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A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

Research Update 660

Conveying Equipment For Pulse Crops

(Funded by: ADF, SPCDB, MWP and SWP)*

INTRODUCTION

Pulse crop production is a growing industry. In 1989, the three prairie provinces devoted 730,000 acres (295,000 ha) to the production of peas and lentils.. Due to good market conditions, it is expected that these acreages will steadily rise.

Pulse crops are much more susceptible to damage than most cereals and other grains. Therefore, it is very important to use conveying equipment that minimizes damage to these high priced crops.

The Prairie Agricultural Machinery Institute (PAMI) has completed a study comparing four unique conveyors. The characteristics of paddle conveyors, belt conveyors, and bristle flighting were compared to the traditional steel flighting used in existing augers.

NOTE: The reader is cautioned that the following information is only a summary of the test results. For complete information, contact PAMI at 1-800-567-PAMI and ask for REPORT # RH0288.

HOW DO THEY COMPARE?

CROP DAMAGE

Crop Damage - General: Handle lentils as little as possible, at a safe, but high moisture content (M.C.). Peas are less susceptible to damage, plus they are not as severely docked at market as the higher priced lentils. For comparisons, the most aggressive conveying system would inflict about 0.1% damage in spring wheat. In these tests, PAMI only used visual tests to determine damage. Other damage, such as reduced germination, was not considered.

Crop Damage - Peas: In Century peas at 13% Moisture content, the belt conveyor had the lowest damage at 0.2% (FIGURE 1). The bristle and paddle conveyors were close behind at ranges of 0.2 to 0.7% and 0.5 to 0.9% respectively. The conventional steel screw auger had the highest damage at 2.7 to 2.8%.

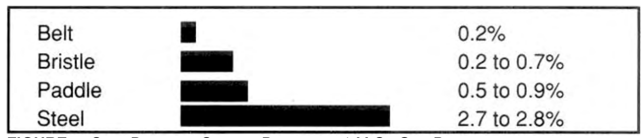


FIGURE 1. Crop Damage, Century Peas at 13% M.C., One Pass.

Crop Damage - Laird Lentils at 12.8% M.C.: In Laird Lentils at 12.8% M.C., the paddle and belt conveyors had the least damage ranging from 0.4 to 1.0%. The bristle conveyor was next with damages of 0.6 to 1.3%. The most damage was caused by the steel flighting auger at 1.8 to 2.6% (FIGURE 2).

FIGURE 2. Crop Damage, Laird Lentils at 12.8% M.C., One Pass.

Crop Damage - Laird Lentils at 15.4% M.C.: Although, there was very little difference at the higher moisture content, the belt and paddle conveyors had the least damage with ranges from 0.1 to 0.3%. The steel screw conveyor was next at 0.2 to 0.5%, while the bristle conveyor had the most damage at 0.3 to 0.7% (FIGURE 3).

Conveying lentils at higher moisture content is advised for reduced damage.

IN BRIEF

During the testing, PAMI made a number of observations which a producer should consider before making a buying decision:

- Pulse crops damage easily. Use appropriate equipment. Avoid unnecessary handling. Whenever possible, handle crops at a high moisture content (M.C.).
- The belt conveyor had lowest damage, while the steel fiighting auger had the highest.
- Paddle conveyors had the highest capacity. Producers should flood feed all conveyors to maximize capacity and minimize damage.
- Belt conveyors had the highest efficiency of power usage (comparison of specific capacities).
- From an economic viewpoint, producers must consider the grain damage that is done by the conveyor. For fragile, high priced crops, the producer should consider a conveyor with low-damage characteristics in spite of the high capital costs.
- When elevating at a steep angle, thedrop height caused grain damage. Some producers use bean ladders to soften the drop.
- Steel and bristle augerswere difficult to comptetely clean. This may be a problem for seed growers.
- Bristle augers tended to plug and break their shear pins when operated at lower PTO speeds.

*Funding for this research project has been provided by the Agriculture Development Fund, the Saskatchewan Pulse Crop Development Board, and the Manitoba and Saskatchewan Wheat Pools.

FIGURE 3. Crop Damage, Laird Lentils at 15.4% M.C., One Pass.

Crop Damage - Elevation Height or Conveyor Speed: Tests indicated that changing elevation height or conveyor speed had little effect on grain damage.

NOTE: PAMI grain damage tests only considered the effect of the crop's travel from the inlet to the outlet of the conveyor. Damage due to crop dropping from a height was not measured. Producers may consider using a bean ladder if the drop height from the conveyor is excessive.

CAPACITY

Capacity - General: In all three crops, the capacity of the paddle conveyor was the highest. Following in capacity were the steel flighting and the belt conveyor. The bristle flighting conveyor had the lowest capacity. If the paddle conveyor was rated at 100%, the others would rank approximately as follows: steel 85%, belt 65% and bristle 50% (FIGURES 4, 5 and 6).

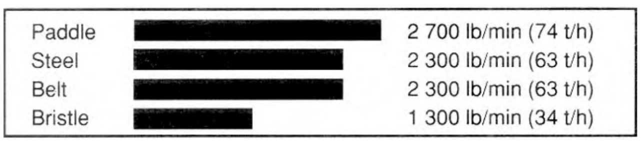


FIGURE 4. Capacity, Century Peas at 13% M.C.

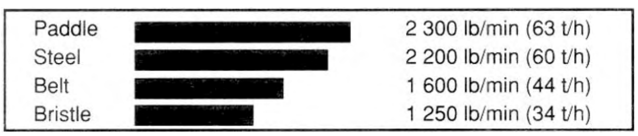


FIGURE 5. Capacity, Laird Lentils at 12.8% M.C.

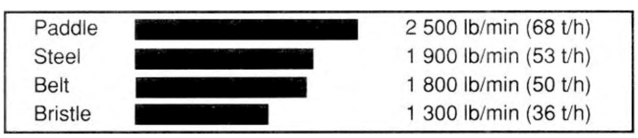


FIGURE 6. Capacity, Laird Lentils at 15.4% M.C.

Capacity - Elevation Height: FIGURES 4, 5 and 6 show capacity at 200 elevation for all crops.

In drier crops, the paddle, steel and bristle conveyors showed very little capacity decrease with an elevation increase to 30°. However, in the same dry conditions, the belt conveyor lost 35% capacity.

In higher moisture crops, all conveyors lost capacity as elevation increased. The steel flighting (9% loss) was the lowest, followed by the paddle (14%), the bristle (26%) and the belt (30%) (FIGURE 7).

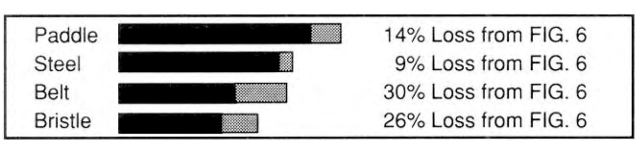


FIGURE 7. Capacity Loss in High Moisture Crops with Elevation Change From 20 to 30°.

Capacity - PTO Speed Change: Generally, the capacity of the paddle and belt conveyors continued to increase as the PTO speed increased. However, the capacity of the steel and bristle screw conveyors, used for these tests, peaked at a PTO speed of 400 to 500 RPM. Also, bristle augers tended to break their shear pins when operated at lower PTO speeds.

EFFICIENCY (SPECIFIC CAPACITY)

Specific Capacity: Specific capacity is a measure of how much crop a conveyor can move for a given energy input. This number can be used to compare a machine's efficiency relative to other machines.

NOTE: Although efficiency comparisons were a part of the PAMI tests, producers should realize that this factor is very small when calculating yearly costs. In all cases, even labour or repair costs were greater than power costs.

Efficiency - Dry Crop: For comparison purposes, in dry material, the paddle and belt conveyors were about equal with the highest specific capacity. Compared to the above, the steel (55%) and the bristle (25%) had reduced efficiencies (FIGURE 8).

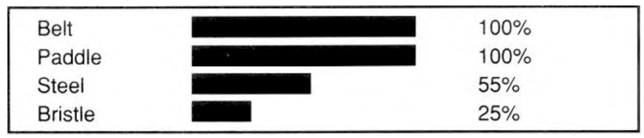


FIGURE 8. Comparative Efficiencies in Dry Crop.

Efficiency - High Moisture Crop: In 15.4% M.C. lentils, the specific capacity of the belt conveyor did not change from the dry crop. Compared to the belt, the efficiencies of the paddle (70%), the steel (40%), and the bristle (20%) were lower for this high M.C. crop (FIGURE 9).

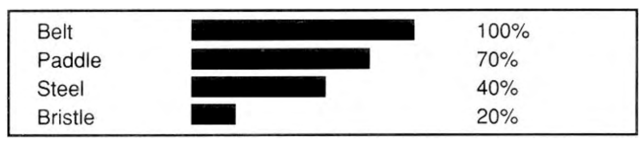


FIGURE 9. Comparative Efficiencies in High Moisture Crop.

POWER REQUIREMENTS

For the PAMI tests, all conveyors were powered by a PTO equipped tractor. At 540 RPM, power requirements ranged from 4 to 19 hp (3 to 14 kW).

ECONOMIC ANALYSIS

Factors Affecting Conveying Costs: For economic analysis, PAMI used an annual production of 200,000 lb (91 t), CONVEYED TWICE, based on 1989 grain and operati.ng prices. To determine TOTAL COST PER YEAR, the following factors were considered: GRAIN DAMAGE, FIXED COST and OTHER COSTS. Unit costs are also given in dollars per hundred weight (dollars per tonne).

The major cost to the systems was the GRAIN DAMAGE with FIXED COST playing a secondary role. GRAIN DAMAGE was especially important when conveying the high priced lentils. OTHER COSTS included POWER, LABOUR, AND REPAIR.

Seed growers should note that extra labour costs may be required to fully clean a bristle flight conveyor.

Conveying Costs - Century Peas: For peas at 13% M.C., total yearly conveying costs with a steel auger were lowest at $510.00 per year, even though damage costs were highest at $222.00 (TABLE 1).

For the same crop, the belt conveyor had the highest operating costs at $754.00/year, even though the damage was only $17.00.

TABLE 1. Yearly Conveying Cost for Century Peas at 13.0% M.C., 1989.

Conveyor	Fixed $/yr (% Total)	Damage $/yr (% Total)	Other $/yr (% Total)	Total $/yr	Unit $/cwt ($/t)
STEEL	223 (44%)	222 (44%)	65 (12%)	510	0.26 (5.62)
BRISTLE	394 (68%)	58 (10%)	126 (22%)	578	0.29 (6.37)
PADDLE	505 (75%)	75 (11%)	95 (14%)	675	0.34 (7.44)
BELT	608 (81%)	17 (2%)	129 (17%)	754	0.38 (8.31)

Conveying Costs - Laird Lentils at 12.8% M.C.: For Laird Lentils at 12.8% M.C., the belt conveyor had the lowest yearly costs at $2 353.00 (TABLE 2). The steel auger had the highest cost per year at $7 430.00.

With the higher priced Lentils, yearly cost was affected mainly by grain damage. The crop damage by the belt conveyor accounted for 68% of its yearly operating costs. The amount damaged by the steel auger amounted to 96% of its yearly operating costs.

TABLE 2. Yearly Conveying Cost for Laird Lentils at 12.8% M.C., 1989.

Conveyor	Fixed $/yr (% Total)	Damage $/yr (% Total)	Other $/yr (% Total)	Total $/yr	Unit $/cwt ($/t)
BELT	611 (26%)	1 597 (68%)	145 (6%)	2 353	1.18 (25.94)
BRISTLE	394 (14%)	2 393 (82%)	125 (4%)	2 912	1.46 (32,11)
PADDLE	506 (17%)	2 393 (80%)	99 (3%)	2 998	1.50 (33.05)
STEEL	224 (3%)	7 135 (96%)	71 (1%)	7 430	3.72 (81.92)

Conveying Costs - Laird Lentils at 15.4% M.C.: For Laird Lentils at 15.4% M.C., the paddle and belt conveyors were about equal for yearly cost performance (TABLE 3). These conveyors caused the least damage at 35 to 40% of the total cost of about $1100.00 per year. The steel conveyor had the highest yearly cost due to damage, accounting for 87% of the yearly cost of $2294.00.

TABLE 3. Yearly Conveying Cost for Laird Lentils at 15.4% M.C., 1989.

Conveyor	Fixed $/yr (% Total)	Damage $/yr (% Total)	Other $/yr (% Total)	Total $/yr	Unit $/cwt ($/t)
PADDLE	506 (50%)	400 (40%)	105 (10%)	1 011	0.51 (11.15)
BELT	609 (53%)	400 (35%)	135 (12%)	1 144	0.57 (12.61)
BRISTLE	395 (23%)	1 198 (69%)	142 (8%)	1 735	0.87 (19.13)
STEEL	224 (10%)	1 995 (87%)	75 (3%)	2 294	1.15 (25.29)

FURTHER INFORMATION

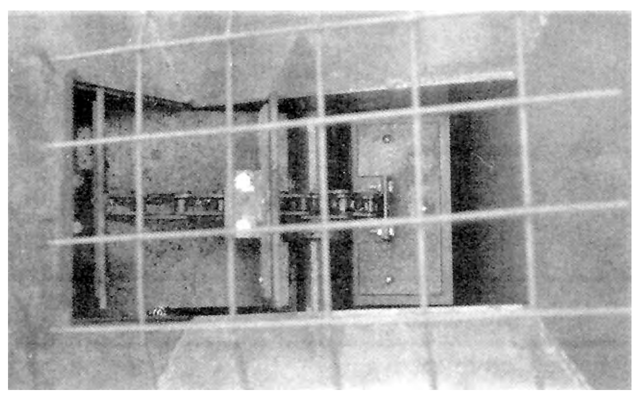
For further information, contact PAMI at 1-800-567-PAMI and ask for Report #RH0288, "Development of Conveying Equipment Guidelines for Optimum Pulse Crop Quality" (cost: $5.00).

To discuss specific results, contact the authors: Doug May, Project Engineer, or Ken Maloff, Information Services, at PAMI.

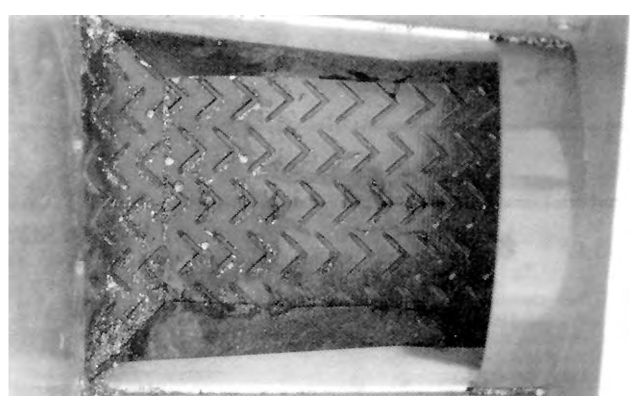
Description of Test Equipment

Steel Flighting Screw Conveyor Inlet: screw conveyor with steel flighting, 8 in (200 mm) diameter, 40 ft (12.2 m) long, with double flighting at inlet.

Bristle Flighting Screw Conveyor Inlet: 6 in (150 mm) steel flighting with 1 in (25 mm) nylon bristles on the edge, 8 in (200 mm) conveyor tube, 41 ft (12.5 m) long.



Paddle Conveyor Inlet: rubber paddles 8 in (200 mm) wide x 4 in (100 mm) high at 6 in (150 mm) intervals, continuous chain, square tube, 60 ft (18.3 m) long.



Belt Conveyor Inlet: 12 in (300 mm) wide belt, textured, continuous, 10 in (250 mm) diameter, 50 ft (15.2 m) long.

Suppliers of Conveying Equipment

The following is a listing of known conveying equipment suppliers for the prairie region.

Bristle Auger Conveyor

Manufacturer	Distributor
Sudenga Industries	Gaber Distributing Ltd. Box 850 Roblin, MB. R0L 1P0 (204) 937-2134
Unvederth Manufacturing Co.	Unvederth Manufacturing Co Box 357 Kalida, Ohio 45853 (419) 532-3121
Wachtman Agri Supply Inc.	Wachtman Agri Supply Box 12 Grelton, Ohio 43523 (419) 256-6725

Belt Conveyor

Manufacturer	Distributor
Speed King Industries Inc.	Ramboc Ent. Ltd. Box 96 Headingley, MB. R0H 0J0 (204) 837-1263
Behlen Industries	Behlen Industries Box 1120 Brandon, MB. R7A 6A4 (204) 728-1188
Commercial Welding	Commercial Welding Box 2008 Winkler, MB. R6W 4B7 (204) 325-4195

Paddle Conveyor

Manufacturer	Distributor
Farm King Allied	Farm King Allied Inc. Box 1450 Morden, MB. R0G 1J0 (204) 822-4467

Steel Auger Conveyor

Manufacturer	Distributor
Brandt Industries Ltd.	Brandt Industries Ltd. 705 Toronto St. Regina, SK. S4R 8G1 (306) 525-1314
Westfield Industries Ltd.	Westfield Industries Ltd. Box 39 Rosenort, MB. R0G 1W0 (204) 746-2396
Farm King Allied	Farm King Allied Inc. Box 1450 Morden, MB. R0G 1J0 (204) 822-4467
Power-Matic Industries Ltd.	Power-Matic Industries Ltd. Box 759 Morris, MB. (204) 746-2364
Sakundiak Farm Equipment	Sakundiak Farm Equipment Box 1996 Regina, SK. S4P 3E1 (306) 545-4044
Bergen Industries	Bergen Industries Box 133 Drake, SK. S0K 1H0 (306) 363-2131
Flexi-coil Limited	Flexi-coil Limited Box 1928 Saskatoon, SK. S7K 3S5 (306) 934-3500
Spray-Air Canada Ltd.	Spray-Air Canada Ltd. Box 188 Carseland, AB. T0J 0M0 (403) 934-3591

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