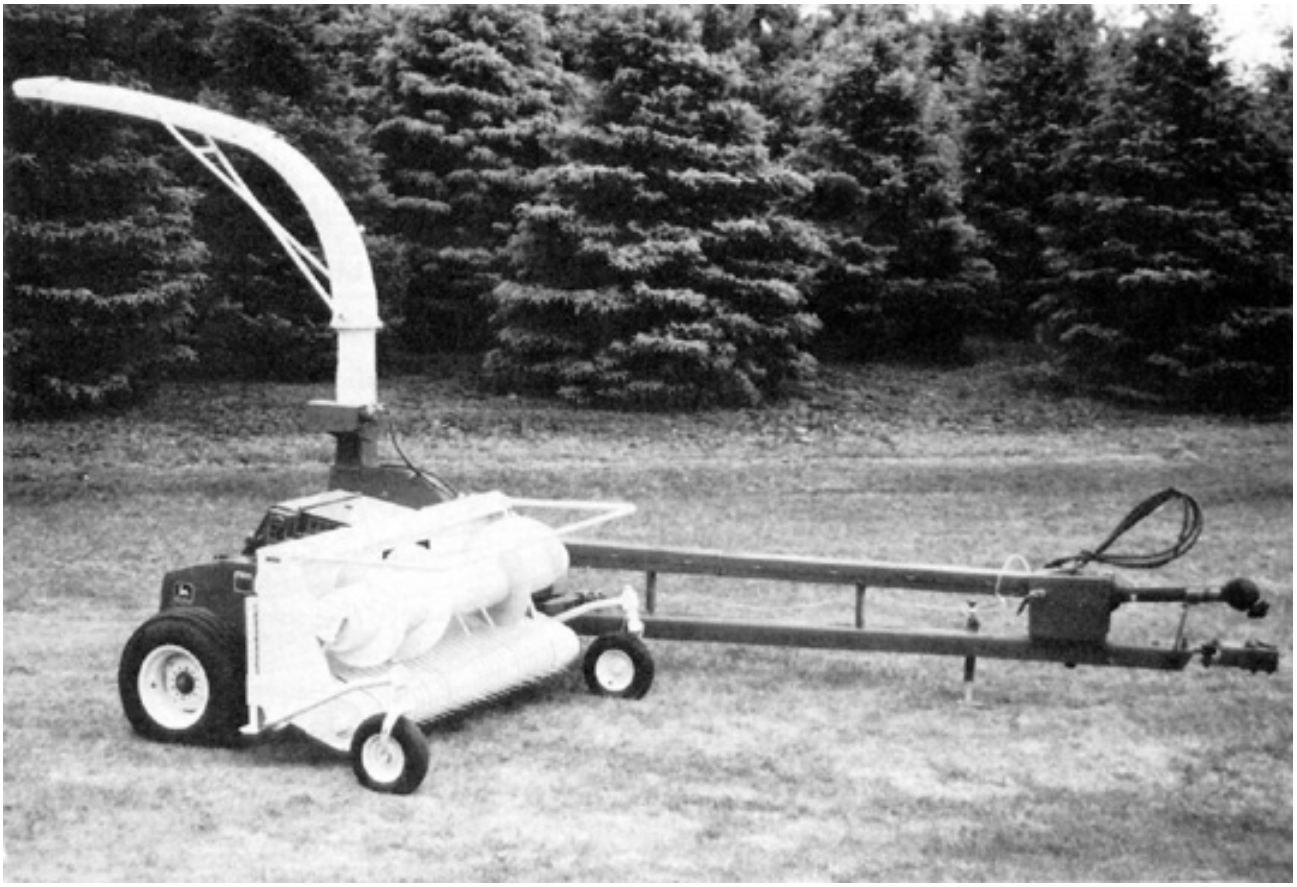
Evaluation Report No. E0180C
Printed: May, 1981
Tested at: Portage La Prairie
ISSN 0383-3445

Evaluation Report 202



John Deere 3960 Forage Harvester

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

JOHN DEERE 3960 FORAGE HARVESTER

MANUFACTURER:

John Deere Ottumwa Works
Ottumwa, Iowa
52501 U.S.A.

DISTRIBUTOR:

John Deere Limited
455 Park Street
Regina, Saskatchewan
S4P 3L8

RETAIL PRICE:

$27,348.00 (April, 1981, f.o.b. Portage La Prairie, with remote controls, 2.1 m (7 ft) windrow pickup, and three-row row crop head).

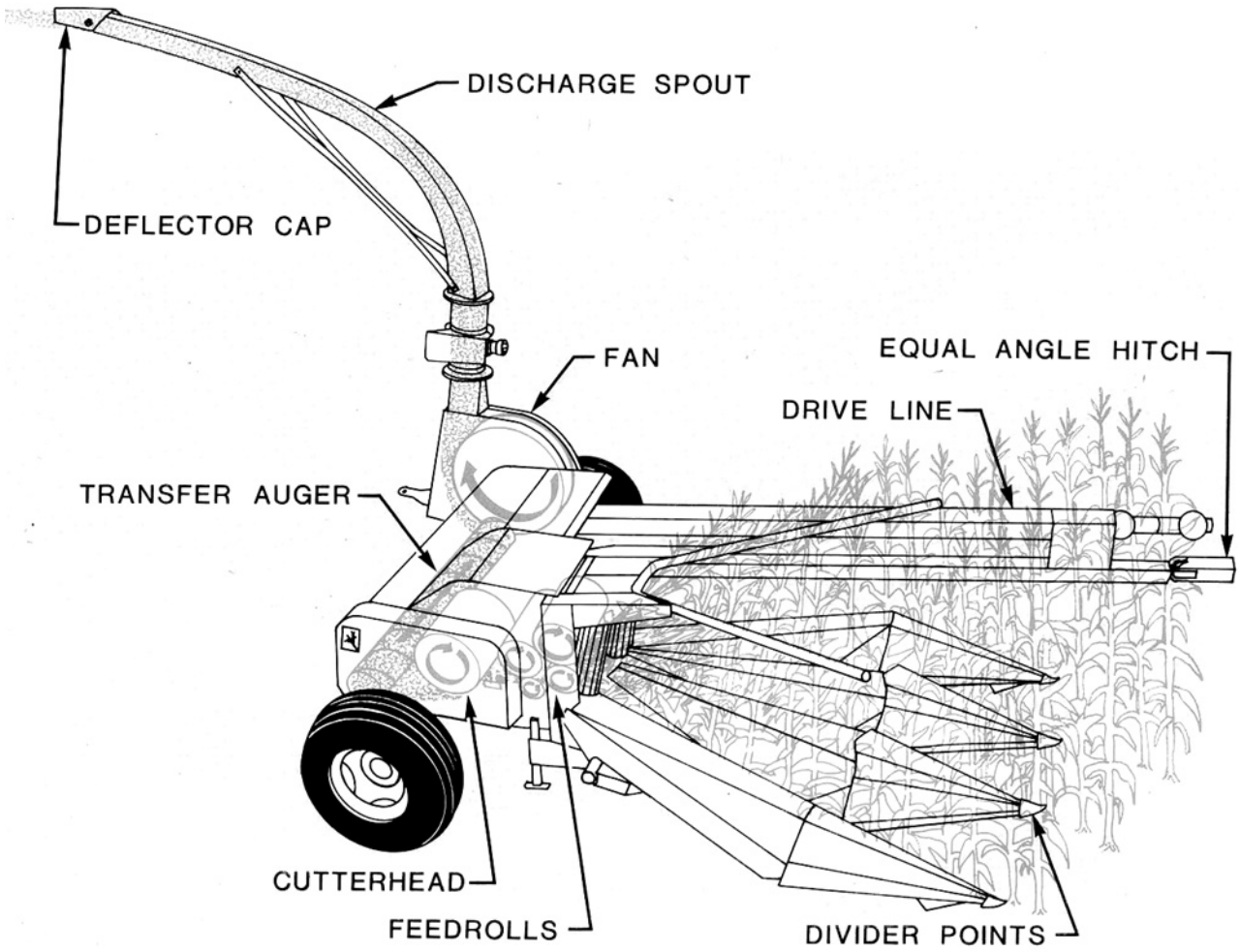


FIGURE 1. John Deere 3960.

SUMMARY AND CONCLUSIONS

Overall functional performance of the John Deere 3960 was *very good*. Ease of operation and adjustment was *very good*.

Workrates[1] ranged up to 64 t/h (70 ton/h) in standing corn, up to 42 t/h (46 ton/h) in alfalfa and up to 43 t/h (47 ton/h) in green rye. Dry-weight workrates ranged up to 26 t/h (29 ton/h) in corn, up to 21 t/h (23 ton/h) in alfalfa and up to 22 t/h (24 ton/h) in rye. The three-row row crop head fully utilized cutterhead capacity. The pickup head had three speed adjustments and performed well at speeds up to 8 km/h (5 mph). The use of a 50 x 240 mm (2 x 10 in) recutter screen reduced workrates by up to 40% in alfalfa and 30% in corn.

At 6 mm (0.25 in) cut length setting, 5% of alfalfa particles were longer than 25 mm (1 in) and 4% of corn particles were longer than 25 mm (1 in).

A tractor of 120 kW (160 hp) maximum power take-off rating would have sufficient power to operate the John Deere 3960 in typical prairie crops.

The harvester was easy to maintain and service. The electrically operated hydraulic remote controls were convenient.

The John Deere was safe to operate if the manufacturer's safety recommendations were followed. The operator manual was well written and illustrated.

One feedroll failure and a few other minor mechanical problems occurred during the 217 hour test.

[1]*The actual workrates, which include the moisture in the crop, indicate the total mass of crop harvested, but should not be used for comparing performance of different forage harvesters. The dry-weight workrates, which consider the mass of dry matter harvested, provide a better comparison of performance of different forage harvesters and assessment of the effect of crop variables and machine settings.*

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifying the recutter screen and frames to allow easier installation and removal.
2. Modifications to allow easier inspection of the smooth feed roll and scraper clearance.
3. Supplying a slow moving vehicle sign as standard equipment.

Chief Engineer -- E.O. Nyborg
Senior Engineer -- J.C. Thauberger
Project Engineer -- C.W. Chapman

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. The 3960 normally gives a good quality of cut without recutter screens. Changes have recently been made that will improve the ease of installation and removal for difficult operating conditions requiring the use of a screen.
2. The two sliding access doors located by the stationary knife (shear plate) provide limited inspection access for smooth feed roll and scraper clearance. Consideration will be given to improve access on future models.
3. The machine does not obscure the slow moving vehicle sign located on the tractor, thus an additional sign is not required on the machine.

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

GENERAL DESCRIPTION

The John Deere 3960 is a power take-off driven, pull-type forage harvester. The cylindrical cutterhead is fed by a reversible feedroll assembly which pivots about the cutterhead shaft. The cut length may be set either by changing feedroll drive sprockets or varying the number of cutterhead knives. Chopped forage is delivered from the cutterhead to the discharge fan by a transfer auger.

The test machine was equipped with a 2.1 m (7 ft) windrow pickup and a three-row row crop head.

Detailed specifications are given in APPENDIX I, while FIGURE 1 shows the location of major components.

SCOPE OF TEST

The John Deere 3960 was operated in the crops shown in TABLE 1 for 217 hours while harvesting about 283 ha (708 ac).

It was evaluated for rate of work, quality of work, power requirements, ease of operation and adjustment, operator safety, and suitability of the operator manual.

TABLE 1. Operating Conditions

CROP	AVERAGE YIELD (t/ha at 60% (Moisture Content)	HOURS	FIELD AREA (ha)
Alfalfa	8 to 10	57	70
Rye	12	7	10
Oats/Barley	12	16	20
Sorghum	15	17	23
Corn (row crop head)	20 to 25	120	160
	TOTAL	217	283

RESULTS AND DISCUSSION

RATE OF WORK

TABLE 2 presents typical workrates for the John Deere 3960 in a variety of field conditions. The workrate for alfalfa was measured in crops yielding 8 to 10 t/ha (3.6 to 4.5 ton/ac) which had been double windrowed with a 6 m (20 ft) wide double-swath windrower. The workrate in green rye was measured in crops yielding 12 t/ha (5.4 ton/ac) and windrowed using a 6 m (20 ft) windrower, while the workrates in corn were measured in standing crops yielding 25 t/ha (11 ton/ac) harvested with the three-row row crop head. The reported values are for average continuous feedrates, with the harvester loaded to optimum levels. They do not include time for maintenance and unloading wagons.

TABLE 2. Average Workrates

CROP	Moisture Content	Cut Length Setting (mm)	WORKRATES (t/h)	
			Actual	Dry-weight
Alfalfa	55		36.7	16.5
	45	6	34.6	19.0
	42		23.6	13.6
	53		41.7	19.6
	47	9.5	38.6	20.5
	44		22.9	12.6
	42	* 9.5	12.1	7.0
Green Rye	48	6	28.1	14.6
		* 6	27.0	14.0
		9.5	42.8	22.3
		*9.5	31.3	16.3
Corn	60	8	55.0	22.0
		*6	30.3	12.1
		9.5	64.0	25.6
		*9.5	34.0	13.6

* with 50 x 240 mm recutter screen

Both actual workrates and dry-weight workrates are reported in TABLE 2. The actual workrates, which include the moisture in the crop, indicate the total mass of the crop harvested, but should not be used for comparing performance of different forage harvesters. The dry-weight workrates, which consider the mass of dry matter harvested, provide a better comparison of performance of different forage harvesters and assessment of the effect of crop variables and machine settings. Actual workrates ranged up to 64 t/h (70 ton/h) whereas dry-weight workrates ranged only up to 26 t/h (28 ton/h).

Workrates were influenced by crop moisture content, cut length setting, use of a recutter screen and the type of header attachment used. Reducing the cut length setting from 9.5 to 6 mm (0.4 to 0.25 in) decreased the dry-weight workrates by 30% in alfalfa and 15% in corn. The use of a recutter screen reduced workrates by 40% in alfalfa, 10 to 15% in green rye and 30 to 40% in corn.

The capacity of the three-row row crop head ensured that the cutterhead was operated to capacity in corn. Lower workrates could be expected, with a two-row header. The pickup header could be set at one of three speeds to permit ground speeds up to 8 km/h (5 mph).

QUALITY OF WORK

Uniformity of Cut:[2] FIGURE 2 presents typical particle length distributions in second-cut, full-bloom alfalfa, harvested at 53% moisture content (APPENDIX IV, FIGURE 9). Particle length variations are given for 6 and 9.5 mm (0.25 and 0.4 in) cut settings, with and without the use of a 50 x 240 mm (2 x 10 in) recutter screen. At a 6 mm (0.25 in) setting, only 5% of the silage had a length greater than 25 mm (1 in), while at the 9.5 mm (0.4 in) setting, 11% had a length greater than 25 mm (lin). The 50 x 240 mm (2 x 10 in) recutter screen significantly red uced the particles greater than 26 mm (1 in) in length.

[2]*For each cut length setting, a forage harvester produces a range of particle lengths. Although variation in particle length has little effect on silage palatability, the performance of some silage unloading equipment may be adversely affected if a significant quantity of material is longer than 40 mm. FIGURES 2 and 3 show material length distribution at various cut length settings, with and without recutter screens. A narrow curve with a high peak indicates uniform particle length distribution. The average material length is about that at the peak of the curve. Forage with a wide range of particle lengths has a wide curve with a low peak.*

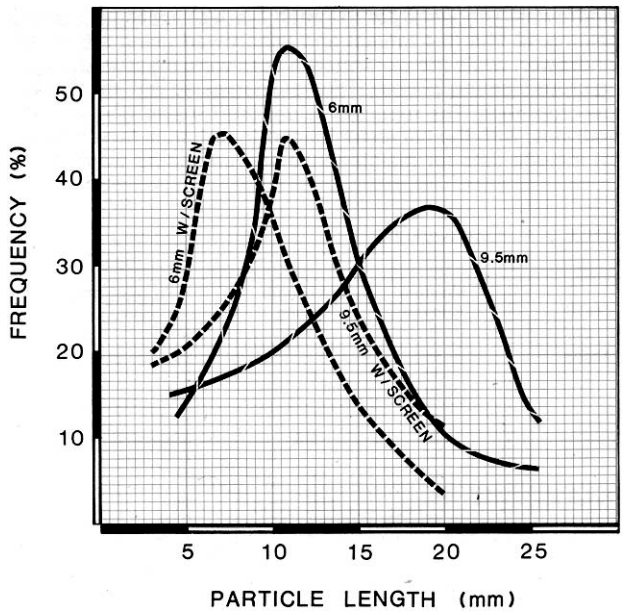


FIGURE 2. Particle Length Distribution in Alfalfa.

FIGURE 3 presents typical length distributions in corn, harvested at 60% moisture content, for 6 and 9.5 mm (0.25 and 0.4 in) settings (APPENDIX IV, FIGURE 9). Only 4% of the chopped corn had a length greater than 25 mm (1 in) atthe 6 mm (0.25 in) setting and 6% of the corn particles were greater than 25 mm (1 in) at 9.5 mm (0.4 in) setting. The smaller percentage of longer particles in corn, compared to alfalfa, was due to perpendicular feeding of the row crop header.

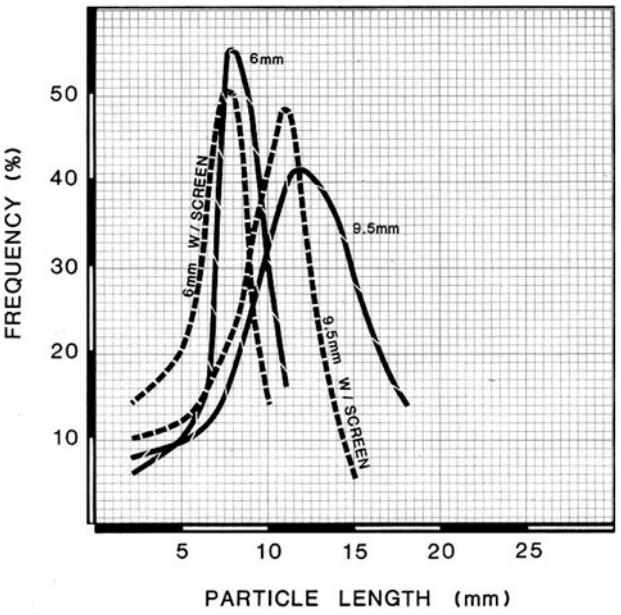


FIGURE 3. Particle Length Distribution in Corn.

Windrow Pickup Losses: Pickup losses were insignificant at speeds up to 8 km/h (5 mph), provided that the windrows were not severely wind-scattered. Some hairpinning occurred at the castor wheels when picking scattered windrows or turning tight corners.

Row Crop Head Losses: Losses from the row crop head were insignificant at speeds below 10 km/h (6 mph) provided care was taken to keep the divider points centred between the rows.

POWER REQUIREMENTS

Tractor Size: The peak power take-off requirement, at maximum work-rate, was about 110 kW (150 hp) in alfalfa and 100 kW (130 hp) in corn. Corresponding average power requirements were about 85 kW (115 hp) and 80 kW (105 hp) respectively.

Power requirements increased with shorter cut settings, higher moisture contents and use of a recutter screen. For example, reducing the cut setting from 9.5 to 6 mm (0.4 to 0.25 in) while harvesting 55% moisture alfalfa yielding 8 t/ha (3.6 ton/ac), increased average power by 15 kW (20 hp). An increase of 10% moisture content in alfalfa increased the power requirements 8 kW (10hp). The use of a 50 x 240 mm (2 x 10 in) recutter screen increased average power 15 kW (20 hp) in alfalfa and 10 kW (13 hp) in corn at 60% moisture content.

Total drawbar power requirements on firm, level fields were about 12 kW (16 hp) at 6 km/h (4 mph). This included the draft of the forage harvester and a dump wagon with a 3 t (3.3 ton) load. In soft, hilly fields, drawbar power requirements could be as great as 20 kW (27 hp).

A tractor of 130 kW (160 hp) maximum power take off rating should have sufficient power to operate the John Deere 3960 at optimum workrates, in most field conditions.

Specific Capacity:[3] FIGURE 4 shows the specific capacity of the John Deere 3960. Specific capacity is a measure of how efficiently a machine operates. A high specific capacity indicates efficient energy use, while a low specific capacity indicates less efficient operation.

As shown in FIGURE 4, a 15% increase in crop moisture content reduced the specific capacity by about 10% in alfalfa. Changing cut length settings from 9.5 to 6 mm (0.4 to 0.25 in) reduced specific capacity by about 20%. The use of a 50 x 240 mm (2 x 10 in) recutter screen reduced specific capacity by 15% at 6 mm (0.25 in) cut setting and by 30% at 9.5 mm (0.4 in) cut setting.

In corn, specific capacities ranged from 0.27 t/kW-h at 6 mm (0.25 in) cut setting to 0.34 t/kW-h at 9.5 mm (0.4 in) cut setting. The use of a 50 x 240 mm (2 x 10 in) recutter screen reduced specific capacity by 35% and 50% at 6 mm (0.25 in) and 9.5 mm (0.4 in) cut settings respectively.

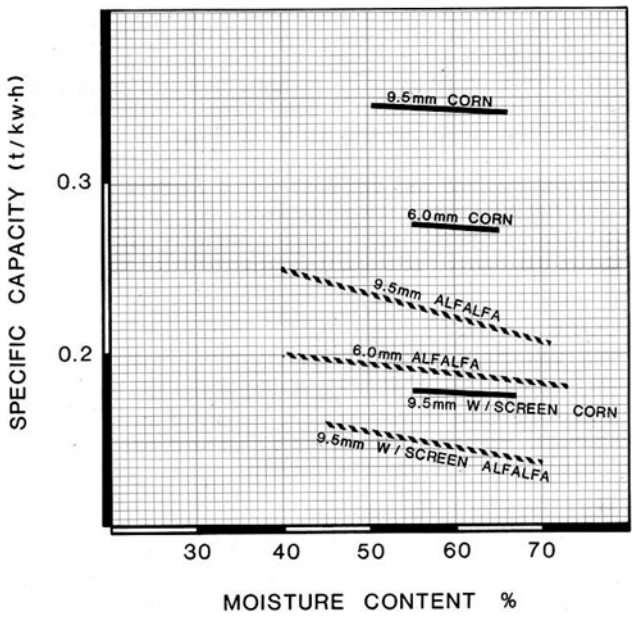


FIGURE 4. Specific Capacity based on Dry-weight Workrates.

In green rye, at 50% moisture content, specific capacities were 0.17 t/kW.h and 0.28 t/kW-h at cut length settings of 6 and 13 mm (0.25 and 0.5 in) respectively. The use of a 50 x 240 mm (2 x 10 in) recutter screen decreased specific capacity by about 40% at both settings.

Higher specific capacity is possible by reducing fan speed in easy to blow crops.

[3]Specific capacities in FIGURE 4 are based on dry-weight workrates. Direct comparison to specific capacities of haying equipment is not valid. Hay usually has a different moisture content and is not refined to the same degree as silage.

EASE OF OPERATION AND ADJUSTMENT

Hitching: The John Deere 3960 was equipped with an equal angle hitch which attached to the tractor drawbar, extending it 255 mm (10 in). The manufacturer recommended that the tractor drawbar be from 330 to 430 mm (13 to 17 in) above the ground. The hitch height was not adjustable. The John Deere 3960 was equipped with a 1000 rpm power take-off drive.

Remote Controls: The John Deere 3960 was equipped with electrically operated hydraulic remote controls for adjusting discharge spout direction, deflector angle, drawpole positioning, header lift and the forward/reverse feedroll clutch. The electric control console, which mounted in the tractor cab, controlled the flow of hydraulic fluid to the individual actuators by means of a bank of solenoid valves mounted on the forage harvester.

The controls were effective and convenient to use.

Windrow Pickup: The pickup attachment had excellent feeding characteristics in most crops. Pickup losses were insignificant at speeds up to 8 km/h (5 mph). Three windrow pickup speeds were possible by exchanging feed auger and pickup drive sprockets. Adjusting the speed took about 20 minutes. Wrapping of hay around the feed auger occurred only rarely, although some hairpinning occurred between the pickup and adjustable castor wheels when picking scattered windrows or turning sharp corners.

Three-row Row Crop Header: The three-row row crop header (FIGURE 5) was equipped with a belt gathering system and reciprocating knives which operated at a row spacing of 960 mm (36 in). The header worked well at speeds up to 10 km/h (6 mph). The pivoting divider noses had a tendency to dig soil when the harvester was set at high ground clearance, lowering the frame, by rotating the offset axles, improved nose floatation. Overall stalk gathering performance was good. For proper performance, maximum side drift from the row had to be less than 150 mm (6 in) which required considerable operator vigilance to minimize losses.

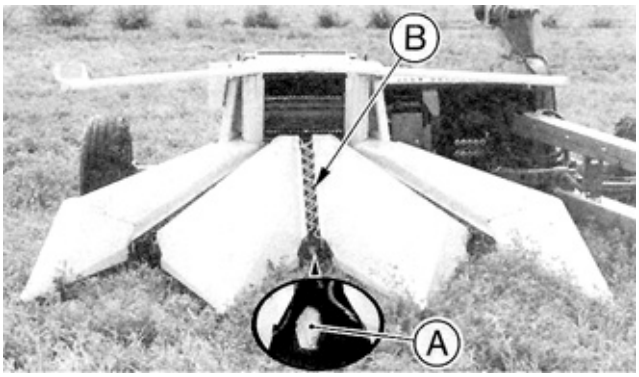


FIGURE 5. Three-row Row Crop Head: (A) Knife, {B) Gathering Belts.

Feedrolls: The feedrolls were very aggressive in most crops. Occasional plugging occurred in bunchy windrows at high feedrates. Unplugging was possible, from the tractor, by reversing the feedroll drive. During the test, several feedroll drive shear pins broke. These were easily replaced. Wrapping of material on the feedrolls was infrequent. Filler bars supplied with the harvester, could be bolted to the upper front feedroll, further reducing wrapping problems.

The smooth, lower rear feedroll was equipped with an adjustable scraper. Correct scraper clearance was difficult to judge and required removal of the header and feedroll springs to gain access. It is recommended that the manufacturer make modifications to allow easier inspection of the smooth feedroll scraper clearance.

Cutterhead Plugging: Cutterhead plugging occurred infrequently and usually resulted in shearing of the shear bolts. Plugging was usually caused by failure to allow all forage to pass through the harvester before disengaging the power take-off clutch.

Access to the shear bolts and to the cutterhead was *very good.*

Discharge Spout: The lift and reach of the discharge spout could be adjusted by adding or removing pipe sections, as shown in FIGURE 6. The extensions used were 1370 mm (54 in) horizontal and 510 mm (20 in) vertical. Several other extensions were available. The dimensions in FIGURE 6 were determined at the maximum ground clearance setting of the adjustable axle, which could be positioned to give discharge spout heights 50 mm (2 in) and 100 mm (4 in) lower than those shown.

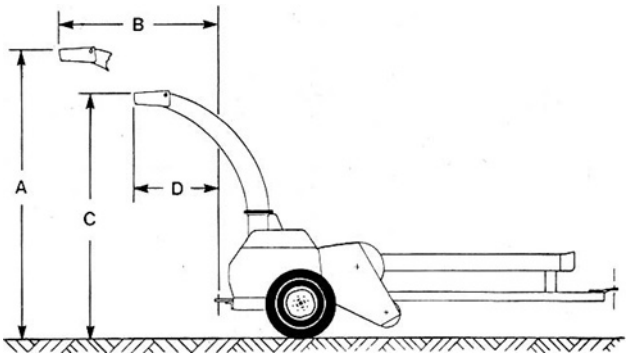


FIGURE 6. Discharge Spout Dimensions: (A) Lift, with extension, 3630 mm; (B) Reach, with extension, 1990 mm; (C) Lift, 2830 mm; (D) Reach, 580 mm.

The forage discharge direction was controlled by spout rotation and deflector cap angle, which were operated by the remote controls. The range of adjustments was adequate for operation with wagons and trucks.

Recutter Screen: A 50 x 240 mm (2 x 10 in) recutter screen was used for about 40 hours of field testing. The recutter screen was effective, provided a close tolerance was maintained between the cutterhead knives and the screen. The clearance was adjusted with bolts at the rear of the screen. Although access to the bolts and adjustment of the screen were easy, installation of the recutter screen was difficult. It was necessary to lower the header and cutterhead housing to its lowest position, which was not always possible' in some conditions. The screen and its two frames were difficult to align. It took two experienced operators about 35 minutes to install the screen. Removal of the screen was easier, taking an experienced operator 15 minutes. It is recommended that the manufacturer modify the recutter screen and frames to allow easier installation and removal.

Knife Sharpening: The John Deere 3960 was equipped with a rectangular sharpening stone and a reversing cutterhead drive for knife sharpening. To reverse the cutterhead, the power take-off shaft was moved to a convenient alternate input shaft on the hitch.

A crank mechanism was used to lower the stone to contact the knives (FIGURE 7), while a lever mechanism controlled the travel of the stone across the cutterhead knives. Shear plate clearance was adjusted using two bolts which were accessible and convenient to adjust. It took an experienced operator 20 minutes to sharpen the knives and set the shear plate.

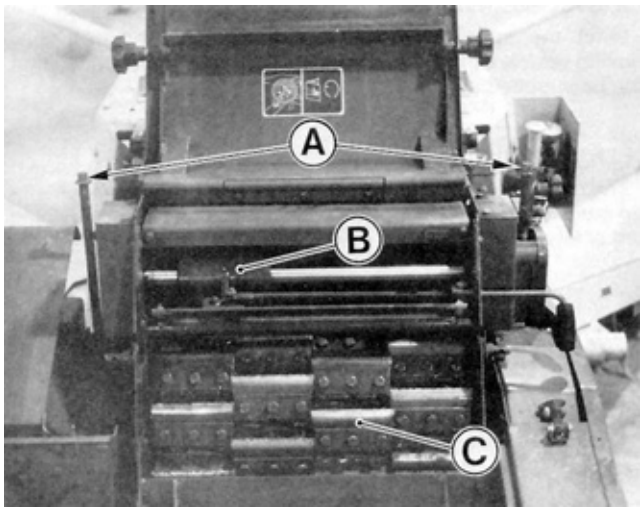


FIGURE 7. Cutterhead Knife Sharpener: (A) Shearplate adjustment, (B) Sharpener assembly, (C) Knife.

The average period between knife sharpenings was about 12 hours. During the 217 hour test, the knives incurred about 6 mm (0.25 in) of wear, due mainly to sharpening.

Several knives and one edge of the four-edged shear plate were damaged once during the test when foreign material entered the cutterhead. Replacement of the knives and reversal of the shear plate were convenient and required only basic farm shop tools.

Adjusting Cut Length: The length of cut could be adjusted either by adding or removing cutterhead knives or by changing or reversing the dual feedroll drive sprocket. Changing or reversing the dual feedroll drive sprocket was the easier method and provided a more uniform cut. The standard drive sprocket provided 6 mm and 9.5 mm (0.25 and 0.4 in) cut length settings, while an optional sprocket permitted 8.5 mm and 13 mm (0.3 in and 0.5 in) cut length settings. Changing or reversing sprockets took only a few minutes.

Exchanging Header Attachments: The windrow pickup head and the row crop head were both easy to mount and remove. Four pins held each header in place. Access to the pins was very good. It was necessary to break the header drive chain when changing the attachment.

Removing either attachment took one man about thirty minutes, while mounting took two men about thirty minutes.

Transporting: The drawpole could be placed in five positions. The extreme right position was used when transporting with the pickup head and the middle position when transporting with the three-row row crop head, due to its greater width. The extreme left position was used with both headers during field operation.

The John Deere 3960 was easy to maneuver and towed well in transport position. Ground clearance was adequate and there was ample hitch clearance for turning sharp corners. Although no hitch was provided with the harvester for towing a wagon in line, when in transport position, one was available as optional equipment.

The hydraulic drawpole positioner made changing from field position to transport position easy. It could also be used to steer the harvester during field operation, as long as the locking pin was retracted. This was often convenient in row crops.

Lubrication: The John Deere 3960 had 20 pressure grease fittings. Eleven required daily lubrication. The windrow pickup head had 11 pressure grease fittings, while the three-row row crop head had two pressure fittings and a convenient central lubrication system. A total of five chains on the main unit and four on the pickup head required daily lubrication. Complete daily and seasonal lubrication could be completed in 20 minutes.

OPERATOR SAFETY

The John Deere 3960 was safe to operate and service, as long as common sense was used and the manufacturer's safety recOmmendations were followed. A comprehensive safety section was included in the operator manual.

Most shields were hinged and opened easily for service.

Since the John Deere 3960 was not equipped with a slow moving vehicle sign or mounting bracket, it is recommended that one be supplied as standard equipment.

OPERATOR MANUAL

The operator manual was concise and clearly written, containing much useful information on operation, adjustment, servicing and safety.

DURABILITY RESULTS

TABLE 3 outlines the mechanical history of the John Deere 3960 during 217 hours of operation while harvesting about 123 ha (308 ac) of windrowed crop and 160 ha (400 ac) of corn. The intent of the test was evaluation of functional performance. An extended durability test was not conducted.

TABLE 3. Mechanical History

Item	Operating Hours	Equivalent Field Area (ha)
A snap ring on power take-off shaft was lost and replaced at	2	4
The weld on the recutter screen frame broke and was repaired at	6	10
The feedroll drive chain broke and the feedroll drive gearbox support bracket bent. Both were replaced at	38	52
The smooth feedroll scraper was adjusted at	53	70
The blower drive belt cracked, and was replaced at	60	83
Several knives and one edge of the shear bar were damaged and replaced at	81	112
The gripper belts on the three-row row crop head were re-timed at	106, 170	130, 237
The smooth feedroll and feedroll scraper broke and were replaced at	106	130
The discharge spout rotating worm gear was worn and was replaced at	140	196

DISCUSSION OF MECHANICAL PROBLEMS

Feedroll Drive Chain: The feedroll drive chain broke due to lack of lubrication. A decal showing correct replacement was confusing. As a result, the chain was improperly installed, causing the gearbox support bracket to bend.

Knives: Several knives and one edge of the shear plate were damaged when a foreign object entered the cutterhead in the field. Several knives had to be replaced and the shear plate was reversed.

Smooth Feedroll: The smooth feedroll shaft broke (FIGURE 8) due to excessive scraper clearance.

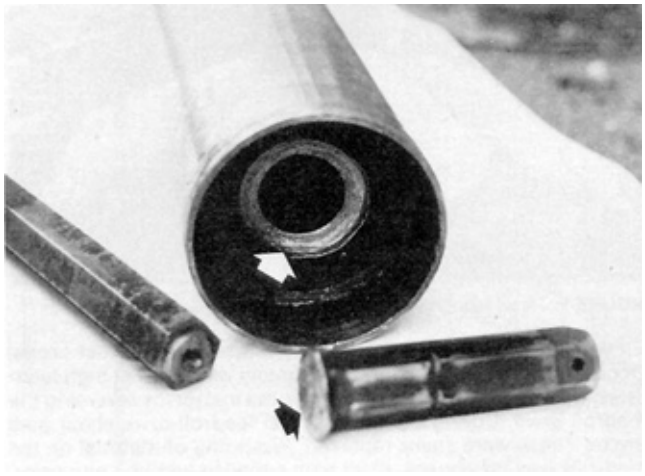


FIGURE 8. Broken Smooth Feedroll.

Examination showed a 5 mm buildup of material on the feedroll scraper, resulting in undue stress on the feedroll shaft, and failure.

APPENDIX I

SPECIFICATIONS

Make:	John Deere
Model:	3960
Serial No.:	524653E

Overall Dimensions:

-- height (discharge spout removed)	1415 mm
-- length	5410 mm
-- width	
-- without attachments	3110 mm
-- with windrow pickup	3810 mm
-- with two-row row crop head	4090 mm
-- ground clearance	150, 200 and 250 mm

Windrow Pickup:

-- serial number	523358E
-- type	floating cylindrical drum with spring teeth adjustable gauge wheels
-- working width	1800 mm
-- overall width	2710 mm
-- tooth spacing	65 mm
-- number of tooth bars	4
-- pickup speed	96, 128, and 170 rpm
-- tooth tip speed	8, 10 and 14 km/h
-- auger diameter	560 mm
-- auger length	2050 mm
-- auger speed	72, 96, and 128 rpm

Three-Row Row Crop Head:

-- serial number	509970E
-- distance between rows	960 mm
-- type of cutter	oscillating knife
-- cutter speed	450 strokes/min
-- type of stalk gatherer	rubber belt mounted to chain
-- gathering belt/ground synchronization speed	5.8 km/h

Feedroll Assembly:

-- throat opening	510 x 152 mm
-- roll width	530 mm

	Front		Rear	
	Upper	Lower	Upper	Lower
-- roll diameter	242 mm	213 mm	150 mm	134 mm
-- roll speed (rpm) (at 6 mm cut setting)	96 rpm	112 rpm	116 rpm	215 rpm

Cutterhead:

-- type	cylindrical
-- number of knives	48
-- width	577 mm
-- diameter	458 mm
-- speed	850 rpm

Recutter Screen:

-- width	605 mm
-- arc length	475 mm
-- opening size	50 x 240 mm

Knife Sharpener:

-- type	rectangular stone
-- size	37 x 73 mm

Conveying Assembly:

-- transfer auger	
-- diameter	280 mm
-- length	1730 mm
-- speed	540 rpm
-- fan	
-- diameter	813 mm
-- blade width	150 mm
-- discharge spout diameter	205 mm
-- speed	720 or 1000 rpm

Tires: two 11L-15, 8 ply

Weights:	with pickup	with three-row crop head
-- left wheel	844 kg	918 kg
-- right wheel	1106 kg	1222 kg
-- hitch	252 kg	378 kg
TOTAL	2202 kg	2518 kg

Lubrication:

-- main unit	
-- grease fittings	11 every 10 h; 3 every 50 h; 6 every 100 h
-- chains	5 every 10 h.
-- wheel bearings	2 seasonal
-- gear boxes	2 every 100 h
-- windrow pickup	
-- grease fittings	11 every 100 h
-- chains	4 every 100 h
-- three-row row crop head	
-- grease fittings	3 every 10 h; 2 every 50 h Multi-lube pump every 10 h
-- chains	1 every 10 h

Optional Equipment:

-- 1.7 m and 2.1 m pickup head
-- 1.8 m mower bar head
-- two-row and three-row row crop heads
-- 760 and 960 mm spacing)
-- two-row and three-row ear corn heads
-- recutter screens (13, 19, 25, 38, 50 mm openings)
-- electro-hydraulic remote controls
-- spout extensions
  -- horizontal 610, 1372 mm
  -- vertical 254, 508, 762, 1016, 1270, 1524 mm
-- automatic wagon hitch
-- hydraulic outlets (for use with high-dump wagon)
-- cantilevered auger
-- axle extensions (150, 330 mm)
-- feedroll drive sprockets
-- lower feed roll pan

APENDIX II

MACHINE RATINGS

The following rating scale is used in PAMI 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 kilometre/hour (km/h)	= 0.6 mile/hour (mph)
1 metre (m)	= 3.3 feet (ft)
1 millimetre (mm)	= 0.04 inches (in)
1 kilowatt (kW)	= 1.3 horsepower (hp)
1 kilogram (kg)	= 2.2 pounds mass (lb)
1 tonne (t)	= 2200 pounds mass (lb)
1 newton (N)	= 0.2 pounds force(lb)
1 tonne/hour (t/h)	= 1.1 ton/hour (ton/h)
1 tonne/kilowatt hour (t/kW-h)	= 0.8 ton/horsepower hour (ton/hp-h)

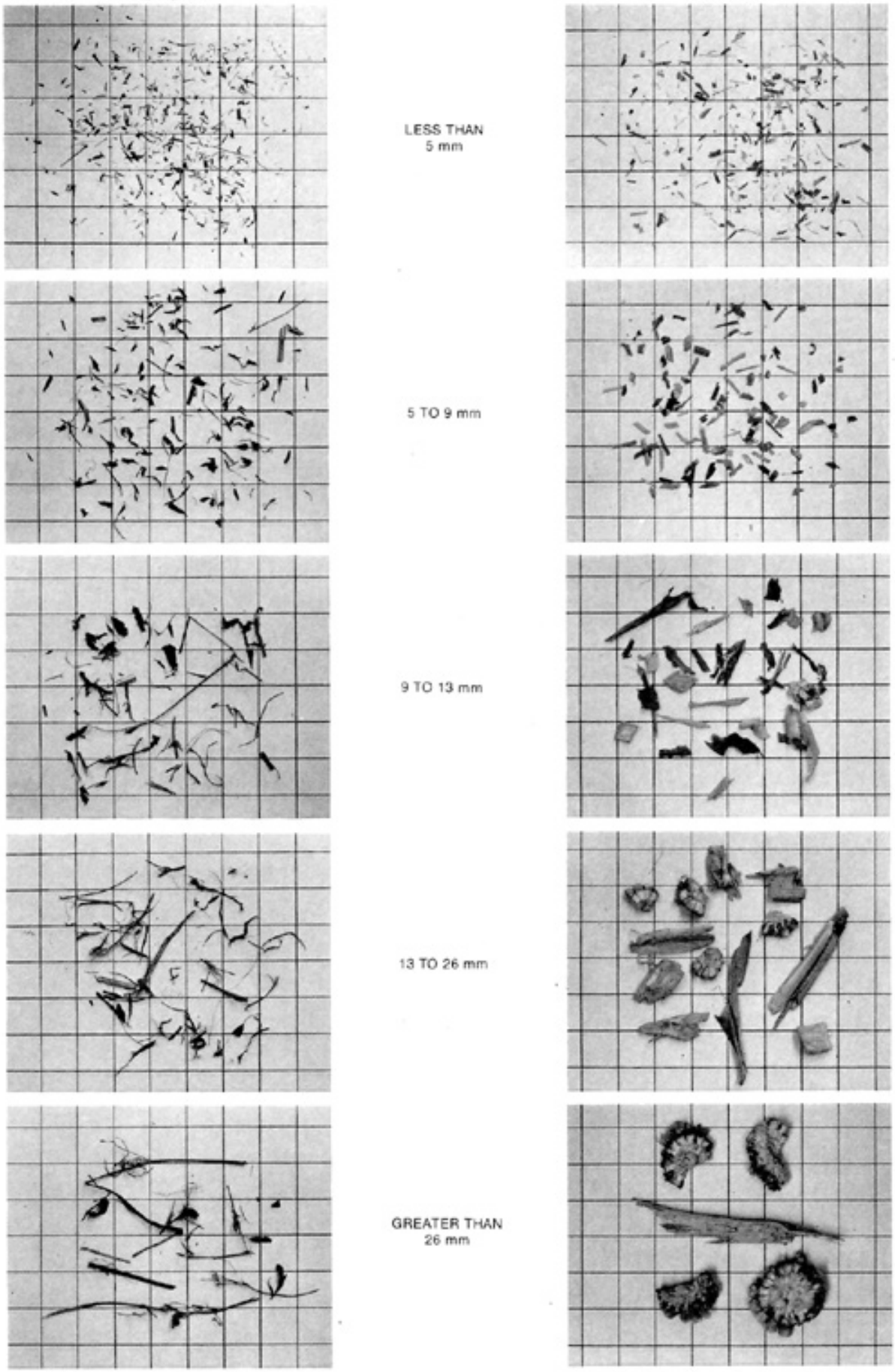


FIGURE 9. Distribution of Particle Lengths (20 mm grid)

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