline bolts
GUARD:	
-- length	6.35 in (160 mm)
-- width	3.80 in (97 mm)
-- height	1.50 in (38 mm)
-- bolt size	3/8 UNC
-- point spacing	3.00 in (76 mm)
KNIFE ALIGNMENT:	spacer bars under cutterbar, no hold-downs required, guard holds knife top and bottom

WESTWARD TWIN TOOTH KNIFE SYSTEM

MANUFACTURER AND DISTRIBUTOR:

Westward Parts Services Ltd.
6517 - 67th Street
Red Deer, Alberta
T4P 1A3
Phone: (403) 342-5510

RETAIL PRICE:

$637.00 [July, 1989, f.o.b. Humboldt, Sask. for a complete 21 ft (6.4 m) knife and guards. Hardware was not supplied].

SUMMARY AND CONCLUSIONS

Rate of Work: The Westward Twin Tooth knife system cut smoothly and effectively up to about 6 mph (10 km/h) in lentils and peas when rigid vine lifters were used. Without lifters, speed had to be reduced for better operator control.

Quality of Work: Quality of cut was very good with rigid lifters and fair without lifters. Lifters reduced cutting toss from 5% of the total crop yield to less than 1%. With a clean cutterbar and sharp knife the stubble was a uniform height and cut cleanly, but as gumming occurred cutting effectiveness decreased. The ability to cut without shattering was very good. Less than 1% of total crop yield was lost through shattering in mature lentils. The ability to operate effectively as crop adhesion or gumming occurred was fair. Gumming usually became severe enough that the cutterbar had to be cleaned about every 10 hours.

Power: About 2.2 to 2.7 hp (1.6 to 2.0 kW) was needed to drive the 21 ft (6.4 m) knife.

Ease of Operation and Adjustment: Ease of installation was fair. It took two people about 1 hour to install the guards and assembled knife. The top and bottom guards had different hole sizes and the mounting belts were not supplied. Ease of adjusting was fair. The wear plates had limited adjustment so shims were required. Ease of cleaning was good. The knife was easily removed if the top guards were loosened. Ease of servicing was excellent, it took only 3 minutes to change one bolt-on knife section as guards did not have to be removed.

Operator Safety: As with all cutterbars, extreme caution was required when servicing or repairing the knife.

Operator's Manual: The operator's manual was poor. No written instructions were provided.

Mechanical History: A total of 46 knife sections and no guards were replaced during 33 hours of cutting,

GENERAL DESCRIPTION

The Westward Twin Tooth knife system (FIGURE 5) consists of 3.0 in (76 mm) wide double-pointed, top serrated, knife sections bolted on top of a continuous length of backing bar. The 6.0 in (150 mm) wide, forged steel, guards have points spaced every 1.5 in (38 mm). The top, forged steel, guards are spaced at 12 in (300 mm) intervals and there are wear plates along the entire length of the cutterbar to hold the knife in place. Shims are placed under the wear plates and top guards to maintain alignment and set the clearance between cutting surfaces. The tips of the knife sections protrude just ahead of the tips of the guards.

SCOPE OF TEST

The Westward Twin Tooth knife system was operated for 33 hours while cutting about 270 ac (110 ha) of lentils and peas. The knife was operated with and without various vine lifters. Half moon rigid lifters were used for all cutting and shatter loss measurements.

RESULTS AND DISCUSSION

RATE OF WORK

The Westward Twin Tooth knife system cut effectively at speeds up to 6 mph (10 km/h) when rigid vine lifters were used. Without vine lifters, the pea or lentil vines had to be aggressively pulled up and over the cutterbar with the pickup reel. This increased crop losses and generally cutting speed had to be reduced to give the operator better control over crop feeding.

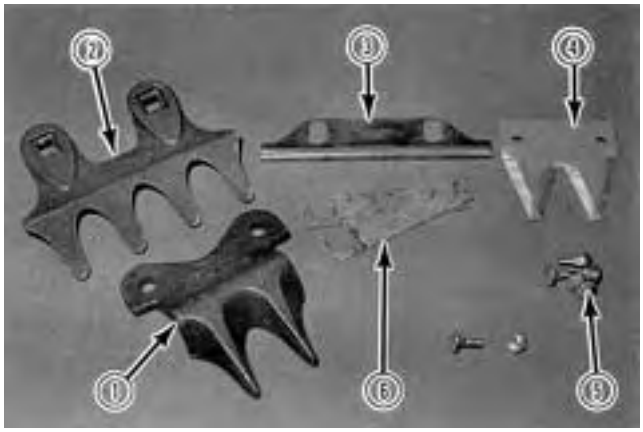


FIGURE 5. Westward Twin Tooth: 1) Upper Guard, 2) Lower Guard, 3) Wear Plate, 4) Knife Section, 5) Belts, 6) Shims.

QUALITY OF WORK

Cutting: Cutting was very good when using rigid vine lifters but was reduced to fair without the vine lifters.

The minimum cutting height for the Westward Twin Tooth knife system on the Westward 7000 windrower was about 2.7 in (69 mm). In some crops, the knife cut above the low growing vines. In lentils, this loss amounted to as much as 5% of the total crop yield. Installing rigid vine lifters helped lift the low vines and cutting losses were greatly reduced. With rigid lifters spaced at 9 or 12 in (230 or 305 mm) along the cutterbar, cutting loss was less than 1% of the total crop yield.

Stubble was usually cut cleanly at a uniform height when using a sharp, clean knife. As gumming occurred, the knife was lifted off the guards, and cutting effectiveness was reduced with the stubble becoming ragged. In green or weedy pulse crops, the knife had to be cleaned about every 10 hours to maintain effective cutting.

Shattering: The ability to cut without shattering was very good.

In the test crop of the mature lentils, less than 1% of the total crop yield was shatter loss caused by the mechanical action of the Westward Twin Tooth knife system. The low loss was attributed to the 1.5 in (37 mm) cutting intervals, which was believed to have produced minimal sideways movement of plants during cutting.

In general shatter loss was highly dependent on crop ripeness, moisture conditions, and weather. As well, natural or shedding loss in some pea crops was in excess of 30% of yield before windrowing. It should be recognized that in such conditions, the shatter loss caused by the Westward Twin Tooth knife system would be insignificant compared to the losses due to weather. For any knife system, shatter and natural losses often can be appreciably reduced by harvesting the crop at an earlier stage, or by cutting during cool, moist weather.

Crop Adhesion: The ability to operate when gumming occurred was fair.

Gumming occurred on all parts of the knife system (FIGURE 6). Material built up in the channel under the knife bar and was especially detrimental as it lifted the knife away from the guards. This reduced the cutting effectiveness and may have contributed to the number of knife sections damaged as the material buildup forced the knife into the top guards.

Gumming was especially severe in immature crops and weed infested areas. In most pea and lentil crops encountered during the test, the knife had to be removed and cleaned about every 10 hours to maintain effective cutting and avoid knife damage.

POWER

In pea and lentil crops, 2.2 to 2.7 hp (1.3 to 1.9 kW) was required to drive the 21 ft (6.4 m) knife. Power requirements increased proportionally to travel speed and crop yield, but power was not affected by gumming.

EASE OF OPERATION AND ADJUSTMENT

Installation: Ease of installing the Westward Twin Tooth knife system was fair. No instructions were supplied, so the manufacturer had to be consulted directly.

The complete installation of the knife, guards and hold-down clips on a 21 ft (6.4 m) windrower took two people about 1 hour. Installation was complicated because no guard bolts were supplied. As well, the top guards had 3/8 in (10 mm) holes, while the bottom guards and the windrower frame holes were 7/16 in (11 mm). Spacers were supplied to shim all holes to 3/8 in (10 mm), but the spacers would not stay in place. As a result, the guards were pushed forward in all holes as an alignment procedure. The wear plates had to be shimmed for proper alignment of the cutting surfaces.

FIGURE 6. Crop Material Adhesion and Buildup.

Adjusting: Ease of adjusting was fair.

The wear plates could not be adjusted enough to provide proper knife position, so shims were added. The top guards could not be bent for adjusting contact between the cutting surfaces, so the shims had to be rechecked after the knife had worn.

Cleaning: Ease of cleaning was good.

The knife had to be removed to thoroughly clean the material from beneath the knife backing bar. To remove the knife, the top guards had to be loosened and the knife head disconnected from the wobble drive. The material buildup was removed with scrapers such as a wide blade screwdriver, or putty knife. It is possible that a high pressure washer may also remove most buildup more quickly although this was not tried.

Servicing: Ease of servicing was excellent.

The bolt-on knife sections were easily changed with hand tools in about 3 minutes. Knife sections could be changed without removing the guards.

Guards and wear plates were very easy to change. The knife was easy to replace by sliding it out the drive end of the cutterbar.

OPERATOR SAFETY

All knife systems present a hazard both when cutting and if not handled safely during service. Extreme care should be exercised at all times. The Westward Twin Tooth knife system did not pose any danger uncommon to other knife systems.

OPERATOR'S MANUAL

The operator's manual was poor.

No written material was provided. A sketch in the manufacturer's catalogue helped identify the correct placement of parts, but the sketch was too general to show exact parts layout for the test windrower.

MECHANICAL HISTORY

A total of 46 knife sections and no guards were replaced during 33 hours of cutting in a variety of soil and crop conditions. Usually only one point broke off the double-pointed knife section. The knife points were also exposed ahead of the guard points, which may have reduced their protection and increased knife section breakage. The cutting edges of the knife sections were beginning to dull after the 33 hours of use.

SPECIFICATIONS

MAKE AND MODEL:	Westward Twin Tooth	
MANUFACTURER:	Westward Parts Services Ltd. 6517 - 67th St. Red Deer, Alberta T4P 1A3	
KNIFE SECTION:		
-- length	3.23 in (82 mm)	
-- width	3.00 in (76 mm)	
-- thickness	0.11 in (2.8 mm)	
-- serration	0.32 in (8 mm) parallel to stroke	
-- point spacing	1.50 in (38 mm)	
-- fasteners	3/16 x 1.0 in UNC carriage head spline bolt	
GUARD:	**Lower**	**Upper**
-- length	4.60 in (117 mm)	4.48 in (114 mm)
-- width	5.90 in (150 mm)	4.30 in (109 mm)
-- height	0.85 in (22 mm)	0.78 in (20 mm)
-- bolt size	7/16 UNC	3/8 UNC
-- point spacing	1.50 in (38 mm)	1.50 in (38 mm)
KNIFE ALIGNMENT:	Shims along cutterbar, upper guards spaced 12 in (300 mm) along top of knife	

CRARY 4 IN I KNIFE SYSTEM

MANUFACTURER:

Crary Company
P.O. Box 1779
Fargo, North Dakota 58107
U.S.A.

DISTRIBUTOR:

Appollo Distributing Company
P.O. Box 528
White City, Saskatchewan
S0G 5B0
Phone: (306) 781-2644

RETAIL PRICE:

$977.00 [July, 1989, f.o.b. Humboldt, Sask. for a complete 21 ft (6.4 m) knife with knife sections, bar, hardware and guards].

SUMMARY AND CONCLUSIONS

Rate of Work: The Crary 4 in 1 system cut smoothly and effectively up to about 6 mph (10 km/h) in lentils and peas when rigid vine lifters were used. Without lifters, speed had to be reduced for better operator control.

Quality of Work: Quality of cut was very good with rigid lifters and fair without lifters. Lifters reduced cutting toss from 5% of total crop yield to less than 1%. With a clean cutterbar and sharp knife, the stubble was a uniform height and cut cleanly, but as gumming occurred cutting effectiveness decreased. The ability to cut without shattering was very good. Less than 1% of total crop yield was lost due to shattering in mature lentils. The ability to operate effectively as crop adhesion or gumming occurred was fair. Gumming usually became severe enough that the cutterbar had to be cleaned about every 10 hours,

Power: About 1.6 to 2.4 hp (1,2 to 1.8 kW) was needed to drive the 21 ft (6.4 m) knife.

Ease of Operation and Adjustment: Ease of installation was good. It took two people about 1 hour to install the guards and assembled knife. Ease of adjusting was good. The shims and wear plates required occasional resetting. Ease of cleaning was good. The knife was easily removed if the hold-downs were loosened. Ease of servicing was very good. It took about 4 to 5 minutes to change a bolt-on knife section.

Operator Safety: As with all cutterbars, extreme caution was required when servicing or repairing the knife.

Operator's Manual: The operator's manual was good. Detailed instructions for several makes of combines were provided, but not for the Westward 7000 windrower.

Mechanical History: A total of four knife sections and no guards had to be replaced during 31 hours of cutting,

GENERAL DESCRIPTION

The Crary 4 in 1 knife system (FIGURE 7) consists of 3.0 in (76 mm) wide, top serrated, knife sections bolted on top of a sectional backing bar. The sectional knife bar consists of 8 ft (2.4 m) lengths, which are joined with knife section bolts. The 6.0 in (150 mm) wide, forged steel, guards provided cutting surfaces spaced 1.5 in (37 mm) apart by using partial guard points between the full guard points spaced every 3.0 in (76 mm). The knife is held in place by the guards and wear plates on the bottom and hold-down clips spaced every 12 in (305 mm) along the top.

SCOPE OF TEST

The Crary 4 in 1 knife system was operated for 31 hours while cutting about 275 ac (110 ha) of lentils and peas. The knife was operated with and without various vine lifters. Half moon, rigid lifters were used for all cutting and shatter loss measurements.

RESULTS AND DISCUSSION

RATE OF WORK

The Crary 4 in 1 knife system cut effectively at speeds up to 6 mph (10 km/h) when rigid vine lifters were used. Without vine lifters, the pea or lentil vines had to be aggressively pulled up and over the cutterbar with the pickup reel. This increased crop losses and generally cutting speed had to be reduced to give the operator better control over crop feeding.

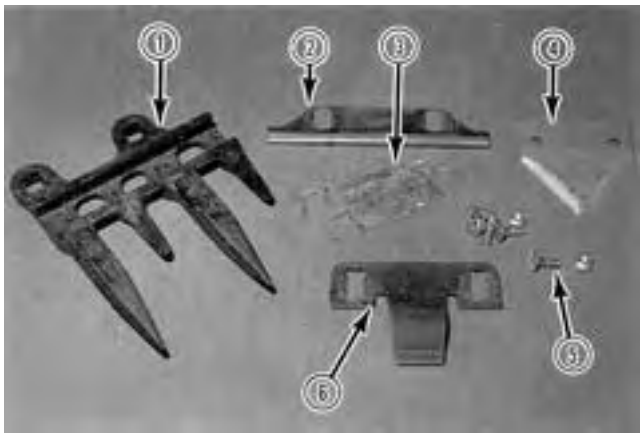


FIGURE 7. Crary 4 in 1: 1) Guard, 2) Wear Plate, 3) Shims, 4) knife Section, 5) Bolts, 6) Hold-down Clip.

QUALITY OF WORK

Cutting: Cutting was very good when using rigid vine lifters, but was reduced to fair without the vine lifters.

The minimum cutting height for the Crary 4 in 1 knife system on the Westward 7000 windrower was about 2.7 in (69 mm). In some crops, the knife cut above the very low growing vines. In lentils, this loss amounted to as much as 5% of the total crop yield. Installing rigid vine lifters (FIGURE 8) helped lift the low vines and cutting losses were greatly reduced. With the rigid lifters spaced at 9 or 12 in (230 or 305 mm) along the cutterbar, cutting loss was less than 1% of the total crop yield.

Stubble was usually cut cleanly at a uniform height when using a sharp, clean knife. As gumming occurred, the knife was lifted off the guards and cutting effectiveness was reduced with the stubble becoming ragged. In green or weedy pulse crops, the knife had to be cleaned about every 10 hours to maintain effective cutting.

Shattering: The ability to cut without shattering was very good. In the test crop of mature lentils, less than 1% of the total crop yield was shatter loss caused by the mechanical action of the Crary 4 in 1 knife system. The low loss was attributed to the 1.5 in (37 mm) cutting intervals, which was believed to have produced minimal sideways movement of the plants during cutting.

In general, shatter loss was highly dependent on crop ripeness, moisture conditions, and weather. As well, natural or shedding loss in some pea crops was in excess of 30% of the yield before windrowing. It should be recognized that in such conditions, the shatter loss caused by the Crary 4 in 1 knife system would be insignificant compared to losses due to weather. For any knife system, shatter and natural losses often can be appreciably reduced by harvesting the crop at an earlier stage, or by cutting during cool, moist weather.

Crop Adhesion: The ability to operate when gumming occurred was fair.

Gumming occurred on all parts of the knife system (FIGURE 8). Material built up in the channel under the knife bar and was especially detrimental as it lifted the knife away from the guards. This reduced the cutting effectiveness.

Gumming was especially severe in immature crops and weed infested areas. In most pea and lentil crops encountered during the test, the knife had to be removed and cleaned after about every 10 hours of cutting to maintain cutting effectiveness.

POWER

In pea and lentil crops, 1.6 to 2.4 hp (1.2 to 1.8 kW) was required to drive the 21 ft (6.4 m) knife. Power requirements increased proportionally to travel speed and crop yield, but power was not affected by gumming.

FIGURE 8. Crop Material Adhesion and Buildup.

SPECIFICATIONS	
MAKE AND MODEL:	Crary 4 in 1
MANUFACTURER:	Crary Company P.O. Box 1779 Fargo, North Dakota 58107
KNIFE SECTION:	
-- length	3.20 in (81 mm)
-- width	3.00 in (76 mm)
-- thickness	0.11 in (2.7 mm)
-- serration	0.43 in (11 mm) parallel to stroke
-- point spacing	3.0 in (76 mm)
-- fasteners	7/32 x 1.0 in UNC carriage head spline bolt
GUARD:	
-- length	6.95 in (177 mm)
-- width	5.40 in (137 mm)
-- height	1.40 in (36 mm)
-- bolt size	7/16 UNC
-- point spacing	full points 3.00 in (76 mm) lower only 1.50 in (38 mm)
KNIFE ALIGNMENT:	wear plates along cutterbar, steel hold-down clips spaced 12 in (300 mm) along top of knife

EASE OF OPERATION AND ADJUSTMENT

Installation: Ease of installing was good.

The manufacturer's instructions were complete and easy to follow.

The complete installation of the knife, guards and hold-down clips on a 21 ft (6.4 m) windrower took two people about 1 hour. All hardware was supplied, but the knife head had to be obtained separately. The wear plates and hold-down clips had to be trimmed at the back to fit around welds on the windrower.

Adjusting: Ease of adjusting was good.

Only one adjustment was necessary. As gumming occurred the hold-down clips were bent upward. After cleaning, the hold-down clips had to be bent downward and the wear plates and shims had to be adjusted to maintain firm contact between the knife and guard cutting surfaces.

Cleaning: Ease of cleaning was good.

The knife had to be removed to thoroughly clean the material from beneath the knife backing bar. To remove the knife, the hold-down clips had to be loosened and the knife head disconnected from the wobble drive. The material buildup was removed with scrapers such as a wide blade screwdriver, or putty knife. It is possible that a high pressure washer may also remove the buildup more quickly although this was not tried.

Servicing: Ease of servicing was very good.

The bolt-on knife sections were easily changed with hand tools in about 4 to 5 minutes. Knife sections could be changed without removing guards.

Guards and hold-down clips were very easy to change, requiring only one wrench. The knife was easy to remove by sliding it out the drive end of the cutterbar.

OPERATOR SAFETY

All knife systems present a hazard, both when cutting and if not handled safely during service. Extreme care should be exercised at all times. The Crary 4 in 1 knife system did not pose any danger uncommon to other knife systems.

OPERATOR'S MANUAL

The operator's manual was good.

The single sheet of instructions was clear, complete and well illustrated. Instructions were intended for straight-cut combine heads, and were not available specifically for the windrower.

MECHANICAL HISTORY

A total of 4 knife sections and no guards had to be replaced during 31 hours of cutting in a variety of soil and crop conditions. The knife sections usually broke when working in very stony fields. The cutting surfaces of both the knives and guards were beginning to dull slightly after the 31 hours of use. The serrations on each knife section gradually became deeper as the knife wore.

VINE LIFTERS

Cutting performance of all four knives was greatly enhanced through the use of vine lifters (FIGURE 9). Vine lifters reduced the number of missed plants of any knife system from 5% to less than 1.5% of crop yield. Vine lifters also reduced the incidence of plugging, and permitted faster travel speeds, up to 6 mph (10 km/h), in most pea and lentil fields.

The study showed that vine lifters are a very economical investment for harvesting peas and lentils. The crop saved is substantial and will pay back the purchase price quickly.

Rigid lifters were preferred over skid lifters in all cases. They penetrated the soil to lift completely flattened vines. Skid lifters rode over the lowest vines, causing losses.

In short and medium height pulse crops the smaller rigid lifters, like those illustrated in FIGURE 9, performed best. In taller, longer vined crops, longer and taller lifters like most half moon designs performed best. Lifters worked best at 9 or 12 in (230 or 300 mm) spacing. Closer spacing caused plugging between lifters, while wider spacing caused some vines to slip under the cutterbar.

The adjustment of rigid lifters was critical. Each lifter had to be shimmed to match the angle of the guards so that the tip of each lifter barely contacted the ground with the header fully lowered. Instructions varied slightly for each manufacturer, and some recommended different settings for different crop conditions.

Crop material adhered to the side of the lifters just as it did to the knives. However, gumming normally did not affect lifter performance.

Eight different types of vine lifters were examined in this study, and many more makes are available from prairie manufacturers. Specifications of the eight makes are listed in VINE LIFTER SPECIFICATIONS.

FIGURE 9. Rigid Type Vine Lifter Attachments.

VINE LIFTER SPECIFICATIONS

LOUIS MEDERNACH RIGID

MANUFACTURER: Dutch Industries
705 - 1st Avenue
Regina, Saskatchewan
S4N 4M4
(306) 949-9522

DIMENSIONS:

-- length	11.6 in (295 mm)
-- width	0.38 in (9.5 mm)
-- height	2.5 in (63.5 mm)

GUARD TIP TO LIFTER POINT: 5 in (127 mm)

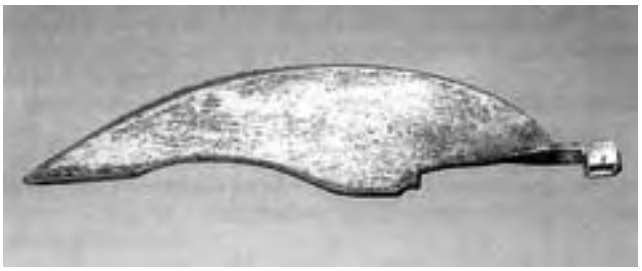
MODIFIED HALF MOON RIGID

MANUFACTURER: Hawken Industries
P.O. Box 342
Moose Jaw, Saskatchewan
S6H 4M9
(306) 788-4938

DIMENSIONS:

-- length	19.5 in (495 mm)
-- width	0.25 in (6.4 mm)
-- height	4.75 in (121 mm)

GUARD TIP TO LIFTER POINT: 12.5 in (318 mm)



HALF MOON RIGID FOR QUICK CUT KNIFE

MANUFACTURER: Empire Welding and
Machine Ltd.
P.O. Box 1565
North Battleford, Sask.
S9A 3W1
(306) 446-3444

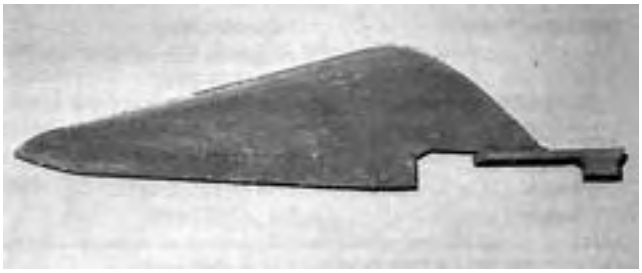
DIMENSIONS:

-- length	12 in (305 mm)
-- width	0.25 in (6.4 mm)
-- height	3.75 in (95.3 mm)

GUARD TIP TO LIFTER POINT: 7.5 in (19.1 mm)

DIAMOND WEDGE RIGID

MANUFACTURER: Joe St. Denis
Morinville, Alberta
T0G 1T0
(403) 961-3368



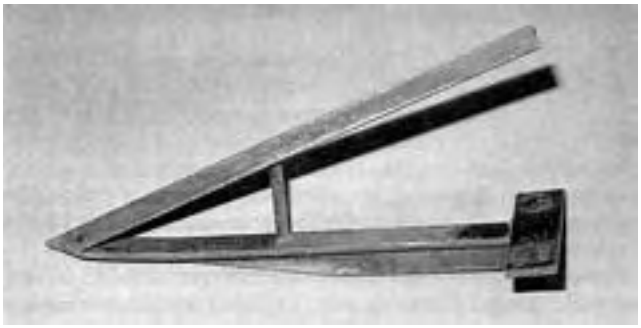
DIMENSIONS:

-- length	18.5 in (470 mm)
-- width	0.25 in (6.4 mm)
-- height	4.5 in (114 mm)

GUARD TIP TO LIFTER POINT: 12 in (305 mm)

“THE MAZE” FOR KWIK CUT SKID

MANUFACTURER: MazeSeed Farm
Phippen, Saskatchewan
S0K 3E0
(306)398-2600



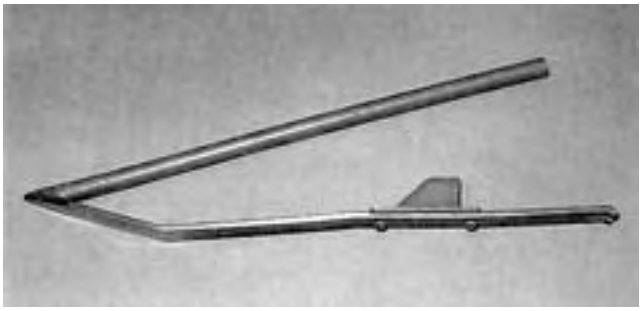
DIMENSIONS:

-- length	16 in (406 mm)
-- width	1.0 in (25.4 mm)
-- height	8.0 in (203 mm)

GUARD TIP TO LIFTER POINT: 11.0 in (279 mm)

INLAND STEEL SKID

MANUFACTURER: Robinson Alamo
2412 Millar Avenue
Saskatoon, Saskatchewan
S7K 3V2
(306) 933-2412

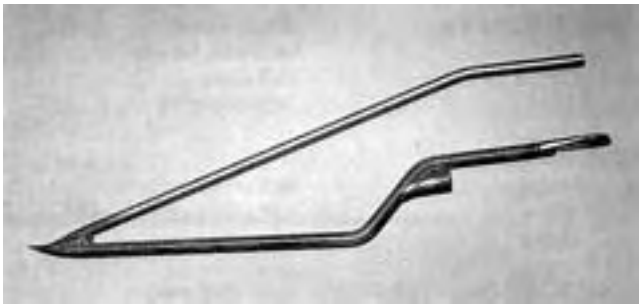


DIMENSIONS:

-- length	22.5 in (572 mm)
-- width	1.25 in (31.8 mm)
-- height	6.5 in (165 mm)

GUARD TIP TO LIFTER POINT: 16.0 in (406 mm)

SCHUMACHER SPECIAL SERIES SKID



MANUFACTURER: Honey Bee Mfg. Ltd.
P.O. Box 120
Frontier, Saskatchewan
S0N 0W0
(306) 296-2297

DIMENSIONS:
-- length 23.5 in (597 mm)
-- width 1.25 in (31.8 mm)
-- height 6.50 in (165 mm)

GUARD TIP TO LIFTER POINT: 8.0 in (203 mm)

PEALIFTER SKID

MANUFACTURER: Felsch Welding
Ridgeville, Manitoba
(204) 373-2059

DIMENSIONS:
-- length 19.0 in (483 mm)
-- width 0.43 in (109 mm)
-- height 6.0 in (152 mm)

GUARD TIP TO LIFTER POINT: 13.5 in (343 mm)

POLYETHYLENE SKID COVER

Polyethylene is marketed as a friction and adhesion reducing surface cover for ground-contacting parts of many agricultural implements. On windrowers, polyethylene is sold as a cover to reduce mud buildup and drag along the cutterbar skid.

A polyethylene skid cover was compared to the conventional bare steel skid on the test windrower. In dry soil conditions both the steel and the polyethylene skids stayed clean. In slightly moist soil conditions (FIGURE 10), soil began to build up on the steel skid, while the polyethylene remained clean. In wet conditions or damp clay soil, particularly with green undergrowth, material adhered equally to both the steel and the polyethylene (FIGURE 11). The buildup was most severe along the sharp crease just under the cutterbar on the Westward 7000 windrower. Adhesion may have been less of a problem on other makes of windrowers with a more gently curving skid.

FIGURE 10. Adhesion to Steel only in Moist Conditions.

FIGURE 11. Adhesion on Both Steel and Polyethylene in Wet Weedy Conditions.

SUMMARY CHART

MACDON CONVENTIONAL KNIFE SYSTEM

RETAIL PRICE	$948.00 [July, 1989, f.o.b. Humboldt, Sask., 21 ft (6.4 m)]
RATE OF WORK	Up to 6 mph (10 km/h) when rigid vine lifters were used
QUALITY OF WORK	
Cutting	**Very Good;** cutting loss with vine lifters, less than 1% of total crop **Fair;** without vine lifters, up to 5% loss of total crop
Shattering	**Fair;** 2 to 2.5% of total crop loss in lentils, loss varied with maturity
Crop Adhesion	**Fair;** material buildup reduced cutting ability, the knife system had to be cleaned every 10 hours
Power	1.7 to 2.6 hp (1.3 to 1.9 kW) to drive 21 ft (6.4 m)
EASE OF OPERATION AND ADJUSTMENT	
Installation	**Very Good;** took two people 1 hour, the knife system is normally factory installed
Adjusting	**Good;** no shims or wear plates required
Cleaning	**Good;** knife was easily removed for scraping if hold-downs loosened
Servicing	**Good;** took 15 minutes to change one knife section, rivet tool was required
OPERATOR SAFETY	Reasonable precautions were needed when changing knife sections
OPERATOR'S MANUAL	**Fair;** limited information provided in the manufacturer's windrower and draper header operator's manual, no separate manual for the knife system available
MECHANICAL HISTORY	Knife sections broken-23, guards broken-9

SCHUMACHER EASY-CUT

RETAIL PRICE	$1062.00 [July 1989, f.o.b. Humboldt, Sask., 21 ft (6.4 m)]
RATE OF WORK	Up to 6 mph (10 km/h) when rigid vine lifters were used
QUALITY OF WORK	
Cutting	**Very Good;** with vine lifters, less than 1% loss of total crop **Fair;** without vine lifters, up to 5% loss of total crop
Shattering	**Fair;** 2 to 2.5% loss of total crop in lentils, loss varied with crop maturity
Crop Adhesion	**Good;** material buildup greatly increased the power requirements, but did not affect cuffing
Power	Normally 1.6 to 2.5 hp (1.2 to 1.9 kW) to drive 21 ft (6.4 m), 14 hp (10 kW) with crop buildup
EASE OF OPERATION AND ADJUSTMENT	
Installing	**Good;** it took two people 1.5 hours, guard bolts were too small for the holes provided on some windrowers
Adjusting	**Excellent;** no adjustments needed
Cleaning	**Fair;** knife difficult to remove for scraping
Servicing	**Very Good;** bolt-on knife sections changed in 5 minutes
OPERATOR SAFETY	Reasonable precautions were needed when changing knife sections
OPERATOR'S MANUAL	**Very Good;** contained a thorough explanation of installation procedure
MECHANICAL HISTORY	Knife sections broken-8, guards broken-1

WESTWARD TWIN TOOTH

RETAIL PRICE	$637.00 [July, 1989, f.o.b. Humboldt, Sask., 21 ft (6.4 m)]
RATE OF WORK	Up to 6 mph (10 km/h) when rigid vine lifters were used
QUALITY OF WORK	
Cutting	**Very Good;** with vine lifters, cutting loss less than 1.5% loss of total crop **Fair;** without vine lifters, cutting loss up to 5% loss of total crop
Shattering	**Very Good;** less than 1% loss of total crop in lentils, loss varied with crop maturity
Crop Adhesion	**Fair;** buildup reduced cutting ability, knife system had to be cleaned every 10 hours
Power	2.2 to 2.7 hp (1.6 to 2.0 kW) to drive 21 ft (6.4 m)
EASE OF OPERATION AND ADJUSTMENT	
Installation	**Fair;** took two people 1 hour, top and bottom guards had different hole sizes, guard bolts not supplied
Adjusting	**Fair;** wear plates had limited adjustability, so shims were required
Cleaning	**Good;** knife was easily removed for scraping if hold-downs were loosened
Servicing	**Excellent;** the bolt-on knife sections were changed in 3 minutes without removing the guard
OPERATOR SAFETY	Reasonable precautions were needed when changing knife sections
OPERATOR'S MANUAL	**Poor;** no written instructions were provided
MECHANICAL HISTORY	knife sections broken-46, guards broken-0

CRARY 4 IN I

RETAIL PRICE	$977.00 [July 1989, f.o.b. Humboldt, Sask., 21 ft (6.4 m)]
RATE OF WORK	Up to 6 mph (10 km/h) when rigid vine lifters were used
QUALITY OF WORK	
Cutting	**Very Good;** with vine lifters, cutting loss less than 1% loss of total crop **Fair;** without vine lifters, cutting loss up to 5% loss of total crop
Shattering	**Very Good;** shatter loss less than 1% loss of total crop in lentils, loss varied with crop maturity
Crop Adhesion	**Fair;** buildup reduced cutting ability, knife system had to be cleaned every 10 hours
Power	1.6 to 2.4 hp (1.2 to 1.8 kW) to drive 21 ft (6.4 m)
EASE OF OPERATION AND ADJUSTMENT	
Installation	**Fair;** took two people 1 hour, some modification required to fit to the Westward windrower
Adjusting	**Good;** shims and wear plates required occasional resetting
Cleaning	**Good;** knife easily removed for scraping if hold-downs loosened
Servicing	**Very Good;** bolt-on knife sections changed in 4 to 5 minutes
OPERATOR SAFETY	Reasonable precautions were needed when changing knife sections
OPERATOR'S MANUAL	**Good;** instructions supplied for combines but not for the Westward windrower
MECHANICAL HISTORY	knife sections broken-4, guards broken-0

ALBERTA FARM MACHINERY RESEARCH CENTRE

3000 College Drive South
Lethbridge, Alberta, Canada T1K 1L6
Telephone: (403) 329-1212
FAX: (403) 329-5562
http://www.agric.gov.ab.ca/navigation/engineering/afmrc/index.html

Prairie Agricultural Machinery Institute
Head Office: P.O. Box 1900, Humboldt, Saskatchewan, Canada S0K 2A0
Telephone: (306) 682-2555

Test Stations:
P.O. Box 1060
Portage la Prairie, Manitoba, Canada R1N 3C5
Telephone: (204) 239-5445
Fax: (204) 239-7124

P.O. Box 1150
Humboldt, Saskatchewan, Canada S0K 2A0
Telephone: (306) 682-5033
Fax: (306) 682-5080