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Evaluation Report 227

John Deere 8820 Self-Propelled Combine

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

JOHN DEERE 8820 SELF-PROPELLED COMBINE

MANUFACTURER:
John Deere Harvester Works
East Moline, Illinois 61244
U.S.A.

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

RETAIL PRICE:
$108,951.89 (June 1981, f.o.b. Humboldt, with 3.8 m variable speed header, 3.4 m belt pickup, straw chopper, 30.5L x 32 front tires, 16.5L x 16.1 rear tires, rectangular opening straw walkers, straw walker risers, block heater and warning monitors).

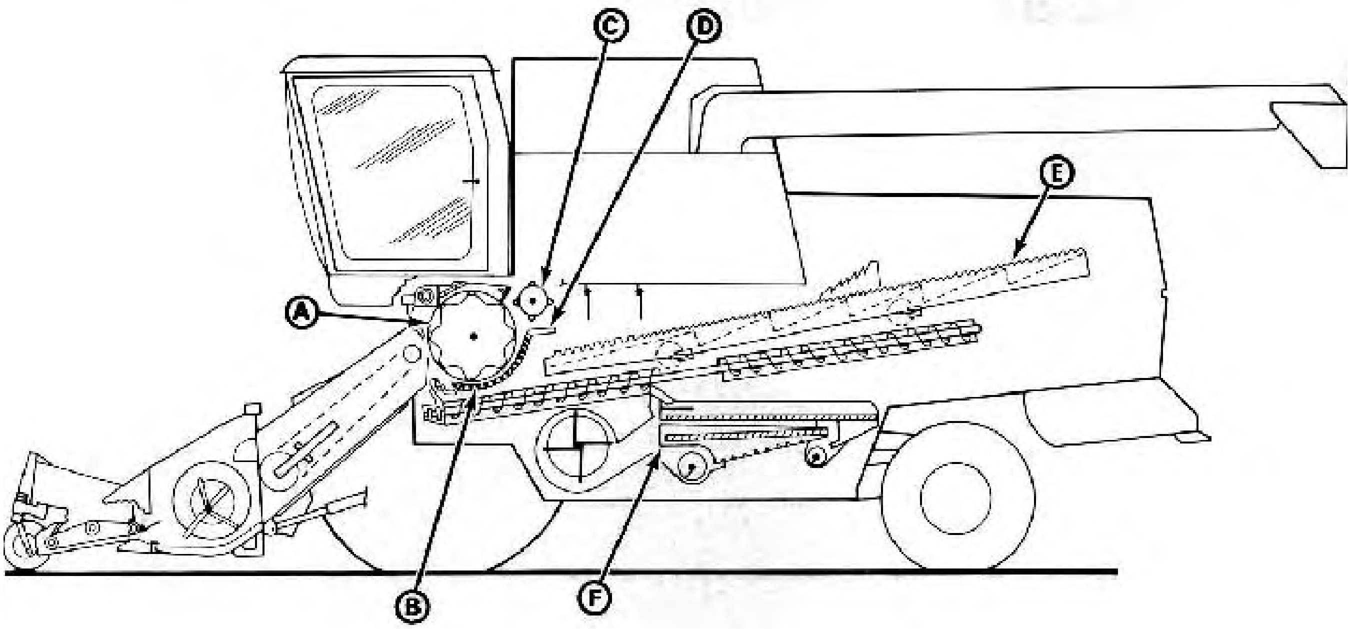

FIGURE 1. John Deere 8820: (A) Cylinder, (B) Concave, (C) Back Beater, (D) Beater Grate, (E) Straw Walkers, (F) Shoe.

SUMMARY AND CONCLUSIONS

Functional performance of the John Deere 8820 self-propelled combine was good in dry and tough grain and rapeseed crops.

The MOG feedrate* at 3% total grain loss varied from 15.3 t/h (565 lb/min) in 2.9 t/ha (43 bu/ac) Neepawa wheat to 10.5 t/h (385 lb/min) in 3.3 t/ha (61 bu/ac) Hector barley.

For similar total grain loss, capacity of the John Deere 8820 was much greater than the capacity of the PAMI reference combine. Straw walker loss limited capacity in barley while cylinder and shoe losses became significant in hard-to-thresh wheat. Uneven air distribution reduced shoe capacity at higher feedrates. To fully utilize combine width, the John Deere 8820 should be used in double-windrowed crops. Overall capacity could be increased up to 10% in some crops in double windrows rather than single windrows.

The engine had ample power for all conditions. Fuel consumption varied from 25 to 34 L/h (5.5 to 7.5 gal/h).

The John Deere 8820 was convenient to operate. Forward and left visibility was very good while right and rear visibility was restricted. Steering and brakes were responsive making the combine very maneuverable both in the field and during transport. Lighting for night time operation was very good. Instruments and controls were conveniently placed, easy to use and responsive. The air conditioner and heater provided comfortable cab temperatures in all conditions. The cab was relatively dust free. Operator station sound level was about 83 dBA.

The John Deere 8820 was easy to set and adjust. Cylinder, pickup and header speeds, as well as concave clearance, were adjusted from within the cab. Return tailings could be conveniently sampled within the cab.

The pickup fed evenly and uniformly in all crops. The table auger and feeder were aggressive and plugging was infrequent. The header drive could be reversed from the cab, for easy unplugging. The cylinder was aggressive. The cylinder plugged occasionally and unplugging was difficult due to poor access to the cylinder and cylinder rocking hub. The stone trap stopped most stones and roots and was easy to clean. The unloading auger was convenient to position and had ample reach and clearance for unloading on-the-go.

All lubrication points were easy to service. Accessibility for cleaning or repair was fair. The John Deere 8820 was safe to operate as long as the manufacturer's safety instructions were followed. The operator's manual was well illustrated, clearly written and contained much useful information. The cylinder variable speed drive belt broke once during the test.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Supplying a convex rear view mirror for the left side of the combine.
2. Modifying the grain tank screens to eliminate leakage in rapeseed.
3. Supplying a full grain tank warning device.
4. Modifications to provide greater clearance between the pickup and windguard.
5. Improving cylinder and cylinder rocking hub accessibility and modifying the cylinder rocking hub to reduce rocking bar slippage.
6. Improving accessibility of the concave adjustment bolts and inspection holes and providing front concave inspection holes.
7. Modifications to provide more uniform air distribution through the chaffer.
8. Modifications to strengthen the support assembly for the variable speed cylinder drive.

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Project Technologist -- L. G. Hill

**The MOG feedrate (Material-Other-than-Grain Feedrate) is the weight of straw and chaff passing through a combine per unit time.*

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. A convex mirror is being evaluated.
2. Grain tank extension screens are used to allow good visibility when filling the tank. There are no plans to change these extensions.
3. A full grain tank warning device is being tested.
4. The windrow hold down can be removed for large fluffy windrows. It does not provide support for the castor wheels.
5. This is being considered.
6. There are no current plans for changes in this area.
7. Air distribution to the chaffer is being evaluated.
8. This is being considered.

GENERAL DESCRIPTION

The John Deere 8820 is a self-propelled combine with a transverse-mounted, tangential threshing cylinder, concave, straw walkers and cleaning shoe. Threshing and initial separation occur at the cylinder and concave while the straw walkers accomplish final separation of grain from straw. Grain is cleaned at the shoe and the tailings returned to the cylinder.

The test machine was equipped with a 150 kW (200 hp) turbocharged 6 cylinder diesel engine, a 3.8 m (12.4 ft) header, a 3.4 m (132 in) three-roller belt pickup, straw chopper and optional accessories as listed on page 2.

The John Deere 8820 has a pressurized operator cab, power steering, hydraulic wheel brakes, and a hydrostatic traction drive. The separator and unloading auger drives are manually engaged while the header drive is electrically engaged. Header height and unloading auger swing are hydraulically controlled. Cylinder, pickup and feeder conveyor speeds, as well as concave clearance, may be adjusted from within the cab. The return tailings may also be inspected within the cab. Most component speeds and harvest functions are displayed on an electronic monitor.

Detailed specifications are given in APPENDIX 1.

SCOPE OF TEST

The John Deere 8820 was operated in conditions shown in TABLES 1 and 2 for 175 hours while harvesting about 515 ha (1270 ac). It was evaluated for ease of operation, ease of adjustment, rate of work, grain loss characteristics, operator safety and suitability of operator's manual. Throughout the test, comparisons were made to the PAMI reference combine.

TABLE 1. Operating Conditions

Crop	Variety	Average Yield t/ha	Swath Width m	Hours	Field Area ha
Barley	Betzes	2.6	6.1	10.5	24
Barley	Hector	3.1	6.1 to 12.2	21.5	30
Barley	Klages	2.5	6.1	1.0	2
Barley	Melvin	3.0	6.1	3.5	7
Flax	Duferin	1.3	6.1 to 7.6	6.5	14
Rapeseed	Altex	1.6	6.1 to 7.3	19.5	74
Rapeseed	Candle	1.3	6.1	8.5	31
Rapeseed	Midas	1.7	7.3	3.0	8
Rapeseed	Regent	1.4	6.1	7.5	24
Rye	Puma	1.1	6.1 to 12.2	27.5	113
Wheat	Neepawa	2.5	6.1 to 12.2	64.0	184
Wheat	Sinton	2.4	6.1 to 12.2	2.0	4
Total				175	515

TABLE 2. Operation in Stony Conditions

Field Condition	Hours	Field Area (ha)
Stone Free	42	67
Occasional Stones	111	352
Moderately Stony	22	78
Total	175	515

RESULTS AND DISCUSSION

EASE OF OPERATION

Operator Location: The cab was positioned ahead of the grain tank and left of the engine giving good visibility forward and to the left, and fair visibility to the right and rear. Rear view mirrors were provided. An additional convex mirror on the left would greatly improve rear visibility and it is recommended that the manufacturer supply a convex rear view mirror for the left side. Header visibility was very good for tall operators and fair for shorter operators. Shorter operators had to lean forward and to the right (FIGURE 2). The grain level was visible through the rear window until the grain tank was nearly full.

The seat and steering column were adjustable, providing a comfortable combination for most operators. Incoming air was effectively filtered while fans pressurized the cab to reduce dust leaks. The air conditioning and heater provided suitable cab temperatures. Operator station sound level was about 83 dBA.

(a)

(b)

FIGURE 2. View of Incoming Windrow (a) Normal Seated Position, (b) Leaning Forward and Right.

Controls: The control arrangement is shown in FIGURE 3. The controls were conveniently located, easy to use, responsive and color coded for easy identification.

FIGURE 3. Instruments and Controls.

Instruments: The instruments were located on a console to the right of the operator (FIGURE 3). Readouts were provided for coolant temperature, battery voltage, engine oil pressure and oil level, cylinder speed, ground speed, engine speed, feeder speed and cleaning fan speed. Warning indicators were provided for air filter restriction, parking brake engagement, hydraulic and hydrostatic oil temperatures, transmission oil pressure, plugged straw walkers and reduced speeds of five combine drives. All of the, instruments performed well.

Lights: Lighting was very good for night time harvesting. There were seven front lights, a grain tank light and an unloading auger light. Cab interior lighting was very good.
The warning lights and taillights were adequate for safe road travel.

Engine: The engine started easily. It had ample power for operating in all conditions. Average fuel consumption varied from 25 to 34 L/h (5.5 to 7.5 gal/h). Oil consumption was insignificant.

The fuel tank was accessible and could be filled from average height gravity fuel tanks.

The rotary air inlet screen effectively prevented radiator plugging. The engine air intake used a screened pre-cleaner, an aspirated pre-cleaner and two dry filters. Periodic outer element cleaning was needed.

Maneuverability: The John Deere 8820 was very maneuverable. The steering was smooth and responsive and the wheel brakes positive. The turning radius was about 8.3 m (27 ft). Using individual wheel brakes, it was possible to pick most windrow corners. The hydrostatic drive made backing up easy on difficult-to-pick corners.

Stability: The John Deere 8820 was very stable in the field even with a full grain tank. Normal caution was needed on hillsides. The combine transported well at speeds up to 25 km/h (16 mph).

Grain Tank: Grain tank volume was 8 m3 (220 bu). The tank filled evenly and completely in all crops. Once the tank had filled above the rear cab window, the operator had to leave the cab to check the level. In addition, some rapeseed varieties leaked through the tank screens. It is recommended that the manufacturer consider modifications to eliminate leakage of small seeds through the grain tank screens and consider supplying a warning device to signal a full grain tank.

The unloading auger had ample reach and clearance for easy unloading on-the-go (FIGURE 4). The hydraulic swing was convenient for topping loads and adjusting auger reach. If the filled unloading auger was swung back into transport position, about 1.5 L (0.05 bu) of grain spilled from the unloader tube. Unloading a full tank of dry wheat took about 100 seconds.

FIGURE 4. Unloading Auger Clearance.

Pickup: The John Deere 8820 was equipped with a 3350 mm (132 in) John Deere three roller draper pickup with nylon teeth. Picking height was controlled by castor wheel adjustment while the picking angle was determined by the header height setting. Draper speed could be adjusted with a flow control valve in the cab.

The pickup performed well at speeds up to 10 km/h (6 mph). It fed evenly and uniformly in all crops as it could be set in three positions forward of the table to suit straw length.

The windguard caused bunching and shelling in heavy rapeseed windrows, but could not be removed as it provided support for the castor wheels. It is recommended that the manufacturer consider modifications to provide greater clearance between the pickup and windguard.

Stone Protection: The stone trap (FIGURE 5) located in front of the cylinder, prevented most stones and roots from entering the cylinder. The stone trap was easy to open, however, cleaning it was a dirty Job.

FIGURE 5. Stone Trap.

Straw Chopper: The straw chopper performed well in all crops. Spreading width was up to 5.5 m (18 ft) in calm conditions. Wind reduced spreading effectiveness.

Removal and installation of the straw chopper was difficult as it was heavy and awkward to handle.

Plugging: The floating table auger and variable speed header were very aggressive, had excellent capacity, and seldom plugged. A plugged table auger or feeder could easily be cleared by power reversing the header, providing the cylinder was not plugged. Feeding off centre did not significantly influence plugging, but caused uneven cylinder and shoe loading.

The cylinder was aggressive and plugged only occasionally in tough or bunchy windrows. Backfeeding was infrequent and never caused plugging. Unplugging the cylinder was difficult and inconvenient. Access to the cylinder and cylinder rocking hub was restricted (FIGURE 6). It was difficult to rock the cylinder as a bar easily slipped from the rocking hub. It is recommended that the manufacturer consider improving cylinder and cylinder rocking hub accessibility and modifying the rocking hub to reduce rocking bar slippage.

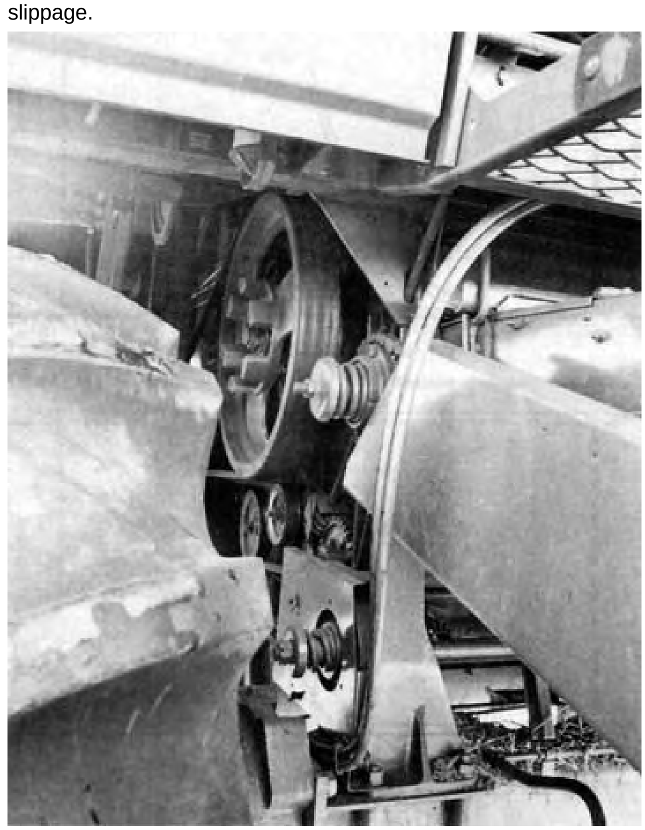


FIGURE 6. Access to the Cylinder Rocking Hub.

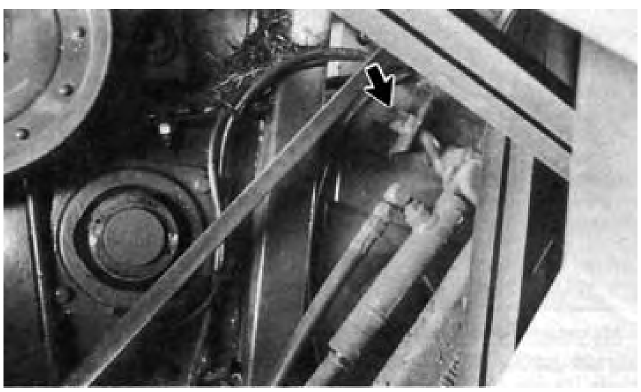
Machine Cleaning: Cleaning the John Deere 8820 completely for combining seed grain was laborious and time consuming. Grain was retained in the grain tank while braces made working in the grain tank inconvenient. The unloading auger sump retained a considerable amount of grain. Cleaning the shoe delivery augers required dropping the rear troughs and opening front clean out ports. Removal of the chaffer and sieve required two people. With the chaffer and sieve removed the return tailing cross auger was accessible. The clean grain cross auger had clean out doors on the bottom of the auger housing. The exterior of the combine was easy to clean.

Lubrication: Ease of lubrication was very good as all lubrication points were accessible. The John Deere 8820 had forty-five pressure grease fittings. Five required greasing every 10 hours, twenty-seven every 50 hours, one at 100 hours, six at 200 hours and six at 400 hours.

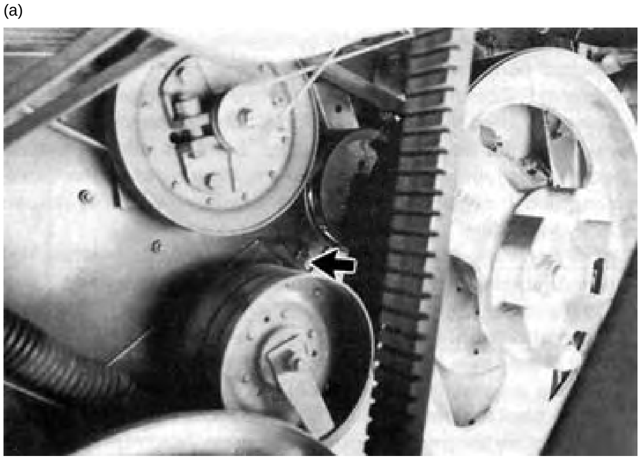
EASE OF ADJUSTMENT

Field Adjustment: The John Deere 8820 was easy to adjust and could be set by one person. Concave clearance and cylinder speed were adjusted from the cab while fan speed and shoe adjustments were set on the machine. The clean grain sample and return tailings could be sampled from the cab.

Concave Adjustment: The John Deere 8820 had a single segment concave. The concave could be levelled with a single draw bolt at the front and two draw bolts at the rear. Front clearance was gauged on the second concave bar through the cylinder inspection door, while rear clearance was gauged through two side inspection holes. Access to the concave adjusting bolts and inspection holes was difficult (FIGURE 7). Suitable initial settings, with the concave indicator set at zero, were 5 mm (0.2 in) at the front and 2 mm (0.08 in) at the rear. It is recommended that the manufacturer consider improving the accessibility of the concave adjustment bolts and inspection holes and providing front inspection holes.



(a)



(b)

FIGURE 7. Concave Adjusting Bolts (a) Left Side (b) Right Side.

Once the concave had been set, threshing clearances were easily adjusted from the cab. The front of the concave opened at about twice the rate of the rear. Front clearance ranged from 5 to 35 mm (0.2 to 1.4 in) while rear clearance ranged from 2 to 18 mm (0.08 to 0.7 in).

Suitable concave indicator settings were 0 in flax, 0 to 1 in spring wheat, 1 to 2 in fall rye, 1 to 3 in barley and 6 to 12 in rapeseed.

Cylinder Adjustment: Cylinder speed was hydraulically controlled through a variable speed belt drive and monitored with a tachometer. The drive provided an adequate speed range from 450 to 1200 rpm.

Suitable cylinder speeds were 1000 rpm in flax, 900 to 1100 rpm in spring wheat, 750 to 900 rpm in fall rye, 650 to 900 rpm in barley and 500 to 650 rpm in rapeseed.

Beater Grate Adjustment: The beater grate could be set in two positions. The top position was used throughout the test.

Shoe Adjustment: The shoe was convenient to adjust. Fan blast was varied with a hand wheel operated variable speed drive. The chaffer, chaffer extension, and clean grain sieves were adjusted at the rear of the shoe while return tailings were easily inspected in the cab (FIGURE 8).

FIGURE 8. Return Tailings Inspection Port.

Shoe capacity was reduced by uneven air distribution on the chaffer. The centre section of the chaffer had less air flow than the sides. When the fan was set for optimum air flow on the chaffer sides, there was inadequate air in the centre. Increasing the fan speed caused air born losses on the sides while still not providing adequate air flow at the centre. It is recommended that the manufacturer consider modifications to provide more uniform air distribution through the chaffer.

The uneven air distribution mainly affected shoe loss. Foreign material in the grain tank varied from 0.3 to 0.8% in most crops.

Header Adjustments: The John Deere 8820 was tested only with the windrow pickup header and variable speed feeder drive. Pickup platform removal was easy. Removal of the complete header and feeder assembly was time consuming as the variable speed header drive had to be disassembled. A header support was not provided.

Convenient adjustments were provided for header levelling, feeder chain tension, conveyor float, table auger clearance and auger finger timing. The pickup could be set in three positions forward of the table.

Slip Clutches: Slip clutches protected the table auger, feeder conveyor, straw walkers, shoe grain augers and the tailings return elevator.

RATE OF WORK

Average Workrates: TABLE 3 presents average workrates for the John Deere 8820 in all the crops harvested during the test. As average workrates are affected by crop conditions, windrow quality, field conditions, and availability of grain handling equipment, they should not be used to compare combines tested in different years. Average workrates varied from 7.3 t/h (268 bu/hr) in 2.5 t/ha (37 bu/ac) Neepawa wheat to 2.9 t/h (114 bu/h) in 1.3 t/h (20 bu/ac) Dufferin flax.

Maximum Feedrates: The workrates in TABLE 3 represent average workrates at acceptable loss levels. The combine had ample power to achieve higher workrates. In all crops the maximum acceptable feedrate was limited by grain loss while the maximum feedrate was limited by cylinder plugging in heavy crops and pickup performance in light crops.

Capacity: Combine capacity is the maximum rate at which a combine, adjusted for optimum performance, can harvest a crop at a specified total loss level. Many crop variables affect combine capacity. Crop type and variety, grain and straw yield and moisture content, local climatic conditions and windrow quality cause capacity variations.

TABLE 3. Average Workrates

Crop	Variety	Average Yield t/ha	Average Speed km/h	Average Workrate	
				ha/h	t/h
Barley	Betzes	2.6	4.0	2.3	6.0
Barley	Hector	3.1	5.5 & 3.0	1.4	4.3
Barley	Klages	2.5	5.5	2.0	5.0
Barley	Melvin	3.0	5.5	2.0	6.0
Flax	Duferin	1.3	5.5	2.2	2.9
Rapeseed	Altex	1.6	7.0	3.6	6.1
Rapeseed	Candle	1.3	6.5	3.6	4.7
Rapeseed	Midas	1.7	4.5	2.7	4.6
Rapeseed	Regent	1.4	7.0	3.2	4.5
Rye	Puma	1.1	9.5 & 8.0	4.1	4.5
Wheat	Neepawa	2.5	7.0 & 4.0	2.0	7.3
Wheat	Sinton	2.4	8.0 & 5.5	2.0	4.8

MOG Feedrate, MOG/G Ratio, and Percent Loss: When determining combine capacity, combine performance and crop conditions must be expressed in a meaningful way. The loss characteristics of a combine depend mainly on two factors, the quantity of the straw and chaff being processed and the quantity of grain being processed. The mass of the straw and chaff passing through a combine per unit time is called MOG Feedrate. MOG is an abbreviation for “Material-Other-than Grain” and represents the mass of all plant material passing through the combine except for the grain or seed.

The mass of grain or seed passing through the combine per unit time is called Grain Feedrate. The ratio of the MOG Feedrate to the Grain Feedrate, abbreviated as MOG/G, indicates how difficult a crop is to separate. For example, if a combine is used in two wheat fields of identical yield, one with long straw and one with short straw, the combine will have better separation ability in the short crop and will be able to operate faster. This crop variable is expressed as the MOG/G ratio. MOG/G ratios for prairie wheat crops vary from about 0.5 to 1.5.

Grain losses from a combine are of two main types, unthreshed grain still in the head and threshed grain, which is discharged with the straw and chaff. Unthreshed grain is called cylinder loss. Free grain in the straw and chaff is called separator loss and consists of shoe and walker (or rotor) loss. Losses are expressed as a percent of total grain passing through the combine.

Combine capacity is expressed as the maximum MOG Feedrate at which total grain loss (cylinder loss plus separator loss) is 3% of the total grain yield.

Capacity of the John Deere 8820: TABLE 4 presents capacity results for the John Deere 8820 in five different crops. MOG Feedrates for a 3% total grain loss varied from 15.4 t/h (565 lb/min) in 2.9 t/ha (43 bu/ac) Neepawa wheat to 10.5 t/h (385 lb/min) in 3.3 t/ha (61 bu/ac) Hector barley.

GRAIN LOSS CHARACTERISTICS

The grain loss characteristics for the John Deere 8820 in the five crops described in TABLE 4 are presented in FIGURES 9 to 13.

Walker Loss: Walker loss was the most significant factor limiting combine capacity in barley. In wheat, walker loss was reduced and did not limit combine capacity.

Walker capacity increased significantly when harvesting double windrows as compared to single windrows. In barley (FIGURES 9 and 10) and wheat (FIGURES 12 and 13), walker capacity increased about 15% in double windrows over single windrows. The overall capacity increase in barley was about 5 to 10%. In wheat, there was no significant increase in overall capacity because of the increased cylinder loss. The John Deere 8820 should be operated in double windrows to’ fully utilize the straw walkers.

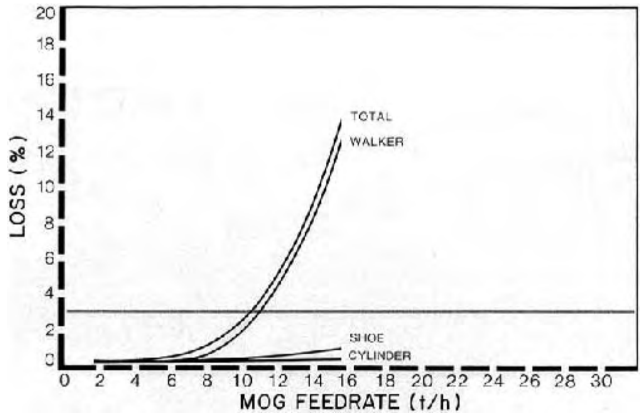


FIGURE 9. Grain Loss in Hector Barley (Field B - Single Windrows).

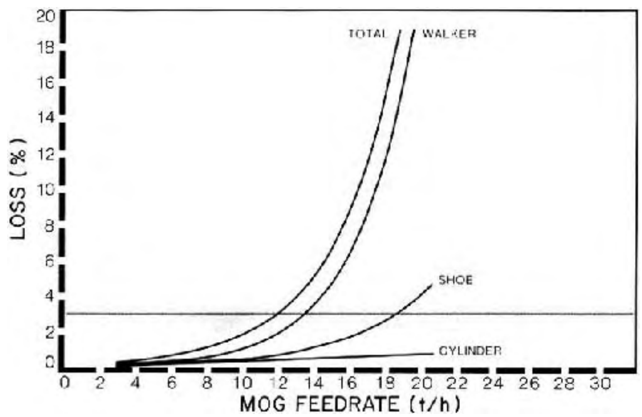


FIGURE 10. Grain Loss in Hector Barley (Field B - Double Windrows).

Shoe Loss: Shoe loss did not limit combine capacity in most crops, but an uneven distribution of air on the chaffer increased losses at higher feedrates. The poor air distribution caused blanketing of the centre 300 mm (12 in) section of the chaffer. Shoe adjustments did not improve this behaviour. In flax the poor air distribution resulted in either an extremely dirty tank sample or excessive shoe losses. An improvement in shoe performance would have enabled higher combining rates.

Cylinder Loss and Grain Damage: In easy-to-thresh crops such as barley (FIGURES 9 and 10), cylinder loss was low, while grain cracks were about 1 to 2.5%. In difficult-to-thresh Neepawa wheat (FIGURES 11 to 13), cylinder loss at 3% total loss was about 2% while grain cracks (FIGURE 14) varied from 2.5 to 4%.

Body Loss: Leakage of grain from the combine body was negligible in both grain and oil seeds.

Comparison to Reference Combine: Comparing combine capacities is complex because crop and growing conditions affect combine performance with the result that slightly different capacity characteristics can be expected every year. As an aid in determining relative combine capacities, PAMI uses a reference combine. This combine is operated alongside test combines whenever capacity measurements are made. This permits the comparison of loss characteristics of every test combine to those of the reference combine, independent of crop conditions. The reference combine

TABLE 4. Capacity at a Total Loss of 3% of Yield

Crop Conditions							Capacity Results			
Crop	Variety	Width of Cut m	Crop Yield t/ha	Grain Moisture		MOG/G	MOG Feedrate t/h	Grain Feedrate t/h	Ground Speed km/h	Loss Curve
				Straw %	Grain %					
Barley (B)	Hector	6.1	3.3	12.5	13.1	0.68	10.5	15.4	7.7	Fig. 9
Barley (B)	Hector[1]	12.2	3.0	12.3	13.5	0.66	11.8	17.9	4.7	Fig. 10
Wheat (C)	Neepawa[1]	12.2	2.8	8.6	12.7	1.02	13.8	13.5	4.3	Fig. 11
Wheat (E)	Neepawa	6.1	3.0	6.9	11.6	1.04	15.0	14.4	7.6	Fig. 12
Wheat (E)	Neepawa1	12.2	2.9	7.4	11.4	1.05	15.3	14.6	4.2	Fig. 13

[1]Side by Side Double Windrows

used by PAMI is commonly accepted in the prairie provinces and is described in PAMI evaluation report E0576C. See APPENDIX III for PAMI reference combine capacity results.

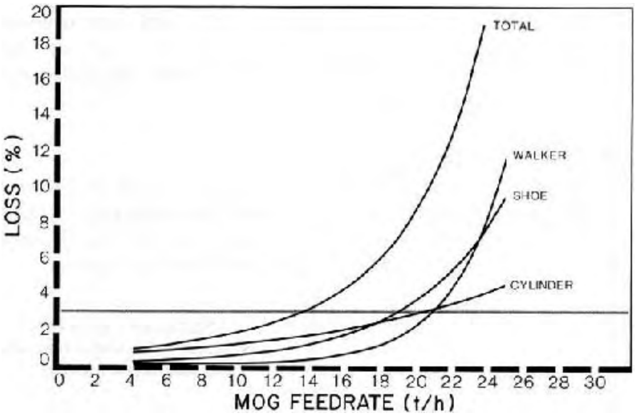


FIGURE 11. Grain Loss in Neepawa Wheat (Field C - Double Windrows).

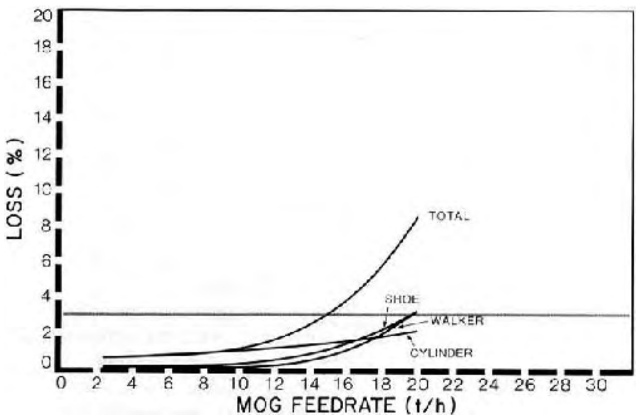


FIGURE 12. Grain Loss in Neepawa Wheat (Field E - Single Windrows).

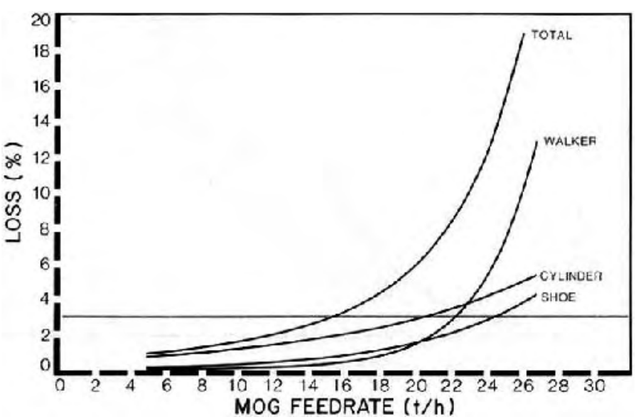


FIGURE 13. Grain Loss in Neepawa Wheat (Field E - Double Windrows).

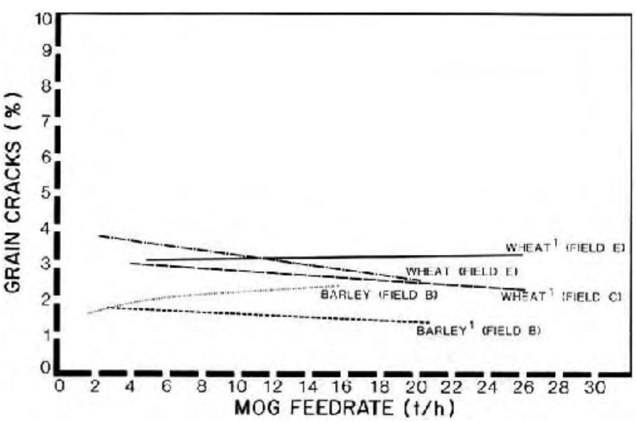


FIGURE 14. Grain Damage (Side by Side Double Windrows).

FIGURES 15 to 19 compare the total grain losses of the John Deere 8820 and the PAMI reference combine in the five crops described in TABLE 4. The shaded areas on the figures are 95% confidence belts. If the shaded areas overlap, the loss characteristics of the two combines are not significantly different whereas if the shaded areas do not overlap losses are significantly different. The capacity of the John Deere 8820 was much greater than the reference combine capacity in wheat and barley.

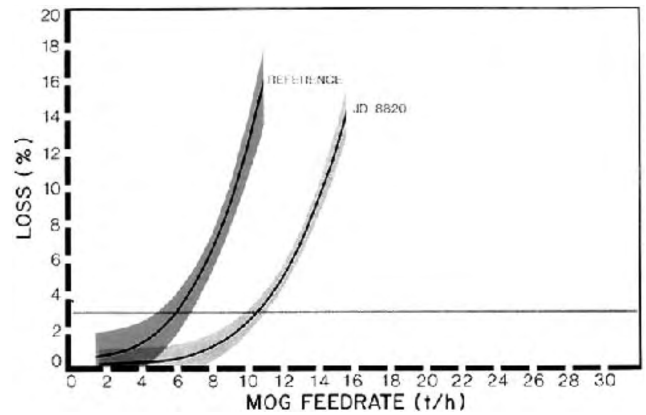


FIGURE 15. Total Grain Loss in Hector Barley (Field B - Single Windrows).

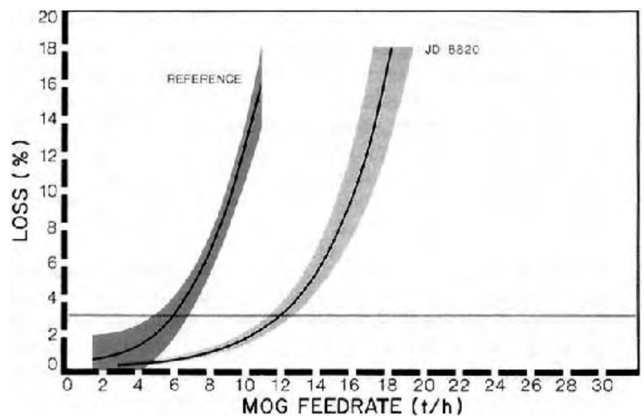


FIGURE 16. Total Grain Loss in Hector Barley (Field B - Double Windrows).

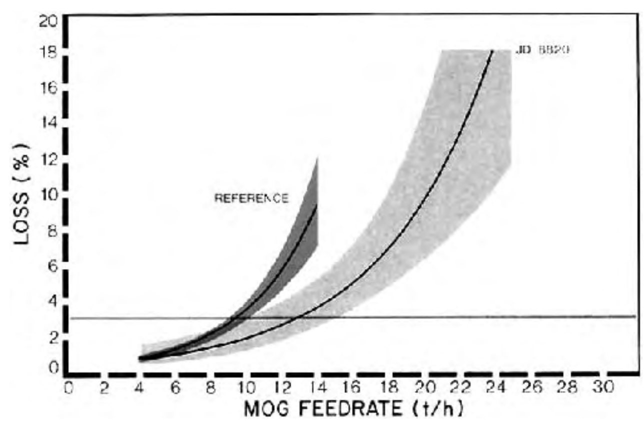


FIGURE 17. Total Grain Loss in Neepawa Wheat (Field C - Double Windrows).

OPERATOR SAFETY

The operator's manual emphasized operator safety.

The John Deere 8820 had adequate warning decals indicating dangerous areas. Moving parts were well shielded. Most shields were on hinges or were easy to remove and replace. A header lock was provided and should be used when working near the header or when the combine is left unattended. Machine adjustments could be made safely. All clutches should be disengaged and the engine shut off before attempting to clear obstructions.

The combine was equipped with a slow moving vehicle sign, warning lights, tail light, signal lights and a right rear view mirror to aid in safe road transport.

A fire extinguisher (class ABC) should be carried on the combine at all times.

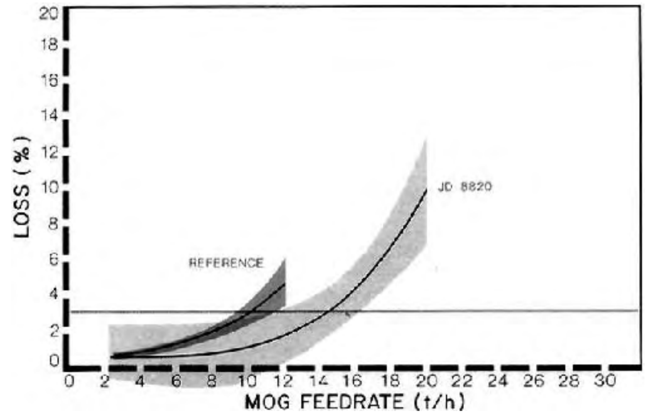


FIGURE 18. Total Grain Loss in Neepawa Wheat (Field E - Single Windrows).

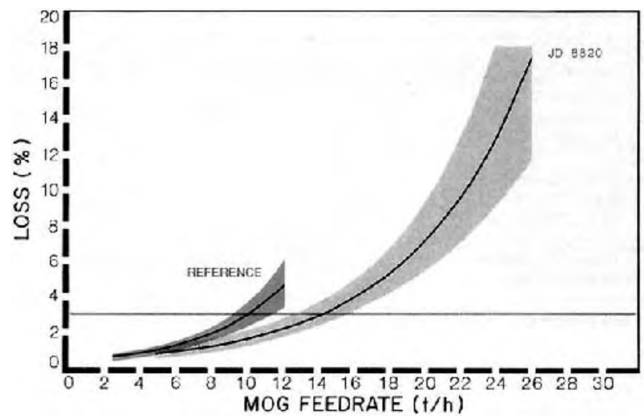


FIGURE 19. Total Grain Loss in Neepawa Wheat (Field E - Double Windrows).

OPERATOR'S MANUAL

The operator's manual was clearly written, well illustrated and well organized. It contained much useful information on safe operation, controls, adjustments, crop settings, servicing and trouble shooting.

DURABILITY RESULTS

TABLE 5 outlines the mechanical history of the John Deere 8820 during 175 hours of operation while harvesting about 515 ha (1270 ac). The intent of the test was functional performance evaluation. Extended durability testing was not conducted.

TABLE 5. Mechanical History

Item	Operating Hours	Field Area ha
Drives		
-The cylinder variable speed drive belt broke and was replaced at	338	114
Electrical		
-A loose electrical connection in the wiring harness for the road lights was repaired at	150	440
Miscellaneous		
-A pin connecting the pickup to the header fell out and was replaced at	10	40
-An attaching clip on the lower shield of the variable feeder drive broke and was repaired at	20	90
-A fuel line T on an engine fuel injector cracked and was replaced at	100	280
-A feeder conveyor slat bent and was straightened at	114	338

DISCUSSION OF MECHANICAL PROBLEMS

Cylinder Variable Speed Drive: The cylinder variable speed drive belt broke, damaging the fan inlet guard and the intermediate drive support, moving the drive ahead about 30 mm (1.2 in).

Replacing the belt was difficult and time consuming. It is recommended that the manufacturer consider modifications to strengthen the cylinder variable speed drive support assembly.

APPENDIX I
SPECIFICATIONS

MAKE:	John Deere
MODEL:	8820 (Self-Propelled Combine)
SERIAL NUMBER:	Header 434948 Body 415563 Engine 6466AH-01 114068RG
MANUFACTURER:	John Deere Harvester Works East Moline, Illinois 61244 U.S.A.
WINDROW PICKUP:	
--make and model	John Deere
--type	belt
--pickup width	3350 mm
--number of belts	6
--teeth per belt	60
--type of teeth	nylon
--number of rollers	3
--height control	castor wheels
--speed control	hydrostatic
--speed range	0.3 to 1.9 m/s
HEADER:	
--type	centre feed
--width	3790 mm
--auger diameter	610 mm
--feeder conveyor	4 roller chains, under-shot slatted conveyor
--conveyor speed	1.5 to 2.3 m/s
--range of picking height	-210 to 1160 mm
--number of lift cylinders	2
--raising time	5 s
--lowering time a	djustable
--options	200 series cutting platform, 50 series row crop head, 40 series corn head, 218 draper platform
CYLINDER:	
--type	rasp bar
--number of bars	8
--diameter	560 mm
--width	1675 mm
--number of spiders	7
--drive	hydraulically controlled variable pitch belt
--speed range	450 to 1200 rpm
--options	370 to 1030 rpm, 300 to 860 rpm and 150 to 250 rpm drives, cylinder filler plates
CYLINDER BEATER:	
--type	drum with 4 triangular bats
--diameter	340 mm
--speed	675 to 1800 rpm
CONCAVE:	
--type	bar and wire grate
--number of bars	14
--configuration	13 intervals with 6.5 mm wires and 18 mm spaces
--wrap	110 degrees
--total area	0.897 m²
--open area	0.505 m²
--transition grate - total area	0.332 m²
--transition grate - open area	0.248 m²
--grain delivery to shoe	augers
--options	stone trap cover, concave cover strips
STRAW WALKERS:	
--type	rotary, formed metal
--number	6
--length	3815 mm
--walker housing width	1675 mm
--separating area	6.39 m²
--crank throw	150 mm
--speed	157 rpm
--grain delivery to shoe	augers
--options	risers
SHOE:	
--type	opposed action
--speed	275 rpm
--chaffer sieve	adjustable lip, 2.492 m 2 with 45 mm throw
--clean grain sieve	adjustable lip, 1.891 m 2 with 38 mm throw
--options	44.3 mm regular tooth chaffer 44.3 mm spaced deep tooth chaffer
CLEANING FAN:	
--type	4 blade undershot
--diameter	510 mm
--width	1630 mm
--drive	variable pitch belt
--speed range	370 to 1120 rpm
ELEVATORS:	
--type	roller chain with rubber flights, top delivery
--clean grain (top drive)	160 x 235 mm
--tailings (bottom drive)	160 x 235 mm)

GRAIN TANK:

--capacity	7.8 m^3
--unloading time	100 s

STRAW CHOPPER:

--type	rotor with 36 freely swinging hammers
--speed	2360 rpm
--option	straw spreaders

ENGINE:

--make and model	John Deere 6466AH-01
--type	4 stroke turbocharged diesel
--number of cylinders	6
--displacement	7.64 L
--governed speed (full throttle)	2340 rpm
--manufacturer's rating	150 kW @ 2340 rpm
--fuel tank capacity	379 L

CLUTCHES:

--header	electro-magnetic
--separator	mechanical v-belt tightener
--unloading auger	electro-magnetic

NUMBER OF CHAIN DRIVES: 9

NUMBER OF BELT DRIVES: 19

NUMBER OF GEARBOXES: 3

NUMBER OF PRELUBRICATED BEARINGS: 92

LUBRICATION POINTS:

--10 h lubrication	5
--50 h lubrication	26
--200 h lubrication	7
--400 h lubrication	7

TIRES:

--front	2, 30.5 L x 32
--rear	2, 16.5 L x 16.1

TRACTION DRIVE:

--type	hydrostatic
--speed ranges	
-1st gear	0 to 2.5 km/h
-2nd gear	0 to 5.5 km/h
-3rd gear	0 to 10 km/h
-4th gear	0 to 23 km/h

OVERALL DIMENSIONS:

--wheel tread (front)	3250 mm
--wheel tread (rear)	3200 mm
--wheel base	3860 mm
--transport height	3795 mm
--transport length	9210 mm
--transport width	4500 mm
--field height	4100 mm
--field length	9120 mm
--field width	4500 mm
--unloader discharge height	3800 mm
--unloader clearance height	3650 mm
--unloader reach	2725 mm
--turning radius	
- left	8120 mm
- right	8480 mm

MASS: (with empty grain tank)

--right front wheel	4290 kg
--left front wheel	4690 kg
--right rear wheel	1050 kg
--left rear wheel	1050 kg
TOTAL	11080 kg

APPENDIX II
REGRESSION EQUA'TIONS FOR CAPACITY RESULTS

Regression equations for the capacity results shown in FIGURES 9 to 13 are presented in TABLE 6. In the regressions, C = cylinder loss in percent of yield, S = shoe loss in percent of yield, W = walker loss in percent of yield. F = the MOG feedrate in t/h, while ln is the natural logarithm. Sample size refers to the number of loss collections. Limits of the regressions may be obtained from FIGURES 9 to 13 while crop conditions are presented in TABLE 4

TABLE 6. Regression Equations

Crop - Variety	Fig. No.	Regression Equations	Simple Correlation Coefficient	Variance Ratio	Sample Size
Barley - Hector	9	$C = 0.08 + 0.01F$ $\ln S = -2.92 + 0.18F$ $W = 0.29 - 0.05F^2 + 0.006F^2$	0.71 0.90 0.99	6.21 12.57[1] 118.50[2]	8
Barley - Hector	10	$C = -0.06 + 0.04F$ $\ln S = -2.92 + 0.18F$ $\ln W = -2.93 + 0.30F$	0.93 0.95 0.85	36.68[2] 59.07[1] 16.08[2]	8
Wheat - Neepawa	11	$\ln C = -0.75 + 0.09F$ $\ln S = -2.51 + 0.19F$ $\ln W = -5.81 + 0.33F$	0.97 0.88 0.97	103.41[2] 20.67[1] 98.94[2]	8
Wheat - Neepawa	12	$\ln C = -0.89 + 0.08F$ $S = -0.005 + 2.0 \times 10^{-5}F^2$ $W = 0.03 - 0.004F^2 + 3.0 \times 10^{-5}F^2$	0.91 0.85 0.99	23.27[2] 13.20[2] 67.90[2]	7
Wheat - Neepawa	13	$\ln C = -0.74 - 0.09F$ $\ln S = 2.57 + 0.15F$ $\ln W = -6.02 + 0.32F$	0.99 0.87 0.99	290.90[2] 15.15[2] 195.58[2]	7

[1]Significant at $P \leq 0.05$
[2]Significant at $P \leq 0.01$

APPENDIX III
PAMI REFERENCE COMBINE CAPACITY RESULTS

TABLE 7 and FIGURES 20 and 21 present the capacity results for the PAMI reference combine in wheat and barley crops harvested from 1976 to 1980.

FIGURE 20 shows capacity differences in Neepawa wheat for the five years. Most 1980 Neepawa wheat crops shown in TABLE 7 were of average straw yield and better than average grain yield. Most of the crops were average-to-thresh while the grain moisture content was slightly lower than other years and the straw moisture content was average to lower than normal.

FIGURE 21 shows capacity differences in six-row Bonanza barley for 1976 to 1978, two-row Fergus barley for 1979 and two-row Hector barley for 1980. The 1980 Hector barley crops shown in TABLE 7 were of average straw yield, easy-to-thresh, and average straw and grain moisture content.

Results show that the reference combine is important in determining the effect of crop variables and in comparing capacity results of combines evaluated in different growing seasons.

TABLE 7. Capacity of the PAMI Reference Combine at a Total Grain Loss of 3% of Yield.

	Crop Conditions							Capacity Results			
					Grain Moisture			MOG Feedrate	Grain Feedrate	Ground Speed	
	Crop	Variety	Width of Cut m	Crop Yield t/ha	Straw %	Grain %	MOG/G	t/h	t/h	km/h	Loss Curve
1980	Barley (A)	Hector	6.1	3.48	13.8	14.5	0.69	5.5	8.0	3.8	Fig. 21
	Barley (B)	Hector	6.1	3.16	13.4	14.4	0.68	5.8	8.5	4.4	
	Wheat (C)	Neepawa	12.2	2.87	7.2	13.2	0.88	9.4	10.6	3.0	
	Wheat (D)	Neepawa	6.1	3.12	6.0	11.4	0.98	10.1	10.3	5.4	Fig. 20
	Wheat (D)	Neepawa	12.2	3.09	6.2	12.2	1.02	10.2	10.0	2.7	
	Wheat (E)	Neepawa	6.1	3.00	4.9	10.8	0.91	10.3	11.3	6.2	
1979	Barley	Klages	6.1	3.67	dry	11.7	0.64	6.8	10.6	4.7	
	Wheat	Neepawa	7.3	2.77	dry	14.1	1.21	9.5	7.8	3.9	
	Wheat	Neepawa	6.1	2.67	dry	14.3	1.09	9.7	8.9	5.4	Fig. 20
	Barley	Fergus	7.3	3.46	dry	12.5	0.77	7.3	9.5	3.7	Fig. 21
1978	Wheat	Canuck	7.3	2.54	7.1	12.1	1.15	11.8	10.3	5.6	
	Wheat	Lemhi[1]	11.0	2.13	6.6	12.0	0.75	10.9	14.5	6.2	
	Wheat	Neepawa	6.1	4.37	10.4	15.9	1.04	9.3	8.9	4.5	Fig. 20
	Barley	Bonanza	6.1	4.06	7.7	13.5	0.68	6.1	9.0	3.6	Fig. 21
1977	Wheat	Neepawa	6.1	3.97	13.4	14.6	0.79	11.1	14.1	5.8	Fig. 20
	Barley	Bonanza	7.3	4.74	25.7	14.6	0.84	7.9	9.4	2.7	Fig 21
1976	Wheat	Neepawa	5.5	2.78	dry to tough	14.7	1.29	7.1	5.5	3.6	Fig. 20
	Barley	Bonanza	7.3	3.18	dry to tough	14.6	0.96	4.8	5.0	2.2	Fig 21

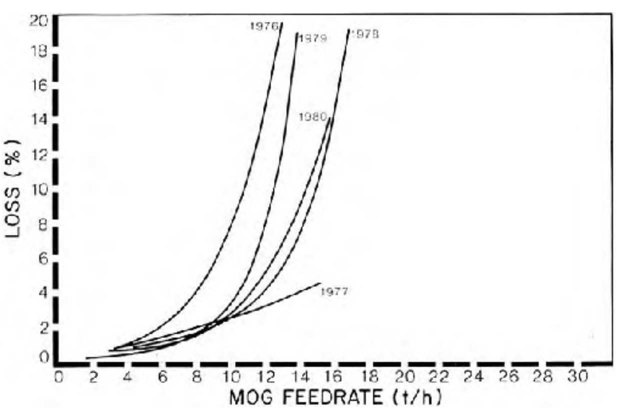


FIGURE 20. Total Grain Loss for the PAMI Reference Combine in Neepawa Wheat.

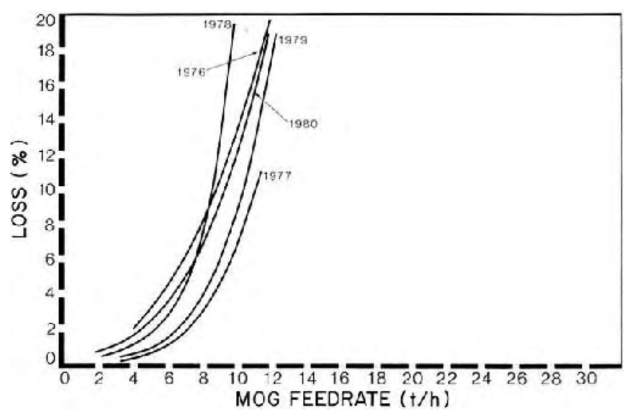


FIGURE 21. Total Grain Loss for the PAMI Reference Combine in Barley.

APPENDIX IV
MACHINE RATINGS

The following rating scale if used in PAMI Evaluation Reports:

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

APPENDIX V
CONVERSION TABLE

1 kilometre/hour (km/hr)	= 0.6 miles/hour (mph)
1 hectare (ha)	= 2.5 acres (ac)
1 kilogram (kg)	= 2.2 pounds mass (lb)
1 tonne (t)	= 2200 pounds mass (lb)
1 tonne/hectare (t/ha)	= 0.5 ton/acre (ton/ac)
1 tonne/hour (t/h)	= 37 pounds/minute (lb/min)
1 kilowatt (kW)	= 1.3 horsepower (hp)
1 litre/hour (L/h)	= 0.2 Imperial gallons/hour (gal/h)
1 metre (m)	= 3.3 feet (ft)
1 millimetre (mm)	= 0.04 inches (in)

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