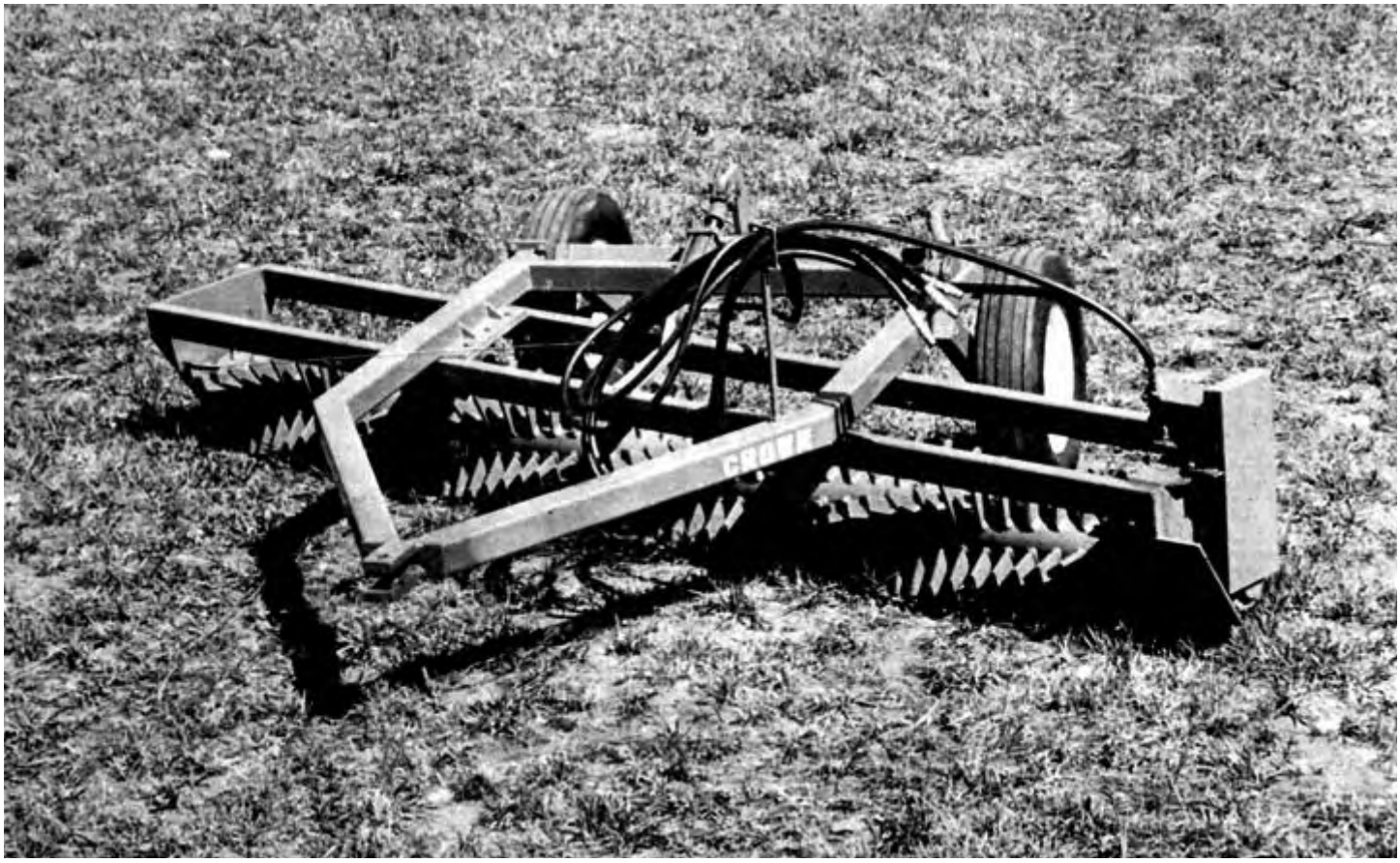
Printed: December, 1981
Tested at: Humboldt
ISSN 0383-3445

Evaluation Report 267



Crown WR 120 Rock Windrower

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

CROWN WR 120 ROCK WINDROWER

MANUFACTURER:
Summers Manufacturing Inc.
Box 338
Maddock, North Dakota 58348

DISTRIBUTOR:
Summers Distributing and Sales
Highway 6 North and Sherwood Road
Regina, Saskatchewan

RETAIL PRICE:
$3050.00 (September. 1981. f.o.b. Humboldt).

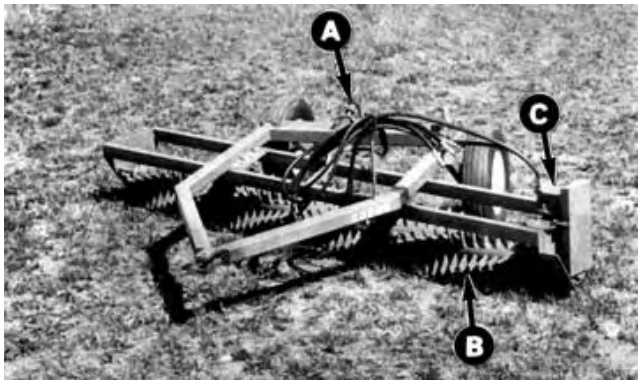


FIGURE 1. Crown WR 120: A) Depth Control, B) Rake Drum, C) Hydraulic Motor.

SUMMARY AND CONCLUSIONS

Overall functional performance of the Crown WR 120 rock rake was very good. Ease of operation was very good, while ease of adjustment and servicing were good.

Typical field speeds were from 2 to 6 km/h (1.2 to 3.7 mph) while average workrates varied from 0.6 to 2 ha/h (1.6 to 5 ac/h). The Crown WR 120 worked well in rocks ranging in size from 30 to 400 mm (1 to 16 in). Performance was best in fields with average rock size less than 300 mm (12 in).

A tractor with 35 kW (47 hp) maximum power take-off rating had sufficient power reserve to operate the Crown WR 120 in most field conditions.

The Crown WR 120 transported well at speeds up to 40 km/h (25 mph). It was safe to operate as long as common sense was used and recommended safety procedures were followed.

Premature rake teeth wear, and a number of weld failures occurred during the test.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Providing an optional rock deflector attachment to reduce the jamming and carryover of small rocks.
2. Modifications to provide a more convenient transport lock.
3. Expanding the operator's manual to include detailed information on windrower operation and adjustment, and safety precautions.
4. Providing a slow moving vehicle sign as standard equipment.
5. Modifications to strengthen the drum drive chain shield.
6. Modifications to reduce rake teeth failure and premature wear.

Senior Engineer: G.E. Frehlich

Project Technologist: D.H. Kelly

THE MANUFACTURER STATES THAT

The Crown WR 120 rock rake is no longer being manufactured. All recommendations will be considered if new models are manufactured in the future.

NOTE: This report has been prepared using SI units of measurement. A conversion table is given in APPENDIX III.

GENERAL DESCRIPTION

The Crown WR 120 is a hydraulically driven, pull-type rock windrower with a 3.4 m (11 ft) raking width. It is designed for use in conjunction with a rock picker.

The rake drum, which is rigidly attached to the frame at a 22° raking angle, delivers rocks to the right. It consists of a cylinder with four rows of teeth, arranged in spirals and welded to the drum surface. Penetration is controlled with a single hydraulic cylinder. The rake drum is chain driven by a hydraulic motor, which is powered by the tractor hydraulics.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The Crown WR 120 was operated in the conditions shown in TABLE 1 for 102 hours, while raking about 150 ha (370 ac). It was evaluated for rate of work, quality of work, ease of operation and adjustment, power requirements, safety and suitability of the operator's manual.

TABLE 1. Operating Conditions

Rock Size	**Hours**
Less than 200 mm (8 in)	42
200 to 300 mm (8 to 12 in)	40
Greater than 300 mm (12 in)	20
Total	102
Rock Concentration	Hours
Light	14
Medium	63
Heavy	35
Total	102

RESULTS AND DISCUSSION

RATE OF WORK

Suitable field speeds ranged from 2 to 6 km/h (1.2 to 3.7 mph). Average workrates varied from 0.6 to 2 ha/h (1.6 to 5 ac/h). Appropriate ground speeds depended on both the size and concentration of rocks in the field. In heavy concentrations, speeds had to be below 4 km/h (2.5 mph) to reduce misses; at higher speeds, some small rocks were missed. Low ground speeds also had to be used in large rocks over 300 mm (12 in) in size, to minimize possible damage to the rake. Dense, uniform windrows were produced at speeds below 4 km/h (2.5 mph) while scattered windrows were formed at higher speeds.

QUALITY OF WORK

Raking Characteristics: The rake drum was rigidly fixed to the frame at a 22° raking angle. The operator's manual recommended operating the drum at 125 to 150 rpm. The drum was operated at 140 rpm, which required a tractor hydraulic supply of 39 L/m (8.5 gpm). This gave adequate raking action and rock movement in most field conditions.

In fields with a heavy concentration of small rocks, a number of rocks were missed by being thrown over the drum. If larger rocks were caught and lifted by the drum, they occasionally jammed between the frame and the drum. It is recommended that the manufacturer consider providing an optional rock deflector attachment to reduce jamming and carryover of small rocks.

To effectively windrow surface rocks and to minimize soil retention in the windrow, forward speed had to be selected to suit field conditions. With a 22° rake angle, best performance was achieved with a tooth index[1] of about 1.9 in fields with light rock concentrations, about 2.8 in fields with medium rock concentrations and about 5.7 in fields with heavy rock concentrations. With a drum speed of 140 rpm, corresponding ground speeds were about 6, 4 and 2 km/h (3.7, 2.5 and 1.2 mph) in light, medium and heavy rock concentrations, respectively. FIGURE 2 shows the effect of ground speed on raking effectiveness in a field with medium rock concentration.

Windrow Formation: As is shown in FIGURE 2, windrow formation depended on drum and ground speed. At a drum speed of 140 rpm, ground speeds below 4.0 km/h (2.5 mph) formed dense,

[1]*The tooth index is the ratio of the tangential tooth tip speed to the forward speed. A high tooth index gives aggressive raking action.*

uniform windrows in most conditions. Higher ground speeds resulted in scattered windrows.

A)

B)

C)

FIGURE 2. Typical Performance in a Field with Medium Rock Concentration at a Drum Speed of 140 rpm: A) Before Windrowing, B) Windrowed at 4.0 km/h, C) Windrowed at greater than 5.0 km/h.

Operating Depth: Performance was best with the rake teeth operating about 25 mm (1 in) below the soil surface. Deeper operation caused considerable soil to be windrowed with the rocks. In fields with subsurface rocks, deeper or faster operation resulted in the rake bouncing, causing some surface rocks to be missed. If tooth penetration was less than 25 mm (1 in), small surface rocks were missed.

It was important to select the proper soil condition for optimum performance. For example, penetration usually was inadequate in fields with a hard surface crust. If the surface soil was very loose, operating depth had to be greater than 25 mm (1 in) to prevent misses. This produced windrows containing excessive soil.

Trashy Conditions: Surface trash caused few problems. The use of a rod weeder prior to raking was desirable since this placed small rocks on the surface, and gave a relatively firm working base.

Soil Pulverization: The windrower caused considerable soil pulverization, especially at low ground speeds. Pulverization decreased with increased ground speeds. Raking levelled the field surface and broke most surface lumps, creating a condition susceptible to wind erosion. In dry fields, operation was very dusty (FIGURE 3), often causing the windrower to be completely obscured. At times the operator was unable to see where the rake had passed on the previous round. Because of the dust problem, a tractor equipped with a cab was desirable.

FIGURE 3. Typical Dust Conditions.

Stability: The Crown WR 120 was stable in most conditions. When large subsurface rocks were encountered, the rake skewed to bypass the rocks. Ground speed had to be selected to suit field conditions. In fields with heavy subsurface rock concentrations, ground speed usually had to be below 4 km/h (2.5 mph). At higher speeds, the rake sometimes began to bounce, missing a large number of rocks. The windrower was relatively stable on hillsides. Skewing was never severe enough to affect operation.

Rock Size: The Crown WR 120 could effectively windrow rocks ranging in size from 30 to 400 mm (1.2 to 16 in). Although it could also handle rocks ranging from 400 to 500 mm (16 to 20 in), such rocks had to be windrowed with caution due to severe shock loads on the rake drum.

Performance was best in fields having a maximum rock size less than 300 mm (12 in). In fields with a large number of rocks ranging from 300 to 400 mm (12 to 16 in) lower ground speed usually had to be used to reduce shock loading. Rocks greater than 500 mm (20 in) in diameter should be removed from the field before windrowing.

EASE OF OPERATION AND ADJUSTMENT

Transporting: The Crown WR 120 transported well at speeds up to 40 km/h (25 mph). The 127 mm (5 in) transport clearance was adequate. The transport lock was inconvenient to use. A metal spacer had to be attached to the fully extended cylinder rod with a hose clamp (FIGURE 4). A storage location was not provided for the transport lock when not in use. Modifications to provide a more convenient transport lock are recommended.

FIGURE 4. Transport Lock.

Rake Drum Drive: The rake drum was chain driven by a hydraulic motor powered by the tractor remote hydraulics. The operator's manual recommended that the tractor hydraulic system be capable of supplying 54 to 68 L/m (12 to 15 gpm) at 8272 to 10,341 kPa (1200 to 1500 psi) to provide proper rock rake operation. At 39 L/m (9 gpm) the drum rotated at 140 rpm, which was adequate for most conditions. Drum speed adjustment was not provided on the rock rake but the drum speed could be adjusted by changing

tractor engine speed or tractor hydraulic flow.

The hydraulic driven rake drum was protected from damage by the tractor hydraulic pressure relief valve. The hydraulic drive eliminated the need for a slip clutch or shear pin and permitted the operator to reverse the rake drum from the tractor to clear blockages.

Hitching: A hitch jack was not provided on the Crown WR 120 rock rake. However, the hitch could easily be raised by activating the depth control cylinder using the tractor hydraulics. The hitch clevis was fixed allowing for one man hitching. The clevis height was not adjustable, and a tractor drawbar height had to be less than 500 mm (20 in) to allow the drum teeth to penetrate the ground 25 mm (1 in).

Ease of Servicing: Serviceability of the Crown WR 120 was good. All grease fittings were easily accessible and were sufficiently shielded to protect them from rocks. The lubrication frequency for the grease fittings was not given in the operator's manual.

Maneuverability: The Crown WR 120 was quite maneuverable. Its turning radius was short enough for easy operation. However, normal care had to be taken to prevent interference between the rear tractor tire and the frame on sharp turns.

POWER REQUIREMENTS

A tractor with 35 kW (47 hp) maximum power take-off rating had sufficient power reserve to operate the Crown WR 120 in most conditions. Actual power requirements depended on field conditions and fluctuated widely due to impact loading of the rake teeth.

OPERATOR'S MANUAL

The operator's manual contained a parts list and some information on the tractor requirements and machine adjustment. It is recommended that the operator's manual be expanded to include detailed information on windrower operation and adjustment as well as safety precautions.

SAFETY

The Crown WR 120 was safe to operate as long as normal safety practices were observed. Shielding provided adequate operator protection from driveline components. A slow moving vehicle sign was not supplied. It is recommended that a slow moving vehicle sign be provided as standard equipment.

DURABILITY RESULTS

TABLE 2 outlines the mechanical history of the Crown WR 120 during 102 hours of field operation. The intent of the test was a functional evaluation. The following mechanical problems are those, which occurred during the functional testing. An extended durability test was not conducted.

TABLE 2. Mechanical History

Item	Hours
Driveline:	
-The drum drive chain shield was damaged by rocks and was repaired at	31
Welds:	
-The weld on the left stabilizer arm failed and was repaired at	80 and 100
Drum:	
-Several welds, attaching the rake teeth to the drum, cracked and were rewelded at	71
-Numerous rake teeth bent and were straightened six times	during the test
-The rake teeth were badly worn and required replacing by	end of test

DISCUSSION OF MECHANICAL PROBLEMS

Driveline: The shield covering the drum drive chain was torn off by rocks. Modifications to strengthen the drum drive chain shield are recommended.

Drum: Several rake teeth were bent by rocks and most of the teeth began to separate from the drum (FIGURE 5) by the end of the test. The teeth wore prematurely and the entire drum needed replacing by the end of the test. Modifications to reduce rake teeth failures and premature wear are recommended.

FIGURE 5. Rake Drum at the End of the Test.

APPENDIX I
SPECIFICATIONS

MAKE:	Crown Rock Windrower
MODEL:	WR 120
WEIGHT (hopper empty):	
-- left wheel	270 kg
-- right wheel	225 kg
-- hitch	185 kg
TOTAL	680 kg
TIRES:	2, 7.60 x 15, 4-ply
0VERALL DIMENSIONS:	
-- width	3425 mm
-- height	1070 mm
-- length	3400 mm
-- ground clearance	120 mm
RAKE DRUM:	
-- width	3600 mm
-- diameter	180 mm
-- tooth length	125 mm
-- lateral tooth spacing	75 mm
-- operating speed	240 rpm at 68 L/m
-- angle of drum to direction of travel	22 degrees
HYDRAULIC MOTOR:	1, Char-Lynn No. 104-1027
NUMBER OF CHAIN DRIVES:	1
NUMBER OF LUBRICATION POINTS:	5

APPENDIX II
MACHINE RATINGS

The following rating scale is used in Machinery Institute Evaluation Reports:

a) excellent	d) fair
b) very good	e) poor
c) good	f) unsatisfactory

APPENDIX III
CONVERSION TABLE

1 hectare (ha)	= 2.5 acres (ac)
1 kilometer/hour (km/h)	= 0.6 miles/hour (mph)
1 metre (m)	= 3.3 feet (ft)
1 millimeter (mm)	= 0.04 inches (in)
1 kilowatt (kW)	= 1.3 horsepower (hp)
1 kilogram (kg)	= 2.2 pounds mass (lb)

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