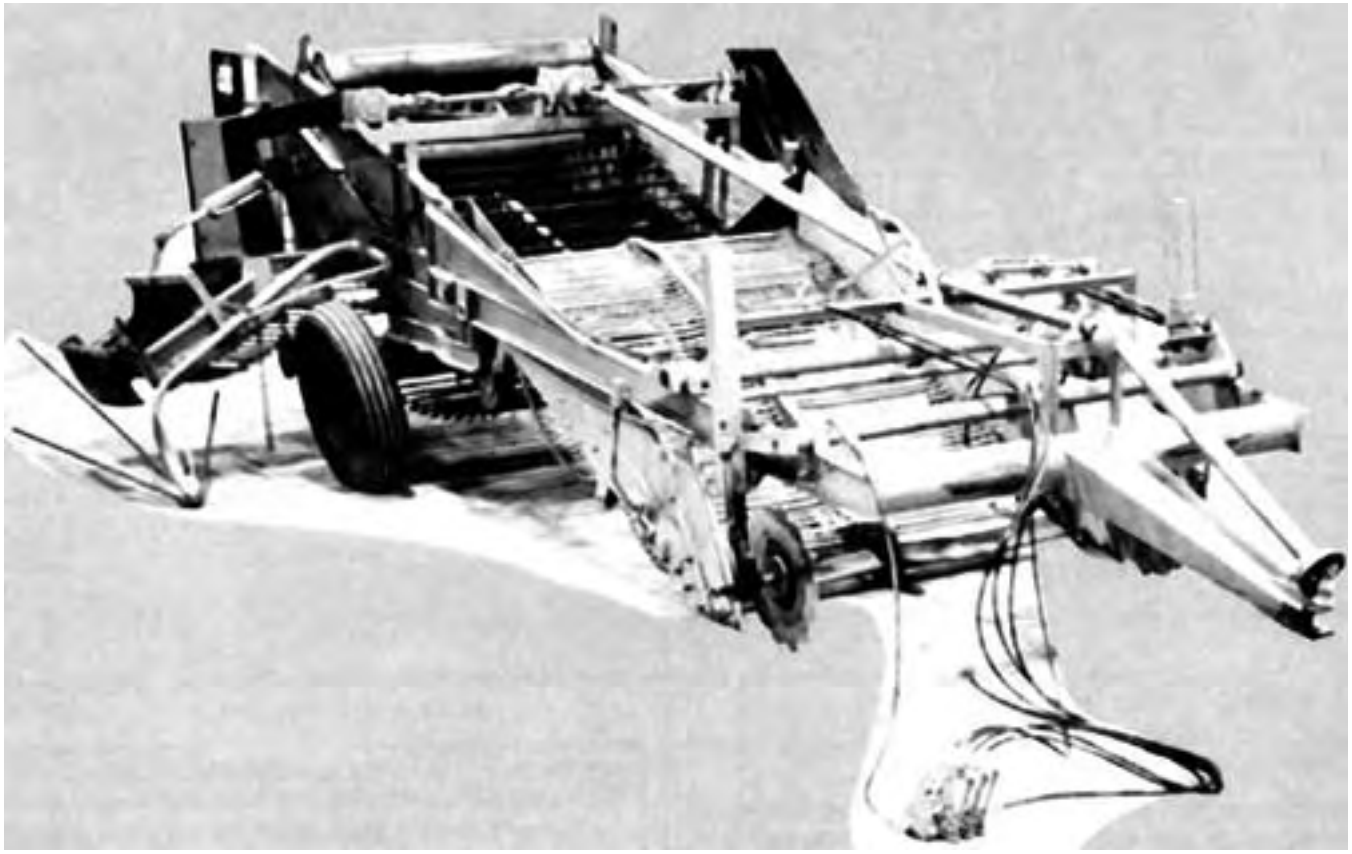
Evaluation Report No. E0978
Printed: July, 1979
Tested at: Portage la Prairie
ISSN 0383-3445

Evaluation Report 127



Thomas Model 660 Potato Harvester

A Co-operative Program Between:
PAMI

THOMAS MODEL 660 POTATO WINDROWER

MANUFACTURER:

Thomas Equipment Limited
Centreville, New Brunswick
E0J 1H0

DISTRIBUTOR:

A.M. Briggs, Limited
P.O. Box 273Portage la Prairie, Manitoba
R1N 3B5

RETAIL PRICE:

$13,772.00 (July, 1979, f.o.b. Portage la Prairie, Manitoba with standard contour bar spade, trash cutting coulters and vine lifter.)

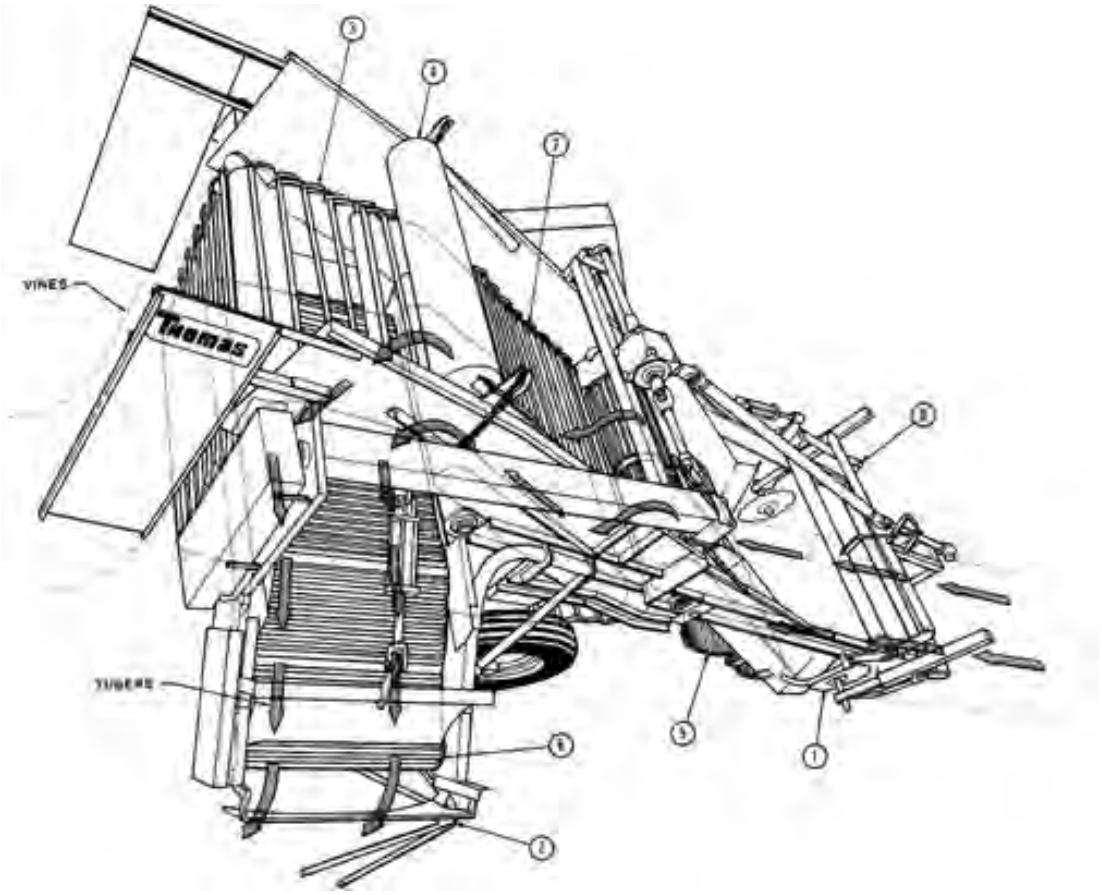


FIGURE 1. Thomas 660 Potato Windrower: (1) Coulters, (2) Vine Lifter, (3) Deviner Chain, (4) Stripper Roller, (5) Primary Digger Chain, (6) Cross Conveyer Boom, (7) Secondary Digger Chain, (8) Coulter Lift Arm.

SUMMARY AND CONCLUSIONS

Functional performance of the Thomas 660 potato windrower was very good in loam and sandy soils with low to normal moisture contents. Performance was good in wet loam soils.

Work rate was governed by the separating ability of the primary and secondary digger chains and depended primarily on soil conditions. Appropriate ground speeds ranged from 2.5 km/h (1.5 mph) in moist, heavy soils to 5 km/h (3 mph) in dry, sandy soils. Average work rates ranged from 0.6 to 0.8 ha/h (1.5 to 2 ac/h) in average crop yields of 20 t/ha (9 ton/ac).

Deviner performance was very good and carry over losses were low in all crops.

Typical samples of windrowed potatoes showed 70% undamaged tubers, 15% slightly skinned, marketable tubers, 5% slightly bruised, unmarketable tubers and 10% severely damaged tubers. To reduce tuber damage, it was important to keep the digger chains well loaded with soil.

Plugging was infrequent in dry soil with relatively dry vines. In wetter soils, with tough green vines, the coulters often did not completely cut the vines, which led to hairpinning on the spade dividing boards and frequent shutdowns for cleaning.

The Thomas 660 was easy to maneuver, but on very short headlands, some backing was needed to align the windrower with the rows. The tractor mounted control console was convenient, permitting quick machine adjustments.

A tractor with a minimum 60 kW (80 hp) power take-off rating should have ample power to operate the Thomas 660 in most soil conditions.

The Thomas 660 was easy to service and lubricate and transported well. All drives were suitably shielded. The right tire was overloaded by 64%, while the left tire was overloaded by 36% at normal transport speeds. No operator's manual was provided.

Several minor mechanical problems occurred during the 220 hour test period: The stripper roller support chains broke, the coulter activating arm buckled and one set of primary digger chains wore sufficiently to require replacement.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifications to improve coulter cutting performance, in adverse conditions, thereby red ucing hairpinning of uncut vines on the spade dividing boards.
2. Modifications to eliminate buckling of the coulter activating arm.
3. Providing a suitable operator's manual.
4. Providing access holes in the drive shields to facilitate chain lubrication.

5. Equipping the windrower with tires with a higher load rating.

Chief Engineer -- E.O. Nyborg
Senior Engineer -- J. C. Thauberger
Project Engineer -- G.R. Pool

THE MANUFACTURER STATES:

With regard to the recommendations: We will analyse your recommendations for possible implementation in future production.

GENERAL DESCRIPTION

The Thomas 660 (FIGURE 1) is a two-row, power take-off driven, pull-type potato windrower with a 1.6 m cutting width. It is designed to be used in conjunction with a potato harvester. The windrower is used immediately ahead of the potato harvester, digging two rows and placing them between the rows to be dug by the harvester. By windrowing in both directions, on each side of a set of rows, four rows may be placed between the rows to be dug by the potato harvester.

The windrower spade moves through the soil below two rows of potato tubers, lifting a mass of soil and vines onto the primary digger chains. A large portion of the soil falls through the primary chains, while the remaining soil, tubers and vines are delivered to the secondary digger chains. A larger pitch deviner chain, which rotates outside the secondary chains, carries vines and trash out the back of the windrower. The secondary chains complete soil separation and convey tubers to the rear cross delivery boom, which transfers them to the ground between two adjacent rows.

The windrower drive is controlled with the tractor power take-off clutch, while hydraulic controls adjust spade depth and delivery boom height. A minimum 60 kW tractor, with 540 rpm power take-off and at least one hydraulic outlet, is needed to operate the Thomas 660.

The test machine was equipped with optional trash cutting coulters, optional vine lifter and a standard contour-bar spade.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The Thomas 660 was operated in the soil conditions shown in TABLE 1 for 220 hours while windrowing about 120 ha of Netted Gem potatoes. It was evaluated for ease of operation and adjustmerits, rate of work, quality of work, power requirements, operator safety and suitability of the operator's manual. Throughout the test, it was powered with an International Harvester Hydro 186 tractor and was used in conjunction with a Thomas 635 potato harvester.
TABLE 1. Operating Conditions

RESULTS AND DISCUSSION

EASE OF OPERATION AND ADJUSTMENTS

Hitching: Since the hitch weight was 420 kg, a jack was needed to hitch the Thomas 660 to a tractor. Alternately, the hitch could usually be raised sufficiently by first connecting the hydraulic hoses and lowering the spade onto the ground with the hydraulic system.

The Thomas 660 was powered by a standard 540 rpm power take-off shaft from the tractor. It was equipped with its own hydraulic control valve assembly (FIGURE 2) which connected to one set of outlets on the tractor hydraulic system. The valve assembly could be mounted either on an adjustable pedestal on the windrower hitch or at a convenient location on the tractor.

Hydraulic Controls: Since the control valve assembly could be mounted at the tractor operator station, access to hydraulic controls was convenient. The standard valve contained controls for spade depth and cross conveyor boom height. An additional valve could be added to the valve assembly for the optional hydraulic coulter depth control or the power steering.

Maneuverability: The model 660 was easy to maneuver on short headlands, but some backing was often needed to align the windrower with the rows. The optional power steering attachment, which was not evaluated, would be beneficial on short head lands.

Visibility: Monitoring of the tubers, dropping to the ground, was easy due to the good visibility of the cross conveyor from the tractor seat. Similarly, operator visibility of the spade, coulters, and primary and secondary chains was excellent. A spade depth indicator on the front of the machine was well designed and easy to view.

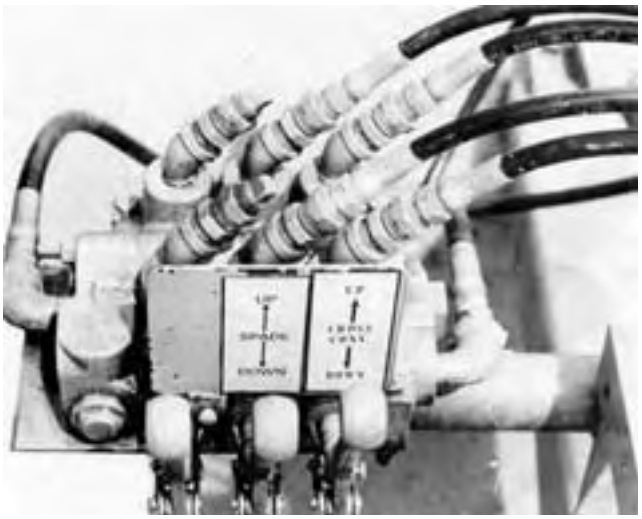


FIGURE 2. Hydraulic Control Valve Assembly.

Night Operation: No lighting system was provided for night operation, however, standard tractor lighting was adequate.
Plugging: Hairpinning of uncut vines on the spade dividing boards occurred in a variety of field conditions. Tough green vines, as well as bunches of dry vines, occasionally were not completely cut by the coulters. The uncut vines would then hairpin on the dividing boards, necessitating stops for cleaning.

Plugging was infrequent in dry soil with relatively dry vines. In wetter soil, with tough green vines, frequent cleaning stops were needed. In adverse conditions, coulter cutting effectiveness was improved by modifying the coulter assembly to increase downward coulter force. Field observation of the plugging pattern indicated that coulter effectiveness could also be increased by placing the coulters further ahead of the spade. It is recommended that the manufacturer modify the coulter assembly, possibly by providing heavier coulter springs and by positioning the coulters further forward, to improve vine cutting effectiveness in adverse conditions.

Vine Divider: The optional vine divider (FIGURE 3) is designed to reduce potato harvester carryover losses in crops with heavy green vines. The divider lifts vines ahead of the windrower delivery boom discharge, allowing tubers to be placed directly on the soil, between the two rows to be dug by the harvester.

Vine divider performance was very good. To disengage the divider the operator had to stop, dismount the tractor and hook the divider into the raised position by hand. This was not a problem, as the divider could be left in the lowered position when turning on headlands.

Transport: The Thomas 660 towed well at speeds up to 25 km/h, on smooth gravel and paved roads. Operator visibility to the rear was good. It was equipped with a slow moving vehicle sign for transport on public roads.

Lubrication: The Thomas 660 had 15 pressure grease fittings and five roller chains that required periodic lubrication. Daily lubrication took about 10 minutes. A lubrication schedule was not specified by the manufacturer. Several shields had to be removed to oil the five roller chains. Although all shields were well designed, removal was fairly difficult.

It is recommended that the manufacturer provide a lubrication schedule and consider providing access holes, in the shields, to facilitate lubrication.

RATE OF WORK

Work rates were governed by the separating ability of the primary and secondary digger chains and depended primarily on the soil type. Work rate was influenced by crop yield, to a lesser extent. Soil was conveyed into the windrow, along with the potatoes, if the windrower travelled too fast for the soil conditions. Appropriate ground speeds ranged from 2.5 km/h in moist, heavy soils to 5 km/h in dry, sandy soils. Average work rates varied from 0.6 to 0.8 ha/h,

in crops yielding an average of 20 t/ha. This corresponds to an average capacity of about 15 tonnes per hour.

FIGURE 3. Optional Vine Divider in Working Position.

FIGURE 4. Potential Eye Hazard Caused by Vine Divider

QUALITY OF WORK

Soil Separation: The 40 mm pitch, primary and secondary digger chains were designed to separate the soil from the potato tubers. Soil separation was very good in all soil conditions, except in heavy wet soil, where the chain links became coated with soil. This reduced the gap between the links resulting in some soil carryover with the potatoes. This is a typical occurrence with most potato harvesters and windrowers.

Carryover: Deviner performance was very good in most field conditions and potato tuber carryover, with the vines, was insignificant. In fields with heavy, green vines, some carryover occurred, however the deviner stripper roller effectively reduced carryover to moderate levels in all crops, by stripping off most potatoes that clung to the vines.

Bruising: An average of 15% of the windrowed potatoes were sufficiently damaged to be unmarketable. The parameter used to determine damage was bruising, which included black spot as well as shatter bruise.[1] Typical samples of windrowed potatoes showed 70% undamaged tubers, 15% slightly skinned but marketable tubers, 5% slightly bruised tubers and 10% severely damaged tubers. The latter two categories were unmarketable.

To reduce tuber damaged to a minimum, it was important to keep the digger chains well loaded with soil and to operate the windrower at the maximum possible feedrate.

POWER REQUIREMENTS

Average power take-off input was about 7.5 kW while draft input varied from 10 to 25 kW, depending on soil conditions and ground speed. A tractor with a minimum 60 kW power take-off rating should have ample power reserve to operate the Thomas 660 in most conditions. In selecting a tractor, consideration should be given to the fact that the tractor must support a 420 kg hitch weight. In addition, tractor tire size should be adequate to provide sufficient floatation, in soft soil, to prevent tire damage to the undug tubers.

OPERATOR SAFETY

The Thomas 660 was equipped with adequate, well designed shields covering all exposed drives. A slow moving Vehicle sign was provided. If normal safety precautions were observed, all servicing and adjustments could be safely performed.

No safety instructions were provided with the Thomas 660. In addition, no safety decals were affixed to the machine to point out potential safety hazards.

The optional vine divider, when suspended in transport position (FIGURE 4) created a potential eye hazard during servicing especially if the suspension chain was not hooked at its shortest length. The operator should raise the divider as high as possible when placing it in transport, to reduce this potential hazard.

The tire loads on the Thomas 660 exceeded the maximum load rating for 7:50x20, 4 ply implement tires.[2] The right tire was overloaded by 64%, while the left tire was overloaded by 36% at normal transport speeds. It is recommended that the manufacturer equip the windrower with tires of higher load rating.

OPERATOR'S MANUAL

No operator's manual was available for the Thomas 660. It is recommended that a suitable operator's manual be provided, complete with servicing, lubrication, operating and safety instructions.

DURABILITY RESULTS

TABLE 2 outlines the mechanical history of the Thomas 660 windrower during 220 hours of operation, while windrowing about 120 ha of potatoes. The intent of the test was evaluation of functional performance. The following failures represent those which occurred during functional testing. An extended durability evaluation was not conducted.

TABLE 2. Mechanical History

ITEM	HOURS	EQUIVALENT FIELD AREA ha
-- The coulter activating arm buckled during operation. It was straightened at	20	11
-- A brace to eliminate vibration in the cross delivery boom drive shaft was installed at	50	27
-- The devinor stripper roller support chains broke and were repaired at	80	44
-- The main gearbox input shaft seal began to leak at	175	95
-- The primary digger chains were worn out and replaced at	190	104

DISCUSSION OF MECHANICAL PROBLEMS

Stripper Roller: The stripper roller support chains broke, primarily due to improper support chain adjustment. The roller was positioned too close to the deviner chain causing the deviner chain links to strike the roller, and accelerating support chain wear. No further problems occurred once the roller was raised to eliminate this interference.

Coulter Activating Arm: The coulter activating arm lowered the coulters into cutting position, when the spade was lowered. The activating arm had inadequate strength, and buckled during field operation. No further problems occurred after the arm was reinforced. (FIGURE 5.)

Cross Delivery Boom Drive Shaft: The drive shaft at the discharge end of the rear cross delivery boom was subjected to vibration during operation. To prevent failure, a brace was installed between the free end of the drive shaft and the main frame.

[1] *PAMI T7719-R78, Detailed Test Procedure for Potato Harvesters*

[2] The Tire and Rim Association, Inc. 1978 Yearbook.

FIGURE 5. Coulter Activating Arm.

APPENDIX I
SPECIFICATIONS

Make:	Thomas
Model:	660
Serial Number:	1079
Coulters:	
-- type	notched blade
--diameter	510 mm
--depth control	integral with spade depth control
Digger Spade:	
-- type	standard contour
-- width	1630 mm
-- depth control	hydraulic ram
Primary Digger Chains:	
-- type	dual offset chain
-- number of links	115
-- length	4600 mm
-- bar size	11.1 mm
-- pitch	40 mm
Secondary Digger Chains:	
-- type	dual rubber covered chain
-- number of !inks	88
-- length	3520 mm
-- bar size	11.1 mm
-- pitch	40 mm
-- number of flights	11, rubber
Deviner Chain:	
-- type	single rubber covered chain
-- number of links	56
-- length	7170 mm
-- bar size	15.9 mm
-- pitch	128 mm
Delivery Boom Conveyor Chain:	
-- type	single, rubber covered chain
-- number of links	140
-- length	5600 mm
-- bar size	11.1 mm
-- pitch	40 mm
Stripper Roller:	
-- length	1400 mm
-- diameter	255 mm
Number of Chain Drives:	5
Number of Gear Boxes:	2
Number of Sealed Bearings:	11
Number of Pressure Grease Fittings: 15	
Clutches:	
-- slip clutches	2
-- torque limiters	2
Tires:	2, 7.50x20SL, 4 ply
Overall Dimensions:	
-- wheel tread	1930 mm
-- length	7470 mm
-- width	3680 mm
-- height	2030 mm
-- ground clearance	250 mm
-- turning radius	18,000 mm
Weight: (unloaded)	
-- right wheel	1292 kg
-- left wheel	1068 kg
-- hitch	420 kg
TOTAL	2780 kg

Optional Equipment: chamfered spade units, three-point spade unit, roller bar spade unit, hydraulic coulters, kickers, power steering.

APPENDIX 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
METRIC UNITS

In keeping with the Canadian metric conversion program this report has been prepared in SI Units. For comparative purposes, the foliowing conversions may be used.

1 hectare (ha)	= 2.47 acres (ac)
1 kilometre/hour (km/h)	= 0.62 miles/hour (mph)
1 kilogram (kg)	= 2.20 pounds mass (lb)
1 tonne (t)	= 2204.6 pounds mass (lb)
1 tonne/hour (t/h)	= 1.10 ton/hour (ton/h)
1 tonne/hectare (t/ha)	= 0.45 ton/acre (ton/ac)
1000 millimetres(mm) = 1 metre (m)	= 39.37inches (in)
1 kilowatt (kW)	= 1.34 horsepower (hp)

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