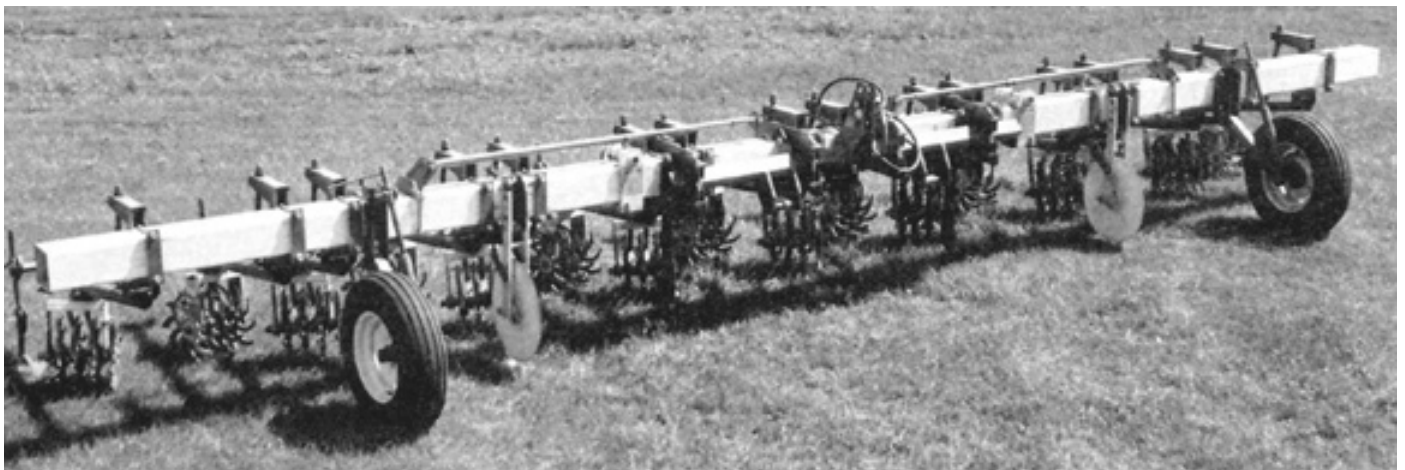


Evaluation Report 316



Lilliston 6420 Row Crop Cultivator

A Co-operative Program Between



LILLISTON 6420 ROW CROP CULTIVATOR

MANUFACTURER AND DISTRIBUTOR:

Lilliston Corporation
Box 3930
Albany, Georgia
31708

RETAIL PRICE: \$11,015.00 (April 19, 1983 f.o.b. Portage la Prairie, Manitoba)

8-row, 36 inch (900 mm) spacing with high-speed sweeps, bed rippers, support wheels, coulters, three-spider gangs and add-on spiders.

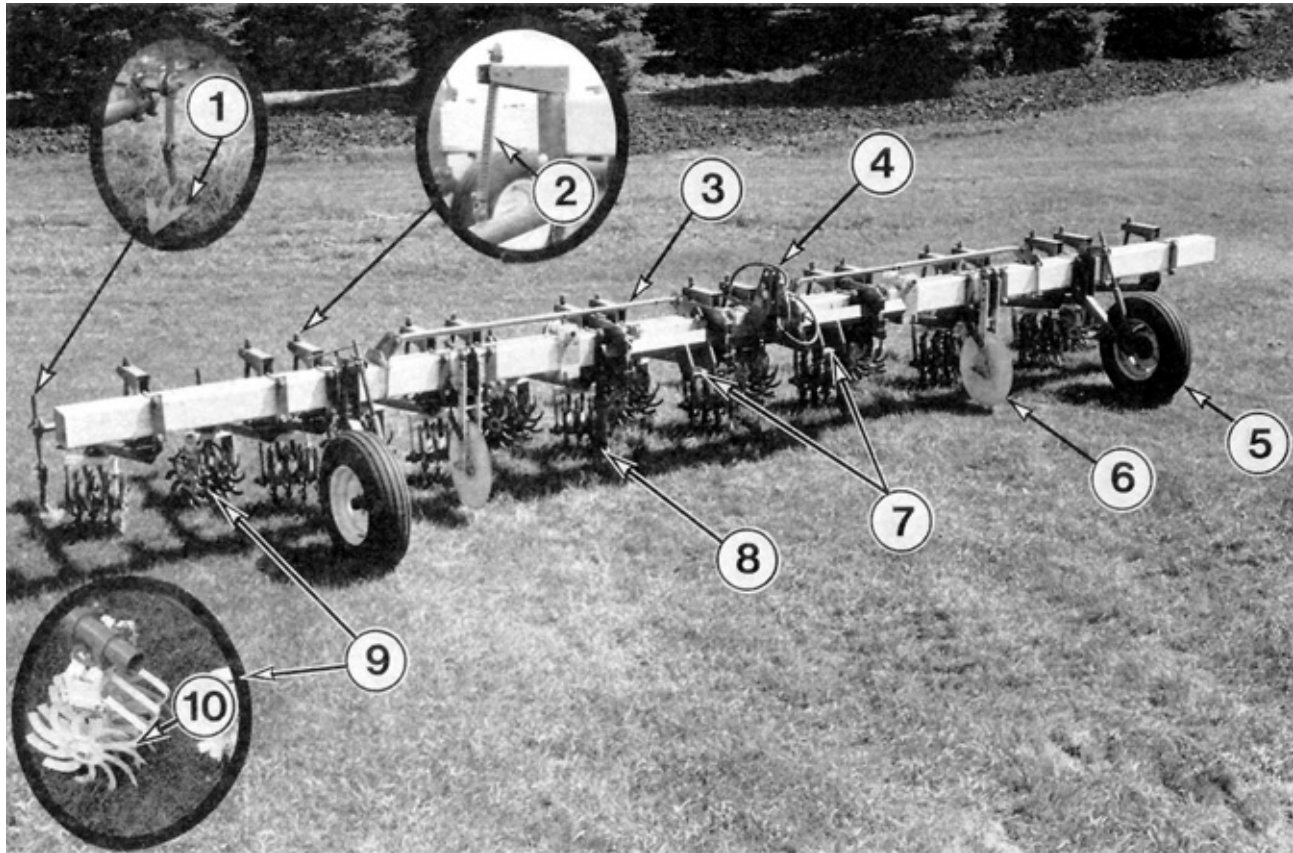


FIGURE 1. Lilliston 6420: (1) High-Speed Sweeps, (2) Depth Control Springs, (3) Transport Braces, (4) Upper Hitch Mast, (5) Support Wheels, (6) Coulters, (7) Lower Hitch Points, (8) Bed Rippers, (9) Spider Gangs, (10) Add-On Spiders.

SUMMARY AND CONCLUSIONS

The overall performance of the Lilliston 6420 row crop cultivator was very good. Weed Kill was good with the gangs set at a moderate angle of attack. Penetration was very good in average field conditions.

Trash burial in light and moderate trash was good. In areas of heavy trash, plugging sometimes occurred between the rear gangs and the high-speed sweeps. This caused the gang to push the soil instead of tilling it. Only moderate skewing occurred where soil hardness varied across the machine width.

The wings on the Lilliston 6420 folded 90 degrees and required pins to keep them in place during transport. The 11 in (280 mm) sweep-to-ground clearance was adequate for normal transport. Transporting on public roads required caution because of the machine's large transport width and height. The Lilliston 6420 was stable during field work and in transport.

Tillage depth was usually level across the cultivator width. Fore-and-aft and lateral levelling was accomplished on the three-point hitch of the tractor. One man could hitch or unhitch the Lilliston 6420 in about 5 minutes.

Total draft (pull force) under average row crop conditions at 5 mph (8 km/h) varied from 1800 lb (8 kN) at the minimum

horizontal angle and penetration settings, to 3,600 lb (16 kN) at the maximum horizontal angle and penetration settings. Under average soil conditions, at 6.2 mph (10 km/h) and maximum horizontal gang angle and gang pressure settings, the draft power was about 100 hp (75 kW). A tractor of about 130 hp (98 kW) was required for safe overall operation of the Lilliston 6420.

Only minor mechanical problems developed during the 262 hours of field operation. One gang pivot clamp broke after 75 hours, and one add-on spider fell off after 155 hours.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifying the fastener to prevent the add-on spiders from coming loose.
2. Providing a more convenient method of locking the wings into the transport position.

Senior Engineer - G.M. Omichinski

Project Coordinator - R.R. Hochstein

Project Engineer - D.J. May

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. We will study the feasibility of providing a different type fastener.
2. We will study the transport locking assembly to determine why the mounting brackets slipped, which caused you some difficulty in lining up holes to insert the locking pin.

GENERAL DESCRIPTION

The Lilliston 6420 is a mounted, folding, eight-row, Rolling Cultivator® suitable for light tillage, and chemical incorporation in row crops of 24 in (610 mm) up to a 42 in (1067 mm) row spacing. FIGURE 1 shows the location of the major components on the Lilliston 6420. Tillage depth is controlled by adjusting the pressure on the depth control springs.

The cultivator was equipped with sixteen, three-spider gangs and a fourth add-on spider at one end of each gang. High-speed sweeps were centred behind each pair of gangs to cover any area that may have been missed by the gangs. It was also equipped with bed rippers to break up hard ground packed by the tractor, disc coulters to prevent side sway, and support wheels. The wings fold into transport position by means of a hydraulic cylinder located within each end of the centre section of the tool bar. A tractor with dual remote hydraulic controls, and a category II or III three-point hitch is required to operate the Lilliston 6420.

Detailed specifications are given in APPENDIX I.

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SCOPE OF TEST¹

The Lilliston Rolling Cultivator® was operated under field conditions as shown in TABLE 1 for 262 hours, while cultivating 2815 ac (1126 ha). It was evaluated for quality of work, ease of operation and adjustment, power requirements, operator safety, and suitability of the operator manual.

TABLE 1. Operating Conditions

FIELD CONDITION	OPERATING HOURS	EQUIVALENT FIELD AREA ac (ha)*
Soil Type:		
— sand	77	830 (332)
— sandy loam	72	770 (308)
— loam	52	555 (222)
— clay loam	61	660 (264)
TOTAL	262	2815 (1126)
Crop:		
— corn	252	2705 (1082)
— sunflowers	7	80 (32)
— potatoes	3	30 (12)
TOTAL	262	2815 (1126)

* EQUIVALENT FIELD AREA includes two to three successive cultivations on the same field. Duration between cultivations was about two weeks.

During the test only a few small stones were encountered. They did not have a significant effect on the test. The cultivator was transported over 300 mi (485 km) on paved roads and 160 mi (260 km) on gravelled roads.

RESULTS AND DISCUSSION

QUALITY OF WORK

Penetration: Penetration was very good under average field conditions. However, penetration was not always uniform across the cultivator width. The spider gangs behind the tractor and implement wheels tended to ride on top of hard soil, packed by these wheels. The depth control springs were adjusted to put more pressure on the individual gangs. This adjustment was less effective in compacted soil conditions.

Uniform penetration also depended on the levelness of the

cultivator. Locking pins were supplied to keep the wings rigid with the centre section in field position. Otherwise, the wings crept upward when the three-point hitch was in the fully lowered position.

Trash Effects: In row crop conditions of moderate or light trash (residue corn stalks and weeds) there were, generally, no problems with plugging. In areas of heavy trash, clumps of old stalks occasionally wrapped around the high speed sweeps and eventually plugged the rear spider set. If this occurred repeatedly, the sweeps were simply lifted out of the way and not used in those conditions. Also, hard roots occasionally jammed between two adjacent blades of a spider. These had to be removed by hand when the cultivator was stopped.

Trash and weed burial was good with the Lilliston 6420. In heavy trash conditions the dry, lighter stalks were left on top of the soil, while the moist, heavy ones were tilled under. Stalks were also broken due to the pulverizing action of the spider blades.

Field Surface: Left hand cutting "No. 1" and right hand cutting "No. 2" gangs are paired on either side of each row on the Lilliston 6420. The No. 1 and No. 2 gangs must be exchanged when reversing soil movement.

When the gangs were set for a small angle of attack, the field was left very smooth (FIGURE 2A). A large angle of attack moved more soil towards or away from the crop row (depending on tilling direction) than did a small angle of attack. Hilling with a large angle of attack provided a good soil bed for crops such as potatoes (FIGURE 2B). The test machine was not equipped with row shields, necessitating movement of soil away from the crop, on the first cultivation. It was found that setting the spiders to move soil away from the plants provided adequate protection against burying or damaging the plants under normal field conditions.



FIGURE 2A. Field surface with no hilling action.



FIGURE 2B. Field surface with hilling action.

¹Prairie Agricultural Machinery Institute Detailed Test Procedure for Row Crop Cultivators.

Furrow Bottom Ridging: Furrow bottom ridging² was apparent wherever the ground was hard packed such as behind the tractor tire or in soils with a hard subsurface layer. Bed rippers on the tool bar and extra compression on the depth control springs reduced this problem, but in extremely hard soil, ridging still occurred.

Skewing and Stability: The Lilliston 6420 was stable and did not skew sideways under average field conditions. The symmetrical gang pattern (FIGURE 3) did not impose any side forces on the cultivator during normal tillage. Some skewing did occur where soil hardness varied across the machine width despite the three-point hitch rigid mounting. No crop loss occurred due to skewing of the cultivator.

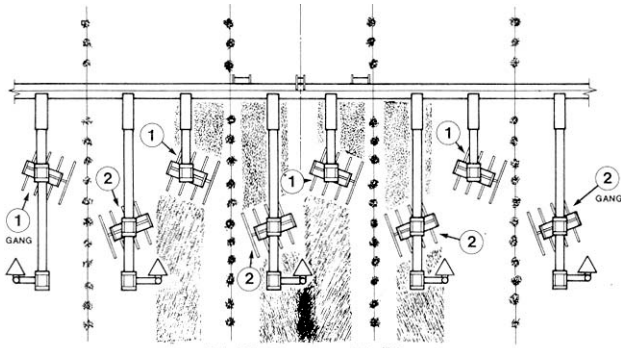


FIGURE 3A. Gang pattern (gangs set to move soil away from plants).

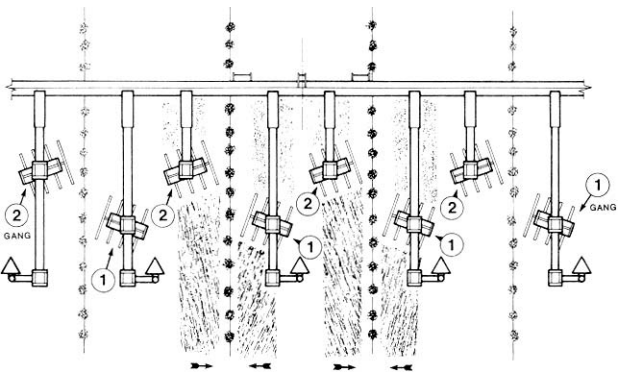


FIGURE 3B. Gang pattern (gangs set to move soil toward plants).

Weed Kill: Weed kill ranged from good with the gangs at a moderate angle of attack to very good at a large angle of attack. Most of the weeds were churned up with the pulverizing action or cut off by the blades. Larger deep rooted weeds sometimes slipped through the spider blades without being cut off. High-speed sweeps helped to slice off any weeds missed between the adjacent gangs.

EASE OF OPERATION AND ADJUSTMENT

Hitching: One person could hitch or unhitch the cultivator in about 5 minutes. Bushings were provided to permit hitching the cultivator to tractors with a category II or III three-point hitch. As with all rear-mounted implements careful backing of the tractor was required to hitch the cultivator quickly. Care should be taken if more than one person is hitching the cultivator.

Frame Levelling: Levelling of the cultivator was achieved by shortening or lengthening the linkage on the three-point hitch. The two bottom links controlled the lateral levelling while the top link controlled the fore-and-aft levelling. The links were adjusted until all of the gang pipes were parallel with the ground at the same time. Some adjustments on the levelness could also be made at the support wheels.

Tillage Depth: Tillage depth was controlled by adjusting the compression on the depth control springs. Increasing the spring compression placed more force on the gangs, thus increasing

the tillage depth. This adjustment was not very effective in hard packed soils. For effective depth control, the lower links on the three-point hitch of the tractor had to be adjusted low enough to allow the cultivator to float at the required tool bar working height.

Maneuverability: Maneuvering the Lilliston 6420 was convenient due to the three-point hitch rigid mount. Cultivating with the spiders set close to the rows, demanded extra operator alertness, to keep skewing loss to a minimum. The heavy cultivator weight required ballasting of the tractor front end in order to retain tractor stability.

Transporting: The Lilliston 6420 row crop cultivator was easily placed into transport position (FIGURE 4) by one person from the tractor in about three minutes. Manually inserted transport lock-pins were provided for safety to hold the wings in the 90 degree position during transport. Lining up the holes for inserting the locking pins in the transport braces was difficult (FIGURE 5). It is recommended that the manufacturer consider providing a more convenient method of locking the wings into transport position. Caution should be observed when folding or unfolding the wings even though they move at a moderate speed.



FIGURE 4. Transport Position.

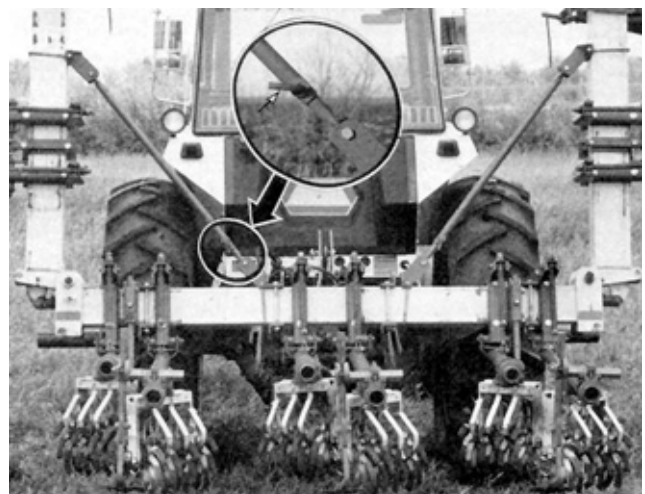


FIGURE 5. Transport Braces (lock-pin shown in inset).

Transport width of the test machine was 14.9 ft (4.5 m) while transport height was 13.2 ft (4.0 m). Care was required when transporting on public roads, through gates, over bridges, and beneath power lines.

The Lilliston transported well without sway at normal transport speeds. The transport sweep-to-ground clearance of 11 in (280 mm) was adequate on slopes and rough terrain. Care should be taken not to engage the clutch too quickly as the front tractor tires may tend to lift off of the ground even when front end ballast is used. The manufacturer suggests adding weight to the front of the tractor and cautions against driving fast on rough ground.

²Ridges left by ground tool in hard surface or subsurface soil

Tilling Direction: The gangs could be changed to reverse soil movement by one person in about 40 minutes. This required exchanging the No. 1 (left cutting) and No. 2 (right cutting) gangs. Adjusting the vertical or horizontal angles on all of the gangs took one person about 20 minutes (FIGURE 6).

Spider Installation: It was necessary to remove the add-on spiders during the second cultivation of potatoes. The 16 add-on spiders could be installed or removed by one person in about 50 minutes. The jam nuts required a torque of 220 lb-ft (300 N-m) as recommended in the operator manual, otherwise, they loosened quickly.

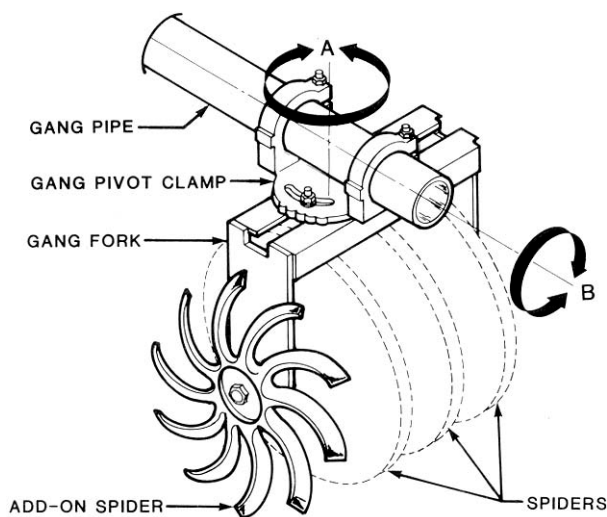


FIGURE 6. Gang terminology: (A) Horizontal angle adjustment (rotation about line through centre of gang pivot clamp), (B) Vertical angle adjustment (rotation about line through centre of gang pipe).

POWER REQUIREMENTS

Draft Characteristics: FIGURE 7 shows draft requirements per row for the Lilliston 6420 under average field conditions at a speed of 5 mph (8 km/h) in moist clay loam. It should be noted that variation in soil conditions affect draft much more than variation in machine make, usually making it difficult to measure significant draft differences between different makes of row crop cultivators. Changing the horizontal angle had the most significant effect on draft, while a change in the vertical angle had a negligible effect on draft (FIGURE 6). Changing the compression of the depth control spring had a negligible effect on draft for small horizontal angles. There was an appreciable increase in draft when the horizontal angle was increased in combination with greater compression of the depth control springs.

Increasing speed by 0.6 mph (1 km/h) increased draft by about 22 lb/row (100 N/row). This represents a draft increase of about 180 lb (800 N) for the eight-row test machine.

Actual draft power requirements for the Lilliston 6420 at the maximum horizontal angle and gang pressure settings varied from 63 to 127 hp (47 to 95 kW) for speeds of 4.3 to 7.5 mph (7 to 12 km/h) respectively.

Tractor Size: Tractor size was dictated by the stability requirements for this eight-row test machine. A tractor (with front ballasting) of about 130 hp (98 kW) was suitable for the Lilliston 6420.

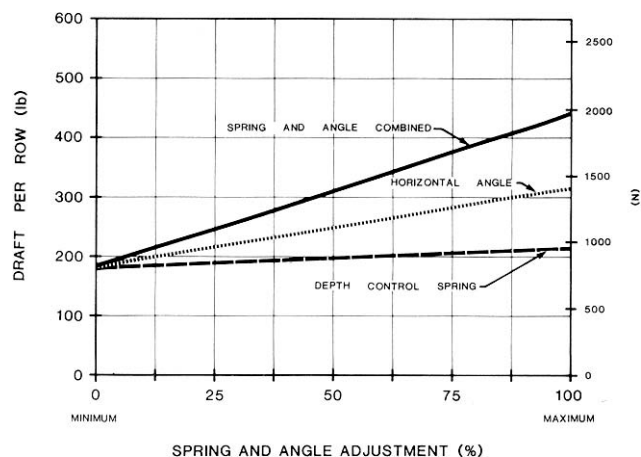


FIGURE 7. Typical draft requirements for Lilliston 6420 at 5 mph (8 km/h), under average conditions for horizontal angle and depth control spring adjustments.

OPERATOR SAFETY

Power lines may be as low as 15 ft (4.6 m) in the three prairie provinces. With a transport height of 13.2 ft (4.0 m) the Lilliston was safely transported under power and telephone lines.

The test machine was 14.9 ft (4.5 m) wide in transport position. This necessitated caution when transporting on public roads, over bridges and through gates. A slow moving vehicle sign was not provided by the manufacturer.

The test machine could be safely hitched to a tractor by one person. If a second person is used to hitch the cultivator the person on the ground should stand behind the cultivator away from the tractor, for maximum safety.

OPERATOR MANUAL

The operator manual included instruction on set-up, operation, adjustment, maintenance and safety. It was generally well written and clearly illustrated.

DURABILITY

The following is a discussion of the mechanical history of the Lilliston 6420 during 262 hours of field operation while tilling about 2815 ac (1126 ha). The intent of this evaluation was a measure of general performance. An extended durability evaluation was not conducted.

Gang Pivot Clamps: One gang pivot clamp, which clamped the spider gang to the gang pipe, broke. The clamp was repaired by welding the broken sections back together. This failure only occurred once, and was not considered a serious problem.

Spiders: The No. 2 add-on spiders came loose and had to be tightened continually throughout the test. This was due to the fact that they had to be screwed onto the left end of the No. 2 gangs. The No. 2 spider gang then turned in a direction such that the add-on spider tended to turn off. It is recommended that the manufacturer consider modifying the fasteners for the add-on spiders.

APPENDIX I

SPECIFICATIONS

MAKE: Lilliston
MODEL: 6420, eight-row, 36 inch spacing
SERIAL NUMBER: 10674

DIMENSIONS:	FIELD POSITION		TRANSPORT POSITION	
	ft	(m)	ft	(m)
-- width	27.3	(8.3)	14.6	(4.5)
-- length (from lower hitch point to rear of cultivator)	6.1	(1.9)	6.1	(1.9)
-- height	3.8	(1.2)	13.2	(4.0)
-- ground clearance			0.9	(0.3)

SPIDERS:
-- number of sets 16
-- number per set three plus one add-on
-- diameter 16 in (405 mm)
-- trash clearance 18.5 in (470 mm)
-- (frame to spider tip) 3.5 in (90 mm)
-- horizontal angle adjustment 25°
-- (max. from parallel with tool bar)

HITCH AND DEPTH CONTROL:
-- Category II or III, three-point hitch

FRAME:
-- type 90° folding wings
-- tool bar 7 in (178 mm), square tubing, 0.2 in (6 mm) wall
-- gang support 3 in (76 mm), round pipe, 0.2 in (6 mm) wall

SUPPORT WHEELS:
-- adjustment 10 in (250 mm)
-- tire two, 7.60 x 15, 4 ply

NUMBER OF LUBRICATION POINTS:
-- four grease fittings
-- service every 50 hours

HYDRAULIC CYLINDERS:
-- wing lift two, 3 in x 15 in (76 mm x 370 mm)

OVERALL WEIGHT: 4020 lb (1830 kg)

OPTIONAL EQUIPMENT:
-- sweep shanks
-- bed rippers
-- guide wheels
-- gauge wheels
-- row guides
-- crop shields
-- twin row disc & spider attachments
-- coulters
-- leg stands
-- add-on-spiders
-- split row spider gang assemblies
-- split row disc gang assemblies
-- disc row markers

APPENDIX II

MACHINE RATINGS

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

Excellent	Fair
Very Good	Poor
Good	Unsatisfactory

APPENDIX III

CONVERSION TABLE

<u>IMPERIAL UNITS</u>	<u>MULTIPLY BY:</u>	<u>S.I. UNITS</u>
Acre (ac)	0.405	Hectare (ha)
Foot (ft)	0.305	Metre (m)
Inches (in)	25.4	Millimetres (mm)
Horsepower (hp)	0.746	Kilowatt (kW)
Miles/Hour (mph)	1.61	Kilometre/hour (km/h)
Pounds Force (lb)	4.45	Newton (N)
Pounds Force/Foot (lb/ft)	14.6	Newton/Metre (N/m)
Pounds Force-Feet (lb-ft)	1.36	Newton-Metre (N-m)
Pounds Force/Square inch (psi)	6.89	Kilopascal (kPa)
Pounds Mass (lb)	0.454	Kilogram (kg)

SUMMARY CHART

LILLISTON 6420 ROW CROP CULTIVATOR	EVALUATION	COMMENTS
QUALITY OF WORK		
Penetration	Very Good	reduced in hard packed soil
Trash Clearance	Very Good	no plugging except in very trashy conditions with high speed sweeps in place
Trash Burial	Good	good churning action
Field Surface	Excellent	variety of field surfaces with different gang adjustments
Weed Kill	Very Good	with large angle of attack
EASE OF OPERATION AND ADJUSTMENT		
Hitching	Very Good	about 5 minutes for Category III
Frame Levelling	Good	additional adjustment, at support & guide wheels
Tillage Depth	Good	some control with depth control springs
Maneuverability	Very Good	three point hitch rigid mount
Transporting	Fair	large transport width & height difficult to insert locking pins
Gang Adjustments	Very Good	soil movement reversed in about 40 minutes
Spider Installation	Good	add-ons installed in about 50 minutes
OPERATOR SAFETY	Good	large transport width and height caution decals provided
OPERATOR MANUAL	Good	well written and clearly illustrated
POWER REQUIREMENTS		
	<u>Per Row</u>	<u>Total</u>
Draft at 5 mph (8 km/h)	330 lb (1.4 kN)	2640 lb (11.2 kN)
Draft increase per mph (1.6 km/h)	36 lb (0.2 kN)	280 lb (1.3 kN)
Minimum Overall Tractor Size		130 hp (98 kW)
		in clay loam
		for cultivator stability
CAUTION: This summary chart is not intended to represent the final conclusions of the evaluation report. The relevance of the ratings is secondary to the information provided in the full text of the report. It is not recommended that a purchase decision be based only on the summary chart.		



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