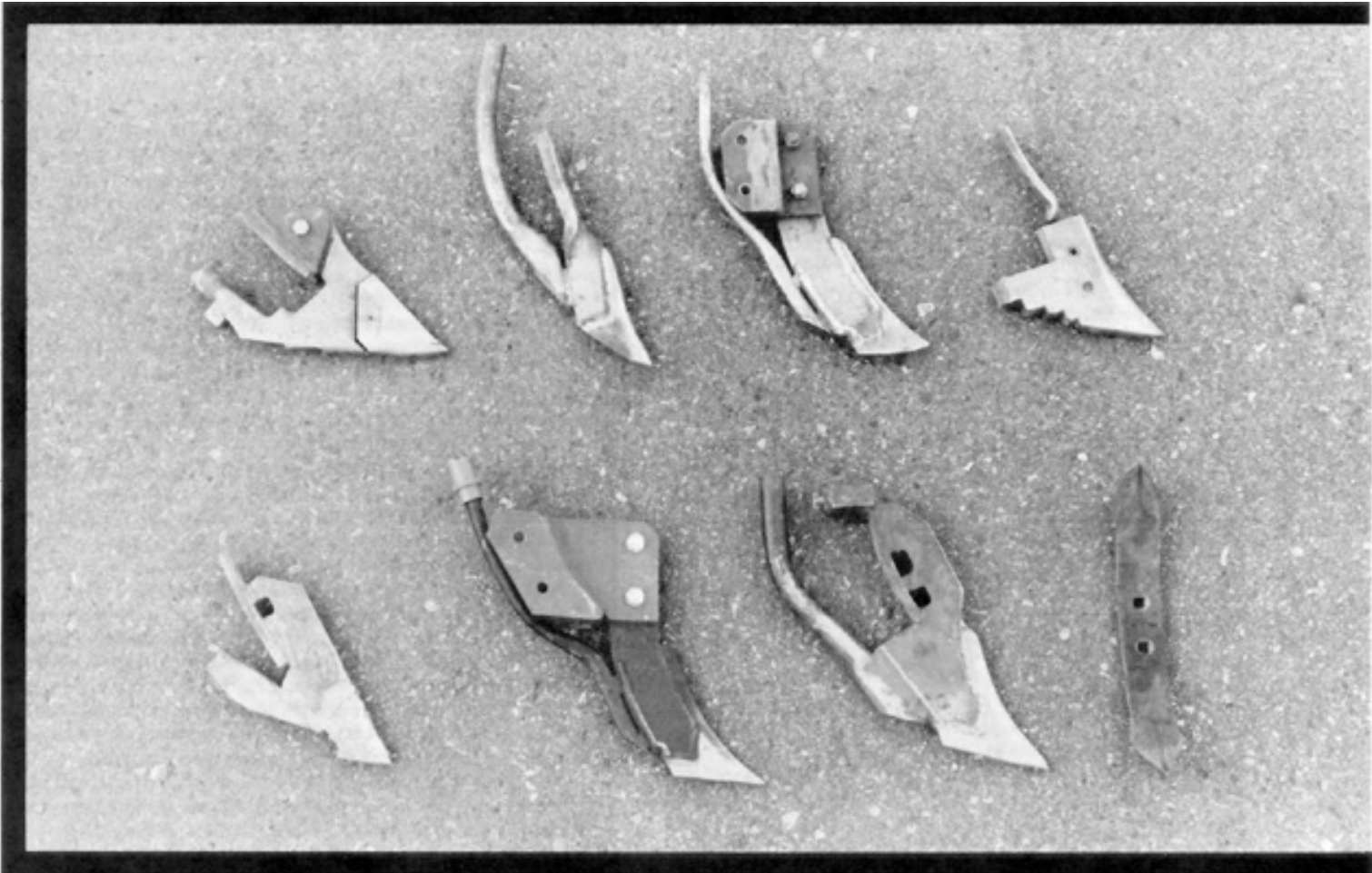


EVALUATION REPORT

387



Fertilizer Banding Knife Attachments

A Co-operative Program Between



FERTILIZER BANDING KNIFE ATTACHMENTS

The following fertilizer banding knife attachments were included in this evaluation:

KNIFE	MANUFACTURER
1. Culti-Band Model QC115	Barnes Western Agriculture Division 640 Mainstreet Selkirk, Manitoba R1A 2C3
2. Dutch Granular Knife Number 7	Dutch Blacksmith Shop Ltd. 705 - 1 Ave. Regina, Saskatchewan S4N 4M4
3. Gromor Deep Banding Knife	Gromor Fertilizer Ltd. Box 897 Kindersley, Saskatchewan S0L 1S0
4. Digger Bandit Snout 3	Digger Bandit Co. 616 - 34 St. S. Lethbridge, Alberta T1J 3W1
5. JAD Opener	Wy-Lee Manufacturing Badland Industrial Park Box 1351 North Battleford, Saskatchewan S9A 3C8
6. TSL Deep Banding Knife	Thompson Sales Ltd. Box 908 Rosetown, Saskatchewan S0L 2V0
7. Haley Deep Banding Knife	Haley Side Bander Ltd. Box 788 Athabasca, Alberta T0G 0B0

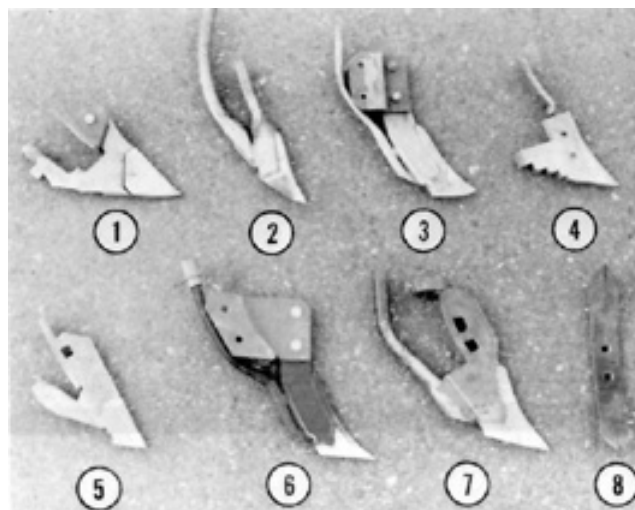


FIGURE 1. 1) Culti-Band Model QC115, 2) Dutch Granular Knife Number 7, 3) Gromor Deep Banding Knife, 4) Digger Bandit Snout 3, 5) JAD Opener, 6) TSL Deep Banding Knife, 7) Haley Deep Banding Knife, 8) Edwards C50-16 Conventional Cultivator Chisel Point.

SUMMARY AND CONCLUSIONS

Conventional Cultivator Chisel Point: Cultivator chisel points left an uneven field surface. Fertilizer was placed in bands

1.25 in (32 mm) wide and varied 0.40 in (10 mm) in depth when the chisel points were new. Installation on the cultivator was convenient. Fertilizer band width increased when the points were worn. Penetration was very good. Power requirements were usually less than for most banding knives.

Culti-Band QC115: Fertilizer was placed in bands 0.75 in (19 mm) wide and varied 0.40 in (10 mm) in depth. Penetration was very good when the knife was new and fair after the knife became worn. Installation on the cultivator was convenient. Power requirements for new knives were about 20 percent greater than those for new chisel points. Power requirements for worn knives were about 6 percent less than for worn chisel points. Several replaceable knife tips were lost during the test.

Dutch Granular Knife Number 7: Fertilizer was placed in bands 1.0 in (25 mm) wide and varied 0.40 in (10 mm) in depth. Penetration was very good when the knife was new and fair after the knife became worn. Installation on the cultivator was convenient. Power requirements for new knives were about 15 percent greater than for new chisel points. Power requirements for worn knives were about 9 percent greater than for worn chisel points.

Gromor Deep Banding Knife: Fertilizer was placed in band 0.75 in (19 mm) wide and varied 0.40 in (10 mm) in depth. Penetration was very good when the knife was new and poor after the knife became worn. Initial installation on the cultivator was inconvenient. The cultivator shanks had to be cut off and modified to accommodate the Gromor deep banding knife. Power requirements for new knives were about 19 percent greater than for new chisel points. Power requirements for worn knives were about 16 percent greater than for worn chisel points.

Digger Bandit Snout 3: Fertilizer was placed in bands 1.0 in (2.5 mm) wide and varied 0.40 in (10 mm) in depth. Penetration was good when the knives were new and fair after the knives became worn. Installation on the cultivator was easy. Fertilizer feed tubes were not supplied. Power requirements for new knives were about 40% greater than for new chisel points. Power requirements for worn knives were about 70% greater than for worn chisel points.

JAD Opener: Fertilizer was placed in bands 1.0 to 1.25 in (25 to 32 mm) wide and varied 0.35 to 0.50 in (9 to 13 mm) in depth. Band width and thickness varied due to variations in knife manufacturing uniformity. Penetration was good when the knives were new and poor after the knives became worn. Installation on the cultivator was inconvenient due to limited access to the lower bolt hole. Power requirements for new knives were about 8 percent greater than for new chisel points. Power requirements for worn knives were about 3 percent higher than for worn chisel points. A weld on one knife support bracket failed when an obstruction was encountered.

TSL Deep Banding Knife: Fertilizer was placed in bands 0.75 in (19 mm) wide and varied 0.40 in (10 mm) in depth. Penetration was very good when the knives were new and poor after the knives became worn. Installation on the cultivator was easy. Power requirements for new knives were about 24 percent greater than for new chisel points. Power requirements for worn knives were about 32 percent greater than for worn chisel points.

Haley Deep Banding Knife: Fertilizer was placed in bands 0.75 in (19 mm) wide and varied 0.40 in (10 mm) in depth. Penetration was poor when the knives were new and poor after the knives became worn. Installation on the cultivator was inconvenient due to limited access to the support bracket bolt holes. Power requirements for new knives were about 20 percent greater than for new chisel points. Power requirements for worn knives were about 18 percent greater than for worn chisel points. Wear of the knife tips was excessive and caused plugging of the fertilizer tubes.

Senior Engineer: E. H. Wiens

Project Technologist: G. A. Magyar

GENERAL DESCRIPTION

Fertilizer banding is a process in which fertilizer is placed in narrow bands at depths of 1.5 in (40 mm) below seeding depth to twice the seeding depth. Fertilizer banding knife attachments are soil openers designed for mounting on conventional heavy duty cultivators. Fertilizer banding knife attachments are usually designed to place fertilizer in a compact narrow band with minimal soil disturbance. Seven fertilizer banding knife attachments (FIGURE 1) were evaluated and include the following: the Culti-Band Model QC115, Dutch Granular Knife Number 7, Gromor Deep Banding Knife, Digger Bandit Snout 3, JAD Opener, TSL Deep Banding Knife and the Haley Deep Banding Knife.

The Culti-Band Model QC115 is made up of a cast knife body, a replaceable cast knife tip and a separate cultivator shank mounting bracket. The mounting bracket bolts to the cultivator shank with two bolts while one bolt connects the knife to the mounting bracket. The replaceable knife tip is fastened to the knife body with a spring roll pin. The Culti-Band Model QC115 has three fertilizer feed tube openings located behind the knife tip for use in applying granular, gaseous and liquid fertilizers.

The Dutch Granular Knife Number 7 consists of a cast knife tip welded to a formed steel shank attachment bracket. The attachment bracket bolts to the cultivator shank with two bolts. The Dutch Number 7 has one fertilizer feed tube welded to the back of the shank attachment bracket for applying granular fertilizer.

The Gromor Deep Banding Knife consists of a cast knife tip welded to a steel knife support bracket with a separate cultivator shank mounting bracket. The mounting bracket bolts to the cultivator shank with two bolts while two bolts connect the knife to the mounting bracket. The Gromor has one fertilizer feed tube welded to the knife support bracket for applying granular fertilizer.

The Digger Bandit Snout 3 consists of a cast knife tip connected to a steel shank attachment bracket with a spring roll pin. The attachment bracket bolts to the cultivator shank with two bolts. The Digger Bandit Snout 3 has three fertilizer feed openings located behind the knife tip for use in applying granular, gaseous and liquid fertilizers.

The JAD Opener consists of a cast knife tip welded to a steel knife support bracket. The knife support bracket mounts on a cultivator shank with two bolts. The JAD has one fertilizer feed tube welded to the knife support bracket for applying granular fertilizer.

The TSL Deep Banding Knife consists of a cast knife tip welded to a steel bracket and a separate shank attachment bracket. The knife tip and steel bracket are connected to the shank attachment bracket with two bolts while two bolts clamp the shank attachment bracket to the cultivator shank. The TSL deep banding knife has one fertilizer feed tube welded to the steel bracket for applying granular fertilizer.

The Haley Deep Banding Knife consists of a cast knife tip welded to a steel shank attachment bracket. The Haley knife is connected to a cultivator shank with two bolts and a clamp. The Haley knife has one fertilizer feed tube welded to the shank attachment bracket for applying granular fertilizer.

The various fertilizer banding knife attachments were mounted on a Leon Vulcan model CP-737 heavy duty cultivator and Leon S-45 air seeder¹. Fertilizing performance was compared to that obtained with conventional cultivator chisel points. Edwards model C50-16 cultivator chisel points were used during the test. FIGURE 1 shows the various attachments while detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The fertilizer banding knife attachments were operated in relatively stone free loam and clay soils in the field conditions

shown in TABLE 1 for approximately 36 hours, with granular fertilizer only, while deep banding fertilizer on about 705 acres (285 ha). The knife attachments were evaluated for quality of work, wear, ease of installation and power requirements.

It should be noted that soil conditions at the time of testing were hard and dry and considered less than ideal for fertilizer banding. Improved performance of all knives could be expected in less severe conditions.

TABLE 1. Operating Conditions.

FIELD TILLAGE CONDITION	HOURS	FIELD AREA	
		ac	(ha)
PRIMARY	3.5	65	(26)
BLADED STUBBLE	32.5	640	(259)
TOTAL	36	705	(285)

RESULTS AND DISCUSSION

GENERAL

Soil Shear Characteristics: The performance of all the fertilizer banding knives was compared, wherever possible, to the performance of conventional cultivator chisel points. The different geometry and shape of cultivator chisel points compared to most banding knives, resulted in observed differences in performance. Since the conventional cultivator chisel point has a wide face and is curved, it tended to fracture and lift the soil, resulting in large lumps of dirt being pulled up in the hard, dry soil conditions at the time of testing. The banding knives were narrower and tended to shear through and push aside the soil as opposed to fracturing and lifting it. This resulted in fewer lumps being brought to the surface than with the chisel points.

The wider chisel points resulted in a wider opening and more soil disturbance, leaving a rough and uneven surface, compared to banding knives (FIGURE 2). In the hard, dry conditions encountered, poorer fertilizer coverage in the furrow bottom was noticed due to the wider opening and large lumps brought to the surface by the chisel points. This would be less noticeable in less severe banding conditions.

It was also observed, due to the differences in geometry, that the shanks equipped with banding knives tripped frequently in the dry hard conditions, while shanks equipped with chisel points tripped only infrequently. This indicated that the shearing and pushing action of the banding knives required more power than the fracturing and lifting action of conventional cultivator chisel points.

The knife tip to cultivator frame clearance was generally greater for the banding knives than for conventional cultivator chisel points. This resulted in improved trash clearance. However, the greater leverage resulted in increased stress on both the cultivator frame and the cultivator shank holders. Increased tripping action of the cultivator shanks, when equipped with banding knives with large tip to frame clearance, was very noticeable in the hard dry conditions encountered during the test. Larger frame to tip clearances also resulted in reduced tip to ground clearance when transporting.

CONVENTIONAL CULTIVATOR CHISEL POINT

Fertilizer Placement: When the chisel points were new, granular fertilizer was placed in bands 1.25 in (32 mm) wide, with fertilizer depth ranging from near chisel tip depth to 0.40 in (10 mm) above chisel tip depth. Wider fertilizer bands were obtained as the chisel points became worn. FIGURE 3 shows the wear after 36 hours of field use.

¹Machinery Institute Report Number 297.



FIGURE 2. Soil Disturbance and Soil Opening (Upper: Conventional Cultivator Chisel Point; Lower: Typical Banding Knife).

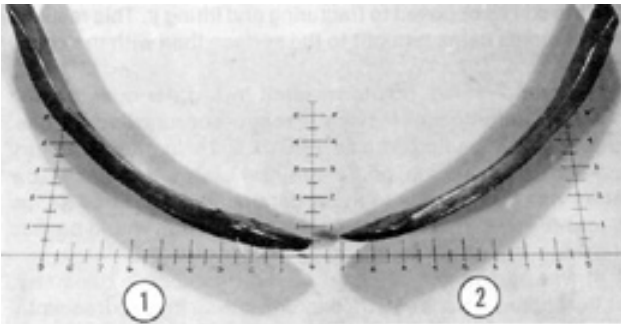


FIGURE 3. Cultivator Chisel Point: 1) New, 2) Used.

Penetration: Penetration of the conventional cultivator chisel points was very good in both primary and secondary tillage with both new and worn chisel points.

Ease of Installation: Conventional chisel points were easily attached to the cultivator shanks with two bolts. FIGURE 4 shows the relationship of the conventional chisel point to the ground when attached to a cultivator shank with a 51 degree stem angle. The distribution hoses normally used for air seeding were too short and longer hoses were required to connect to the fertilizer banding boot.

The chisel point tip to frame clearance was 26.6 in (676 mm).

Power Requirements: The draft (drawbar pull) required for conventional cultivator chisel points was usually less than for most banding knives. Throughout the report, power requirements for chisel points are used as the norm, with comparisons being made to power requirements for the various banding knives.

Mechanical Problems: No mechanical problems were encountered during the 36 hour test.

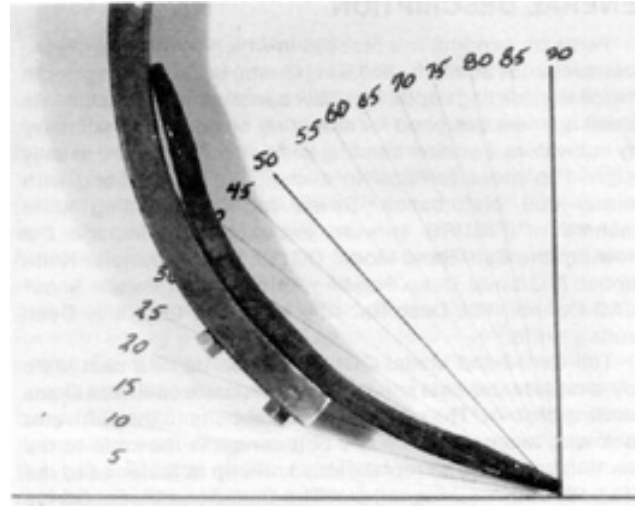


FIGURE 4. Conventional Cultivator Chisel Point Mounted on a Cultivator Shank.

CULTI-BAND MODEL QC115

Fertilizer Placement: The Culti-Band Model QC115 placed granular fertilizer in bands 0.75 in (19 mm) wide, with fertilizer depth ranging from near knife tip depth to 0.40 in (10 mm) above knife tip depth. Fertilizer band width and depth were not affected by knife wear after 36 hours of field use. FIGURE 5 shows the wear on the Culti-Band QC115 after 36 hours of field use.

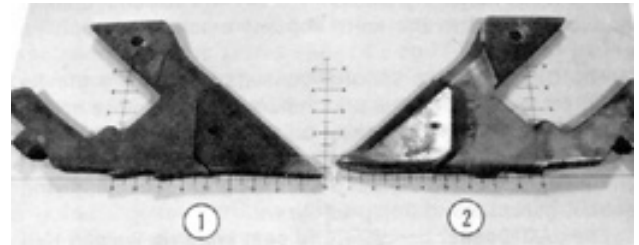


FIGURE. Culti-Band QC115: 1) New, 2) Used.

Penetration: Penetration of the QC115 was very good when the knife was new and only fair after the knife became worn. When new, the QC115 maintained a uniform fertilizer placement depth in both primary and secondary tillage. After 36 hours of field use, the QC115 failed to provide uniform fertilizer placement depth in very hard areas due to insufficient penetration.

Ease of Installation: Installation of the Culti-Band QC115 fertilizer banding knife attachments was easy. FIGURE 6 shows the relationship of the Culti-Band to the ground when attached to a cultivator shank with a 51 degree stem angle. The cultivator shank attachment bracket fit most cultivator shanks. The knife was easily bolted to the shank attachment bracket and the replaceable knife tip was easily replaced. The distribution hoses normally used for air seeding were too short and longer hoses were required to connect to the Culti-Band feed tube opening. Fertilizer distribution hoses were attached to the feed tube opening with hose clamps.

The knife tip to frame clearance was 28.4 in (721 mm), which was about 1.8 in (46 mm) more than for conventional chisel points. This could result in increased trash clearance but it could also result in increased stress on cultivator shank holders and would reduce transport clearance accordingly.

Power Requirements: Draft (drawbar pull) requirements for new Culti-Band QC115 knives were about 20 percent greater than those for new conventional cultivator chisel points. After 36 hours of operation, draft requirements were about 6 percent less than for worn chisel points.

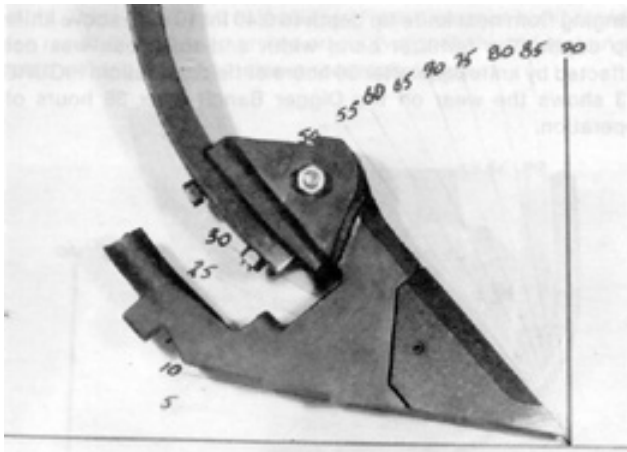


FIGURE 6. Culti-Band QC15 Knife Mounted on a Cultivator Shank.

Mechanical Problems: Three replaceable knife tips were lost during the test when the spring roll pin (FIGURE 7) connecting the knife tip to the knife body was lost. Modifications to adequately secure the replaceable knife tips are recommended.

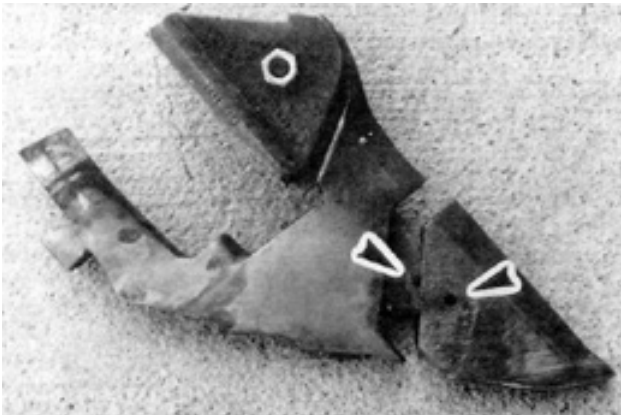


FIGURE 7. Missing Replaceable Spring Roll Pin.

DUTCH GRANULAR KNIFE NUMBER 7

Fertilizer Placement: The Dutch Granular Knife Number 7 placed granular fertilizer in bands 1.0 in (25 mm) wide, with fertilizer depth ranging from near knife tip depth to 0.40 in (10 mm) above knife tip depth. After 36 hours of field use the knife wear slightly reduced the thickness of the fertilizer band. FIGURE 8 shows the wear on the Dutch Number 7 knife after 36 hours of field use.

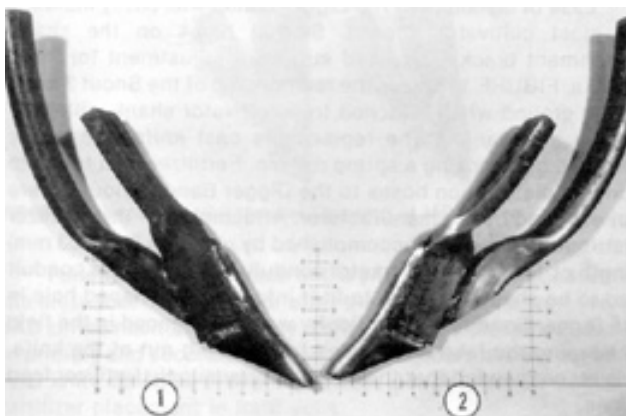


FIGURE 8. Dutch Granular Knife Number 7: 1) New, 2) Used.

Penetration: Penetration of the Number 7 knife was very good when the knife was new and only fair after the knife became worn. When new, the Number 7 maintained a uniform fertilizer placement depth in both primary and secondary tillage. After 36 hours of field operation, the Number 7 failed to provide uniform fertilizer placement depth in very hard areas due to insufficient penetration.

Ease of Installation: The Dutch Granular Knife Number 7 was easily attached to most cultivator shanks. FIGURE 9 shows the relationship of the Dutch knife to the ground when attached to a cultivator shank with a 51 degree stem angle. The distribution hoses normally used for air seeding were long enough but had to be split to fit over the Dutch feed tube opening. Fertilizer distribution hoses were easily attached to the feed tube opening with hose clamps.

The knife tip to frame clearance was 30 in (762 mm), which was about 3.4 in (86 mm) more than for conventional chisel points. This could result in increased trash clearance but it could also result in increased stress on cultivator shank holders and would reduce transport clearance accordingly.

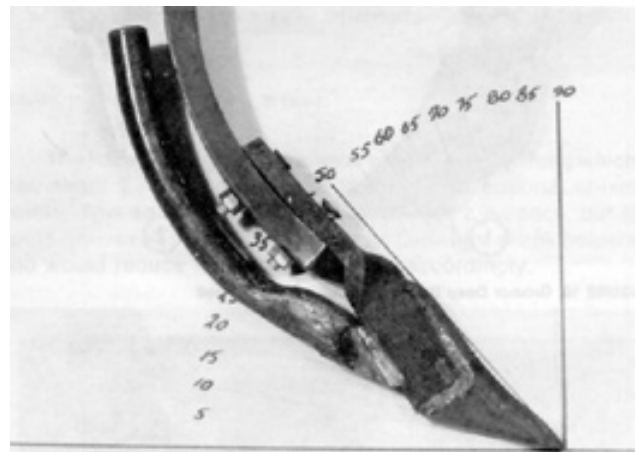


FIGURE 9. Dutch Number 7 Knife Mounted on a Cultivator Shank.

Power Requirements: Draft (drawbar pull) requirements for new Dutch Granular Number 7 knives were about 15 percent greater than those for new conventional cultivator chisel points. After 36 hours of operation, draft requirements were about 9 percent greater than for worn chisel points.

Mechanical Problems: No mechanical problems were encountered during the 36 hour test.

GROMOR DEEP BANDING KNIFE

Fertilizer Placement: The Gromor deep banding knife placed fertilizer in bands 0.75 in (19 mm) wide, with fertilizer depth ranging from near knife tip depth to 0.40 in (10 mm) above knife tip depth. After 36 hours of field use, knife wear slightly reduced the thickness of the fertilizer band. FIGURE 10 shows the wear on the Gromor knife after 36 hours of field use.

Penetration: Penetration of the Gromor deep banding knife was very good when the knife was new and poor after the knife became worn. New Gromor knives maintained a uniform fertilizer placement depth in primary and secondary tillage. After 36 hours of field use the Gromor knives failed to provide adequate penetration for fertilizer placement in hard soils.

Ease of Installation: Initial installation of the Gromor deep banding knife required modifications to the cultivator shank. About 6 in (150 mm) of the cultivator shank had to be cut off to accommodate the Gromor knives. In addition, a rod had to be welded to the back of the shank (FIGURE 11) to secure the knife on the shank. Installation of Gromor knives on a cultivator would require an additional set of shanks for normal cultivator operations. Mounting a Gromor knife was easy once the shank

was modified. It is recommended that the manufacturer consider supplying an optional mounting bracket to permit convenient installation on regular cultivator shanks for those users who do not want to modify their shanks. FIGURE 12 shows the relationship of the Gromor to the ground when attached to a modified cultivator shank with a 51 degree stem angle. The distribution hoses normally used for air seeding were long enough and conveniently fit over the Gromor feed tube opening.

The knife tip to frame clearance was 25.8 in (655 mm), which was about 0.8 in (20 mm) less than for conventional chisel points. This is a possible advantage of cutting off the shanks since stress on cultivator shank holders, transport clearance and trash clearance would be similar to that of conventional chisel points.

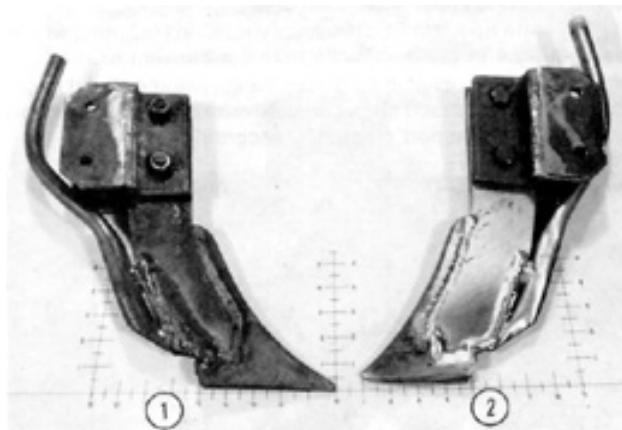


FIGURE 10. Gromor Deep Banding Knife: 1) New, 2) Used.

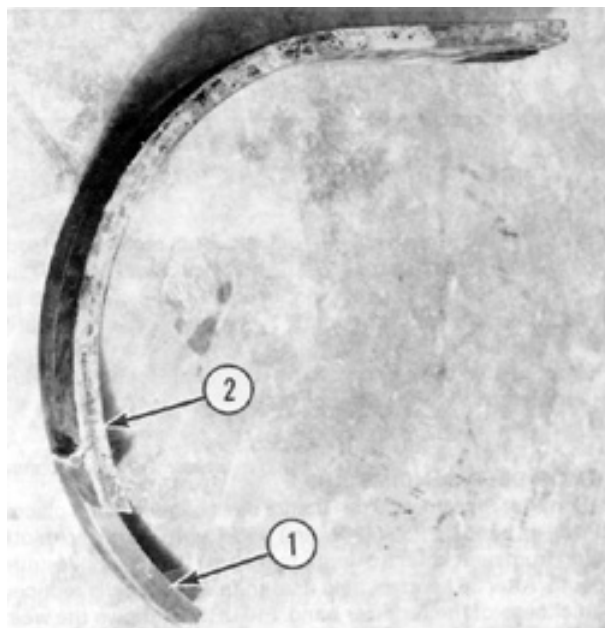


FIGURE 11. Shank Comparison: 1) Regular, 2) Cut-off and Modified.

Power Requirements: Draft (drawbar pull) requirements for new Gromor deep banding knives were about 19 percent greater than those for new conventional cultivator chisel points. After 36 hours of operation, draft requirements were about 16 percent greater than for worn chisel points.

Mechanical Problems: No mechanical problems were encountered during the 36 hour test.

DIGGER BANDIT SNOOT 3

Fertilizer Placement: The Digger Bandit placed granular fertilizer in bands 1.00 in (25 mm) wide, with fertilizer depth

ranging from near knife tip depth to 0.40 in (10 mm) above knife tip depth. The fertilizer band width and thickness was not affected by knife wear after 36 hours of field operation. FIGURE 13 shows the wear on the Digger Bandit after 36 hours of operation.



FIGURE 12. Gromor Knife Mounted on a Cultivator Shank.

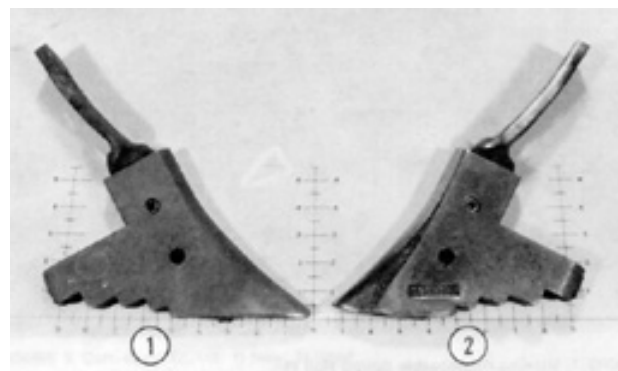


FIGURE 13. Digger Bandit Snout 3: 1) New, 2) Used.

Penetration: Penetration of the Digger Bandit was good when the knife was new and only fair after the knife became worn. A new Digger Bandit knife maintained a uniform fertilizer placement depth in primary and secondary tillage. After 36 hours of field use the knife became worn and failed to provide uniform fertilizer placement depth due to insufficient penetration in very hard areas.

Ease of Installation: The Digger Bandit was easily installed on most cultivator shanks. Slotted holes on the shank attachment bracket provided sufficient adjustment for most shanks. FIGURE 14 shows the relationship of the Snout 3 knife to the ground when attached to a cultivator shank with a 51 degree stem angle. The replaceable cast knife was easily changed by removing a spring roll pin. Fertilizer feed tubes to connect distribution hoses to the Digger Bandit Snout 3 were not supplied by the manufacturer. Attachment of the fertilizer distribution hose was accomplished by using an 8 in (203 mm) length of 1 in (25 mm) diameter conduit. The end of the conduit had to be shaped in order to fit it into the oval shaped hole in the Digger Bandit knife. Difficulty was experienced in the field in keeping the fabricated tubes from pulling out of the knife. It is recommended that the manufacturer supply fertilizer feed tubes.

The knife tip to frame clearance was 30 in (762 mm), which was about 3.5 in (86 mm) more than for conventional chisel

points. This could result in increased trash clearance but it could also result in increased stress on cultivator shank holders and would reduce transport clearance accordingly.

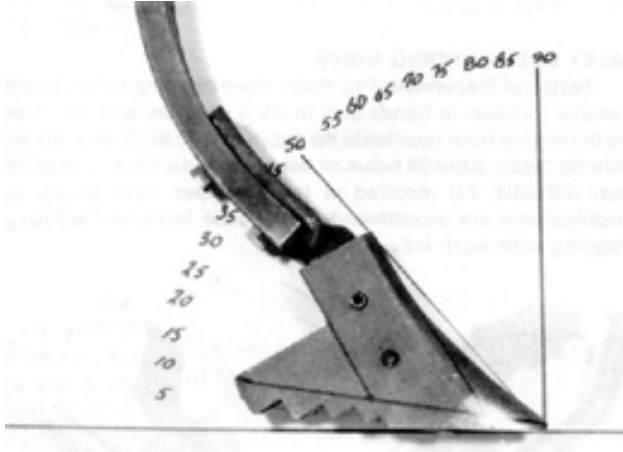


FIGURE 14. Digger Bandit Knife Mounted on a Cultivator Shank.

Power Requirements: Draft (drawbar pull) requirements for new Digger Bandit knives were about 40 percent greater than those required for new conventional cultivator chisel points. After 36 hours of field use, draft requirements were about 70 percent greater than those for worn chisel points.

Mechanical Problems: No mechanical problems were encountered during the 36 hour test.

JAD OPENER

Fertilizer Placement: The JAD placed granular fertilizer in bands varying from 1.0 to 1.25 in (25 to 32 mm) wide, with fertilizer depth ranging from near knife tip depth to from 0.35 to 0.50 in (9 to 13 mm) from knife tip depth. Variations in fertilizer band width and thickness were due to variations in knife manufacturing uniformity. FIGURE 15 shows the variation in manufacturing uniformity of five JAD knives. It is recommended that the manufacturer improve quality control so that knives are more uniform.

FIGURE 16 shows the wear of the JAD knife after 36 hours of field use. The fertilizer band width and thickness was not affected by knife wear.



FIGURE 15. Variation of Manufacturing Uniformity of JAD Openers.

Penetration: Penetration of the JAD opener was good when the knife was new and poor after the knife became worn. New JAD knives maintained a fairly uniform fertilizer placement depth in primary and secondary tillage. After 36 hours of field use, the JAD knife failed to provide adequate penetration for uniform fertilizer placement in hard soils.

Ease of Installation: The JAD knife could be installed on most conventional cultivator shanks. Installing the JAD knives

was inconvenient due to limited access to the lower support bracket bolt hole (FIGURE 17). Modifications to improve the ease of installation are recommended. The distribution hoses normally used for air seeding were too short and longer hoses were required to connect to the JAD feed tube opening. Attaching the fertilizer distribution hose to the feed tube was easy. The distribution hose was secured to the feed tube with a screw. FIGURE 17 shows the relationship of the JAD opener to the ground when attached to a cultivator shank with a 51 degree stem angle.

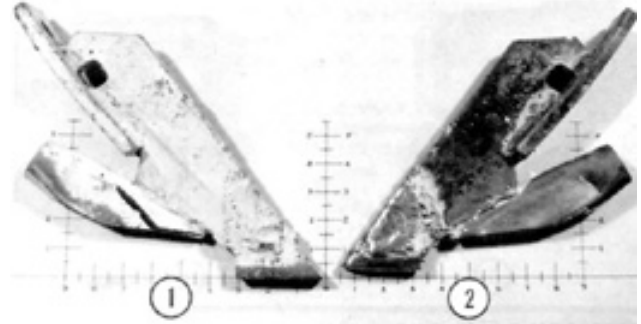


FIGURE 16. JAD Opener: 1) New, 2) Used.

The knife tip to frame clearance was 28.8 in (731 mm) which was about 2.2 in (56 mm) more than for conventional chisel points. This could result in increased trash clearance, but it could also result in increased stress on cultivator shank holders and would reduce transport clearance accordingly.

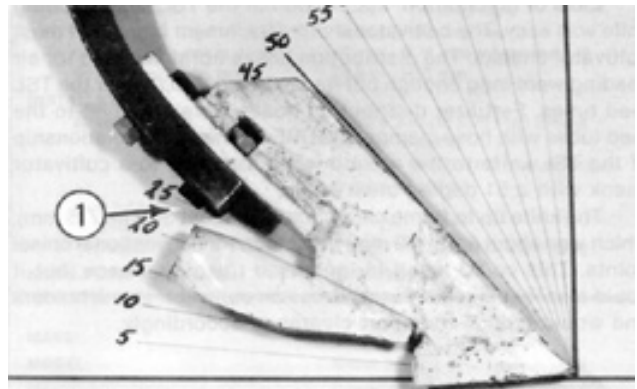


FIGURE 17. JAD Knife Mounted on a Cultivator Shank: (1) Limited Access to the Lower Support Bracket Bolt Hole.

Power Requirements: Draft (drawbar pull) requirements for new JAD openers were about 8 percent higher than for new cultivator chisel points. After 36 hours of operation, draft requirements were about 3 percent higher than for worn chisel points.

Mechanical Problems: During the 36 hour test, the weld on one knife support bracket failed (FIGURE 18) when the knife hit an obstruction.



FIGURE 18. Broken Support Bracket.

TSL DEEP BANDING KNIFE

Fertilizer Placement: The TSL deep banding knife placed granular fertilizer in bands 0.75 in (19 mm) wide, with fertilizer depth ranging from near knife tip depth to 0.40 in (10 mm) above knife tip depth. The fertilizer band width and thickness was not affected by knife wear after 36 hours of field operation. FIGURE 19 shows the wear on the TSL deep banding knife after 36 hours of field use.

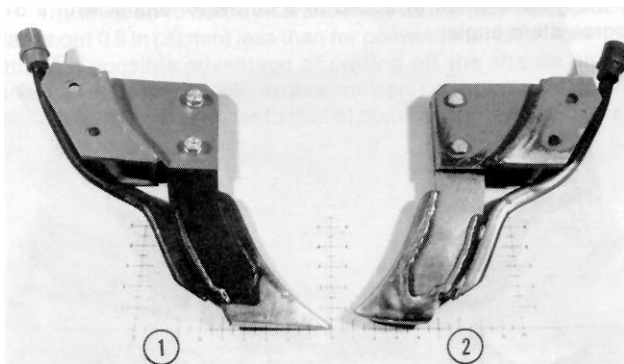


FIGURE 19. TSL Deep Banding Knife: 1) New, 2) Used.

Penetration: Penetration of the TSL deep banding knife was very good when the knife was new and poor after the knife became worn. A new TSL knife maintained a uniform fertilizer placement depth in primary and secondary tillage. After 36 hours of field use the TSL failed to provide adequate penetration for uniform fertilizer placement in hard soils.

Ease of Installation: Installation of the TSL deep banding knife was easy. The cultivator shank attachment bracket fit most cultivator shanks. The distribution hoses normally used for air seeding were long enough but had to be split to fit over the TSL feed tubes. Fertilizer distribution hoses were attached to the feed tubes with hose clamps. FIGURE 20 shows the relationship of the TSL knife to the ground when attached to a cultivator shank with a 51 degree stem angle.

The knife tip to frame clearance was about 30.5 in (775 mm), which was about 3.9 in (99 mm) more than for conventional chisel points. This could result in increased trash clearance, but it could also result in increased stress on cultivator shank holders and would reduce transport clearance accordingly.

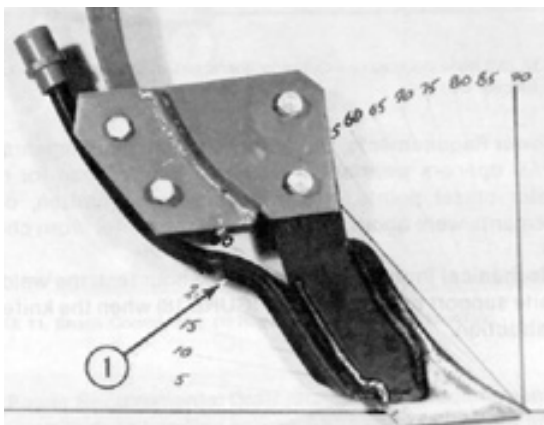


FIGURE 20. TSL Knife Mounted on a Cultivator Shank: 1) Location of Fertilizer Plugging.

Power Requirements: Draft (drawbar pull) requirements for new TSL deep banding knives were about 24 percent greater than for new conventional cultivator chisel points. After 36 hours of operation, draft requirements were about 32 percent greater than those for worn chisel points.

Mechanical Problems: The fertilizer tubes plugged with small lumps of fertilizer along the flattened portion of the feed tube (FIGURE 20). Modifications are recommended to reduce fertilizer feed tube plugging.

HALEY DEEP BANDING KNIFE

Fertilizer Placement: The Haley deep banding knife placed granular fertilizer in bands 0.75 in (19 mm) wide, with fertilizer depth ranging from near knife tip depth to 0.40 in (10 mm) above knife tip depth. After 36 hours of field operation, excessive knife wear (FIGURE 21) resulted in fertilizer feed tube plugging. Modifications are recommended to reduce fertilizer feed tube plugging with worn knives.

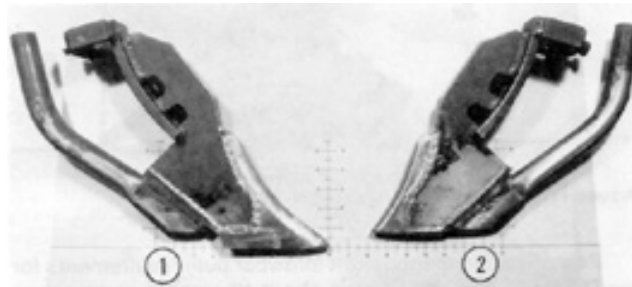


FIGURE 21. Haley Side Bander: 1) New, 2) Used.

Penetration: Penetration of the Haley knife was poor when the knife was new and poor when the knife became worn. The Haley knife failed to maintain uniform fertilizer placement depth in primary tillage. Modifications to improve penetration are recommended.

Ease of Installation: The Haley deep banding knife could be installed on most conventional cultivator shanks. Installing the Haley knife was inconvenient due to the limited access to the support bracket bolt holes (FIGURE 22). Modifications to permit convenient knife installation are recommended. The distribution hoses normally used for air seeding were long enough but had to be split to fit over the Haley feed tubes. Fertilizer distribution hoses were attached to the feed tube with hose clamps. FIGURE 22 shows the relationship of the Haley knife to the ground when attached to a cultivator shank with a 51 degree stem angle.

The knife tip to frame clearance was about 30 in (762 mm), which was about 3.4 in (86 mm) more than for conventional chisel points. This could result in increased trash clearance, but it could also result in increased stress on cultivator shank holders and would reduce transport clearance accordingly.

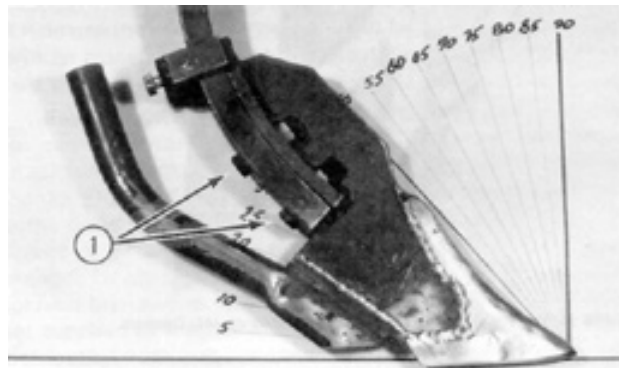


FIGURE 22. Haley Knife Mounted on a Cultivator Shank: (1) Limited Access to the Support Bracket Bolt Holes.

Power Requirements: Draft (drawbar pull) requirements for new Haley deep banding knives were 20 percent greater than for new conventional cultivator chisel points. After 36 hours of

field operation, draft requirements were 18 percent greater than those for worn chisel points.

Mechanical Problems: Wear of the knife tip during the 36 hour test was excessive, and caused plugging of the fertilizer feed tube.

APPENDIX I

SPECIFICATIONS

MAKE: Edwards Conventional Cultivator
Chisel Point

MODEL: C 50-16

MANUFACTURER: Edwards Rod Weeder Ltd.
3102 - 5 Ave. North
Lethbridge, Alberta
T1J 4A2

DIMENSIONS:

- overall width 2.5 in (64 mm)
- overall height 12 in (305 mm)
- overall length 10 in (254 mm)

MOUNTED DIMENSIONS:

- cutting width "V" Taper 0 - 2.5 in (0 - 64 mm)
- cutting depth below shank 2 in (51 mm)
- knife tip to frame bottom 26.6 in (676 mm)

INSTALLATION:

- attaching bolts 2, 7/16 x 2 1/4 in (11 x 57 mm) plow bolts
- spacing 2.5 in (64 mm)

KNIFE POINT HARDNESS: 47 Rockwell "C"

MAKE: Culti-Band Deep Banding Knife

MODEL: QC 115 With Replaceable Tip

MANUFACTURER: Barnes Western (Agricultural Division)
640 Mainstreet
Selkirk, Manitoba
R1A 2C3

DIMENSIONS:

	Without Shank Bracket	With Shank Bracket
- overall width	1.25 in (32 mm)	2.9 in (74 mm)
- overall height	8.75 in (222 mm)	9.25 in (235 mm)
- overall length	13.0 in (330 mm)	13.0 in (330 mm)

MOUNTED DIMENSIONS:

- cutting width 0.75 in (19 mm)
- cutting depth below shank 3.75 in (95 mm)
- knife tip to frame bottom 28.4 in (721 mm)

INSTALLATION:

- attaching bolts 1, 1/2 x 2 in (12 x 50 mm) capscrew (shank bracket to knife)
2, 1/2 x 2-1/4 in (12 x 57 mm) capscrews (shank bracket to shank)
- spacing 1.75 - 2.5 in (44 - 64 mm) slotted holes
- feed tubes
 - number 1
 - sizes 1.25 in (32 mm) O.D.
- feed openings
 - number 2
 - sizes 0.58 in (15 mm) I.D.
0.45 in (11 mm) I.D.

KNIFE POINT HARDNESS: 64 Rockwell "C"

MAKE: Dutch Granular Knife

MODEL: Number 7

MANUFACTURER: Dutch Blacksmith Shop Ltd.
705 - 1 Ave.
Regina, Saskatchewan
S4N 4M4

DIMENSIONS:

- overall width 2 in (51 mm)
- overall height 14.5 in (368 mm)
- overall length 13.5 in (343 mm)

MOUNTED DIMENSIONS:

- cutting width 0.95 in (24 mm)
- cutting depth below shank 5.5 in (140 mm)
- knife tip to frame bottom 30 in (762 mm)

INSTALLATION:

- attaching bolts 2, 1/2 x 2 1/2 in (12 x 64 mm) capscrews
- spacing 1.75 - 2.5 in (44 - 64 mm) slotted holes
- feed tubes
 - number 1
 - sizes 1.0 in (25 mm) I.D.,
1.25 in (32 mm) O.D.

KNIFE POINT HARDNESS: 59 Rockwell "C"

MAKE: Gromor Deep Banding Knife

MANUFACTURER: Gromor Fertilizer Ltd.
Box 897
Kindersley, Saskatchewan
S0L 1S0

DIMENSIONS:

- overall width 4.25 in (108 mm)
- overall height 14.75 in (375 mm)
- overall length 13.25 in (336 mm)

MOUNTED DIMENSIONS:

- cutting width 0.4 in (10 mm) front
0.8 in (20 mm) rear
- cutting depth below shank 7 in (178 mm) (shank cut off)
- knife tip to frame bottom 25.8 in (655 mm)

INSTALLATION:

- attaching bolts 2, 1/2 x 3 in (12 x 75 mm) (shank bracket to knife)
2, 1/2 x 4 in (12 x 100 mm) (shank bracket to shank)
- feed tubes
 - number 1
 - sizes 0.75 in (19 mm) O.D. steel tube

KNIFE POINT HARDNESS: 60 Rockwell "C"

MAKE: Digger Bandit

MODEL: Snout 3

MANUFACTURER: Digger Bandit Co.
616 - 34 St. S.
Lethbridge, Alberta
T1J 3W1

DIMENSIONS:

- overall width 1.88 in (48 mm)
- overall height 10.25 in (260 mm)
- overall length 9.75 in (248 mm)

MOUNTED DIMENSIONS:

- cutting width 1.2 in (30 mm)
- cutting depth below shank 5.5 in (140 mm)
- knife tip to frame bottom 30 in (762 mm)

INSTALLATION:

- attaching bolts 2, 1/2 x 2 1/2 in (12 x 64 mm) plow bolts
- spacing 1.75 - 2.75 in (44 - 70 mm) slotted holes
- feed openings
 - number 3
 - sizes 1, 1 x 1.4 in (25 x 36 mm) I.D.
2, 0.63 in (16 mm) I.D.

KNIFE POINT HARDNESS: 83 Rockwell "C"

MAKE: JAD Opener

MANUFACTURER: Wy-Lee Manufacturing
Badlands Industrial Park
Box 1351
North Battleford, Saskatchewan
S9A 3L8

DIMENSIONS:	
- overall width	2 in (51 mm)
- overall height	9.25 in (235 mm)
- overall length	10 in (250 mm)
MOUNTED DIMENSIONS:	
- cutting width	0.8 in (20 mm)
- cutting depth below shank	4.2 in (107 mm)
- knife tip to frame bottom	28.8 in (731 mm)
INSTALLATION:	
- attaching bolts	2, 1/2 x 2-3/4 in (12 x 70 mm) capscrews
- spacing	2 - 2.5 in (51 - 64 mm) slotted holes
- feed openings	
- number	1
- sizes	1.25 in (32 mm) I.D. 1.5 in (38 mm) O.D.
KNIFE POINT HARDNESS:	53 Rockwell "C"

MAKE:	TSL Deep Banding Knife
MANUFACTURER:	Thompson Sales Ltd. Box 908 Rosetown, Saskatchewan SOL 2V0
DIMENSIONS:	
- overall width	3.75 in (95 mm)
- overall height	13.75 in (349 mm)
- overall length	17.5 in (445 mm)
MOUNTED DIMENSIONS:	
- cutting width	0.4 in (10 mm) front 0.8 in (20 mm) back
- cutting depth below shank	5.9 in (150 mm) to tip 6.1 in (155 mm) to heel
- knife tip to frame bottom	30.5 in (775 mm) to tip 30.75 in (781 mm) to heel
INSTALLATION:	
- attaching bolts	2, 1/2 x 3-1/2 in (12 x 90 mm) capscrews 1/2 in (12 mm) stud (fits into lower shank bolt hole) 2, 1/2 x 1-1/2 in (12 x 38 mm) (shank back to knife)
- feed tubes	
- number	1
- sizes	1.1 in (28 mm) I.D. 1.9 in (48 mm) O.D.
KNIFE POINT HARDNESS:	61 Rockwell "C"

MAKE:	Haley Deep Banding Knife
MANUFACTURER:	Haley Sidebender Ltd. Box 788 Athabasca, Alberta TOG 0B0
DIMENSIONS:	
- overall width	3.1 in (79 mm)
- overall height	12.25 in (311 mm)
- overall length	16.0 in (406 mm)
MOUNTED DIMENSIONS:	
- cutting width	0.75 in (19 mm)
- cutting depth below shank	4.6 in (116 mm) to tip, 5 in (125 mm) to heel
- knife tip to frame bottom	30 in (743 mm)
INSTALLATION:	
- attaching bolts	2, 1/2 x 2 in (12 x 50 mm) capscrews 1, 1/2 in (12 mm) setscrew
- spacing	1.75 - 2.5 in (44 - 64 mm) slotted holes
- feed tubes	
- number	1
- sizes	1 in (25 mm) I.D. 1.25 in (32 mm) O.D.
KNIFE POINT HARDNESS:	31 Rockwell "C"

APPENDIX II
MACHINE RATINGS
The following rating scale is used in PAMI Evaluation Reports:
Excellent
Very Good
Good
Fair
Poor
Unsatisfactory

APPENDIX III	
CONVERSION TABLE	
acres (ac) x 0.40	= hectares (ha)
feet (ft) x 0.305	= metres (m)
horsepower (hp) x 0.75	= kilowatts (kW)
inches (in) x 25.4	= millimetres (mm)
miles/hours (mph) x 1.61	= kilometres/hour (km/h)

SUMMARY CHART FERTILIZER BANDING KNIFE ATTACHMENTS

CULTI-BAND QC115	
FERTILIZER BAND:	0.75 in wide x 0.40 in variation in depth (19 x 10 mm)
PENETRATION:	
- new	very good
- worn	fair
EASE OF INSTALLATION:	easy
POWER REQUIREMENTS:	
- new	20 percent greater than new chisel points
- worn	6 percent less than worn chisel points
DUTCH GRANULAR KNIFE 7	
FERTILIZER BAND:	1.0 in wide x 0.40 in variation in depth (25 x 10 mm)
PENETRATION:	
- new	very good
- worn	fair
EASE OF INSTALLATION:	easy
POWER REQUIREMENTS:	
- new	15 percent greater than new chisel points
- worn	9 percent greater than worn chisel points
GROMOR DEEP BANDING KNIFE	
FERTILIZER BAND:	0.75 in wide x 0.40 in variation in depth (19 x 10 mm)
PENETRATION:	
- new	very good
- worn	poor
EASE OF INSTALLATION:	required cultivator shanks to be cut off and modified
POWER REQUIREMENTS:	
- new	19 percent greater than new chisel points
- worn	16 percent greater than worn chisel points
DIGGER BANDIT SNOOT 3	
FERTILIZER BAND:	1.0 in wide x 0.40 in variation in depth (25 x 10 mm)
PENETRATION:	
- new	good
- worn	fair
EASE OF INSTALLATION:	easy
POWER REQUIREMENTS:	
- new	40 percent greater than new chisel points
- worn	70 percent greater than worn chisel points
JAD OPENER	
FERTILIZER BAND:	1.0 to 1.25 in wide x 0.35 to 0.50 in variation in depth (25 to 32 mm x 9 to 13 mm)
PENETRATION:	
- new	good
- worn	poor
EASE OF INSTALLATION:	inconvenient
POWER REQUIREMENTS:	
- new	8 percent greater than new chisel points
- worn	3 percent greater than worn chisel points

TSL DEEP BANDING KNIFE	
FERTILIZER BAND:	0.75 in wide x 0.40 in variation in depth (19 x 10 mm)
PENETRATION:	
- new	very good
- worn	poor
EASE OF INSTALLATION:	easy
POWER REQUIREMENTS:	
- new	24 percent greater than new chisel points
- worn	32 percent greater than worn chisel points
HALEY BANDING KNIFE	
FERTILIZER BAND:	0.75 in wide x 0.40 in variation in depth (19 x 10 mm)
PENETRATION:	
- new	poor
- worn	poor
EASE OF INSTALLATION:	inconvenient
POWER REQUIREMENTS:	
- new	20 percent greater than new chisel points
- worn	18 percent greater than worn chisel points



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