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Research Update

Does Soil Packing Matter?

An Evaluation of Opener Design and Packing Force Requirements on Wheat, Canola, and Field Pea

Choosing a direct seeding opener and packer might be easier if more were known about how opener design, packer shape, and on-row packing pressure influence crop emergence and grain yield in different conditions. The Prairie Agricultural Machinery Institute (PAMI), Agriculture and Agri-Food Canada, and Saskatchewan Wheat Pool recently completed a three-year field trial examining the interaction of these factors with seedling emergence and grain yield of wheat, canola, and field pea.

Openers and Packers

One of the advantages of no-till or direct seeding systems is that accumulated crop residues help to retain soil moisture. This aids seed germination, particularly in dry climates. However, some producers have expressed concern that packer wheel design and down pressure behind seed openers may have negative impacts on crop emergence and yields in this moist soil environment.

Field trials were conducted over three crop years -- 1997, 1998, and 1999 -- to gather information about the impact of packer design and operation in a variety of soil conditions. Three sites in Saskatchewan were selected, providing researchers with nine site-years of data. The sites were chosen for their range in soil texture: Sylvania (sandy loam), Watrous (silt loam), and Indian Head (heavy clay).

Five opener-packer combinations were tested:

- Bourgault spoon with a steel "V" packer (spoon/V packer),
- Bourgault spoon with a flat rubber packer (spoon/flat rubber),

- Morris paired-row with a steel "V" (paired/V packer),
- Morris paired-row with a flat rubber packer (paired/flat rubber)
- Sweep with a 15cm (6in) seed spread followed by a 15cm (6in) pneumatic tire (sweep/pneumatic tire).

Packing pressure was applied on each packer at 74, 124, 174 and 224 lb/wheel, and also at 0 lb/wheel or no packing wheel.

Crops seeded at each location were spring wheat (AC Barrie), canola (Innovator), and field pea (Carneval) and were direct seeded into existing crop residue. Fertilizers, inoculants, insecticides, and herbicides were applied as required.

At a Glance...

The good news in this study is that producers needn't be overly concerned about matching openers and packers to optimize response in different crops. In fact, the advantages observed were minor and would likely result in little economic significance to most farmers. Some degree of soil packing resulted in increased wheat yield.

Minimal packing was necessary for optimum crop establishment in the soil moisture conditions found while testing these openers in direct seeding systems.

Packing also improved stand establishment under dry conditions. Over-packing is a risk to crop emergence in wet soil conditions, though this was not reflected in the final grain yields in this study.

Three different packer types were tested with five different openers. Top: Steel 'V' shapped packer; Centre: Flat Rubber Packer; Bottom: Rubber Tire Packer.

Results: Wheat

Emergence

Crop emergence in wheat showed a definite response to packing and the opener-packer combinations evaluated in this study (Table 1). Some degree ofpacking almost always resulted in better crop emergence than no packing at all, however, there was no improvement in crop emergence as packing pressure was increased beyond 74 lb/wheel. The only exception to this was the sweep/pneumatic tire treatment, where emergence progressively improved with increasing packing pressure up to 174 lb/wheel (Figure 1).

The only instance where crop emergence was reduced with increasing packing pressure was on the heavy clay site in 1999. The combination of wet conditions and heavy clay soil resulted in over packing and reduced emergence at this site.

Weld

When all nine site-years of data are summarized, wheat yield response to packing was much less obvious than the improvement noted in crop emergence (Table 1). This indicates that the crop is capable of compensating for the variation in plant stand density. However, some amount of packing always resulted in a modest wheat yield response over the unpacked check for all opener/packer combinations (Figure 2).

In specific instances, four of the nine site-year situations exhibited a positive yield response to increased packing pressure over the unpacked check: the heavy clay in 1998 and 1999, and the sandy loam in 1997 and 1999. Increasing packing pressure above 74 lb/wheel showed no added benefit.

Table 1. *Emergence and yield results with various opener/packer/force combinations.*

	Wheat		Canola		Pea	
	Seedlings	Grain Yield	Seedlings	Grain Yield	Seedlings	Grain Yield
Packer (lbs force)						
0	173	39.8	93	26.3	59	39.8
74	194	41.9	91	26.7	59	40.3
124	195	42.2	91	27.0	59	40.2
174	194	42.2	90	26.7	60	40.2
224	190	41.9	85	26.9	60	39.6
Opener/Packer Combination						
Spoon + Steel V Packer	190	40.5	92	27.6	57	40.2
Spoon + Flat Rubber Packer	195	41.0	86	26.4	58	40.1
Paired Row + Steel V Packer	186	41.9	92	26.6	60	38.8
Paired Row + Flat Rubber Packer	190	41.1	94	26.5	59	38.8
Sweep + Tire	184	43.5	85	26.5	63	42.1

Figure 1. *Wheat seedling opener-packer by packer pressure response - mean for 9 site-years, 1997-1999.*

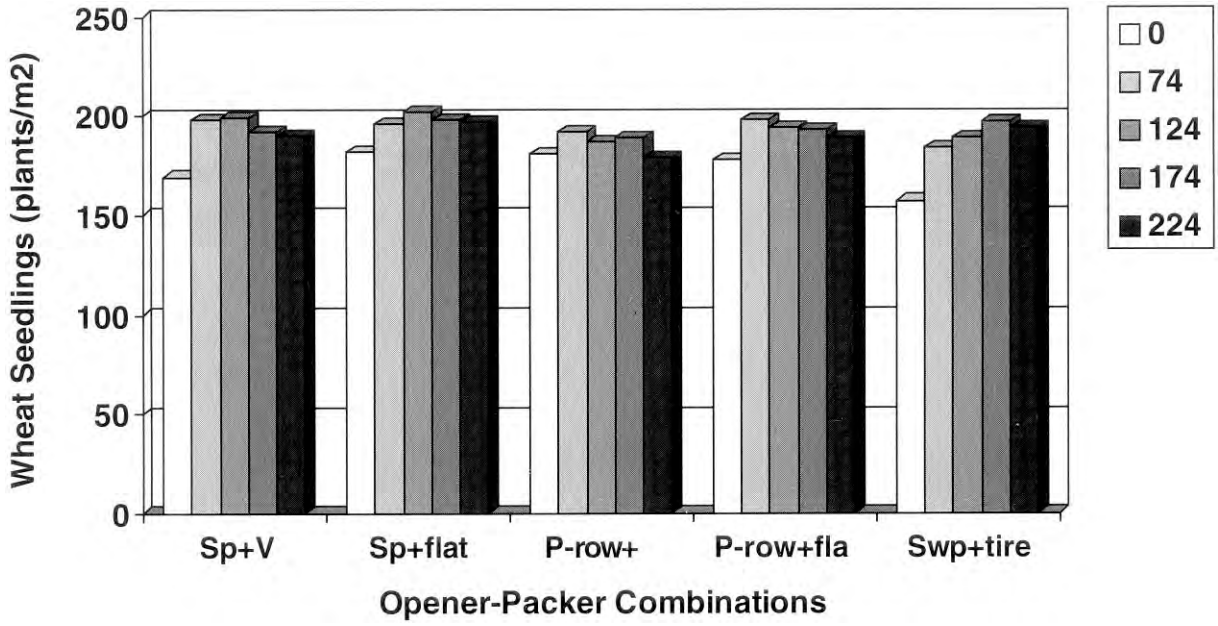
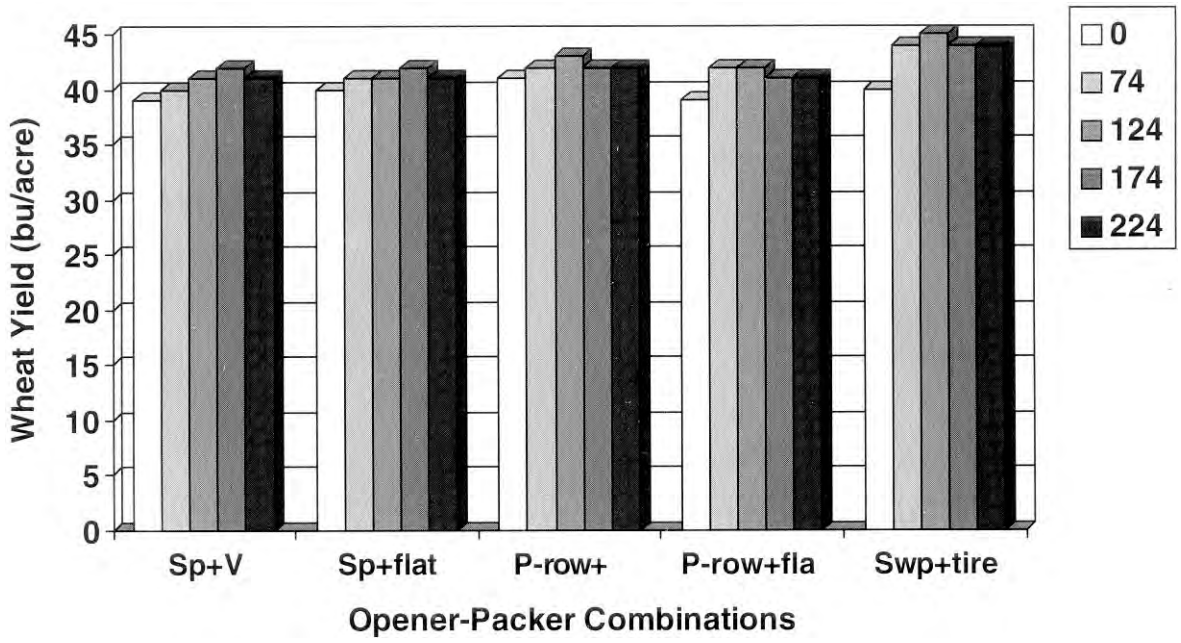


Figure 2*. Wheat grain yield opener-packer by packing pressure response - mean for 9 site-years, 1997-1999.*



Best Bet for Wheat

No single opener/packer combination was better suited than any other to all conditions sampled in this study.

For example, in heavy clay, the spoon/V packer or the spoon/flat packer were best for wheat emergence, while in the sandy loam, the sweep/pneumatic tire and paired-row opener provided better emergence. The spoon and paired row openers were superior to the sweep/pneumatic tire for seedling establishment on the silt-loam soil.

There was no relationship between grain yield and wheat seedling stand establishment response to opener type, with one exception (sandy loam, 1999). Except for a slight benefit to the sweep/pneumatic tire, yields were comparable across the board.

Figure 3. *Canola seedling opener-packer by packing pressure response - mean for 9 site-years, 1997-1999.*

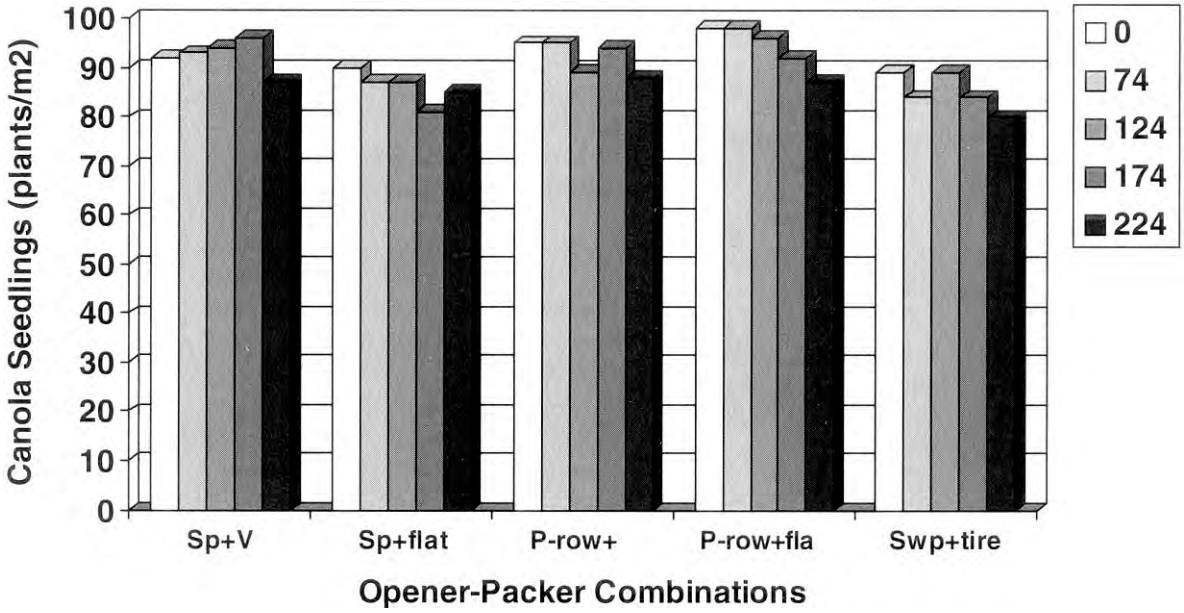
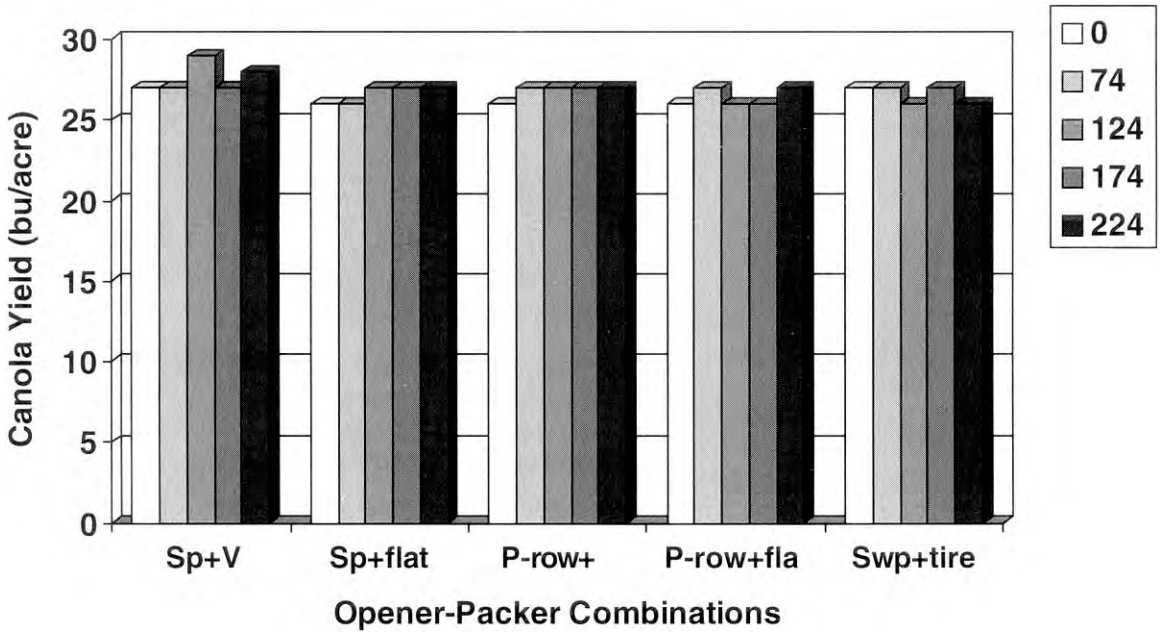


Figure 4. *Canola grain yield opener-packer by packing pressure response - mean for 9 site-years, 1997-1999.*



Results: Canola

Emergence

When all nine site-years of data were combined, only the spoon/V packer combination provided a positive response in crop emergence to increasing packing pressure; and it produced a negative response at the 224 lb/wheel pressure (Figure 3). All other opener-packer combinations showed a decline in canola seedling stand m although the reductions were small compared to no packing.

The most significant negative response to packing was observed in 1999 under wet field conditions.

Weld

Even though crop emergence was somewhat inhibited by packing, generally there was no difference in yield due to packing pressure or opener-packer combination (Table 1). This is likely due to the elastic nature of the canola plant, whereby branching and flowering allow it to compensate for poor plant establishment (Figure 4).

However, in one instance, (sandy loam, 1997) a significant positive response of canola yield to increasing packing pressure was recorded.

Best Bet for Canola

There does not seem to be one clear-cut opener/packer best choice for canola.

For example, on heavy clay, the narrow spoon opener provided superior plant stands in 1997 and 1998, but significantly poorer stands than the paired-row and sweep openers in the wet year, 1999. With regards to grain yield, only on the sandy loam did any specific trend emerge from the data. The V packer combined with both the spoon and paired-row openers provided a minor yield advantage over the fiat packers and the sweep/pneumatic tire.

Results: Field Pea

Emergence

In general, field pea showed the least response of the three crops to opener-packer combination and packing pressure (Table 1). Of the five opener/packer combinations, when the results from all nine site-years are considered together, only the sweep/pneumatic tire combination produced some positive response in seedling emergence by increasing packing pressure (Figure 5).

Weld

Although crop emergence showed some benefit to packing behind the sweep, this was not reflected in yield. Yields for the sweep/pneumatic tire combination were consistent regardless of the emergence response to packing (Figure 6). The elastic growth habit of peas resulted in the crop compensating for the minor differences in plant stand, similar to canola.

A negative crop emergence response to packing on heavy clay in 1998 was reflected in a negative response on grain yield. Conversely, a positive response to packing on emergence on the silt loam in 1997 was reflected in a positive grain yield response.

Best Bet for Peas

Summarized across all trials, the sweep/pneumatic tire resulted in the best plant stands for pea (Figure 5).

Overall, the sweep/pneumatic tire produced slightly higher grain yields, followed by the spoons and then the paired-row.

Summary

On average, across the 9 site-years in this study, minimal packing (74 lb/wheel) had a positive impact on the establishment and grain yield of spring wheat, with increasing packing pressure above 74 lb/wheel showing no additional benefit. Canola emergence was inhibited somewhat by packing, although this did not result in a decrease in yield.

For specific openers, field pea was the only crop to show an increase in crop emergence in response to packing with the sweep/pneumatic tire combination. The sweep/pneumatic tire produced a slight grain yield advantage for wheat and peas, while no difference was observed for canola. For peas, the spoon was on average slightly better than the paired-row opener for yield, however, the exact opposite was observed for wheat. Little or no difference in crop emergence was observed between the V and flat packers for the spoon and paired-row openers.

Under the wet field conditions in 1999, over-packing reduced the emergence of all crops at all locations, however, this did not reduce yields.

The elastic growth habit of both canola and pea resulted in little grain yield effect from variations in crop establishment due to opener or packer type or packing pressure.

Conclusions

Minimal packing is necessary for optimum crop establishment under the soil moisture conditions found with these openers in direct seeding systems.

Packing improved stand establishment under dry conditions, however, over-packing is a risk to crop emergence under wet soil conditions, although this was not reflected in final grain yields in this study.

The advantages observed in this field trial between the various opener-packer combinations were minor and likely of little agronomic or economic significance to most farmers.

Adjusting packer weights at a test site.

Figure 5. *Pea seedling opener-packer by packing pressure response - mean for 9 site-years, 1997-1999.*

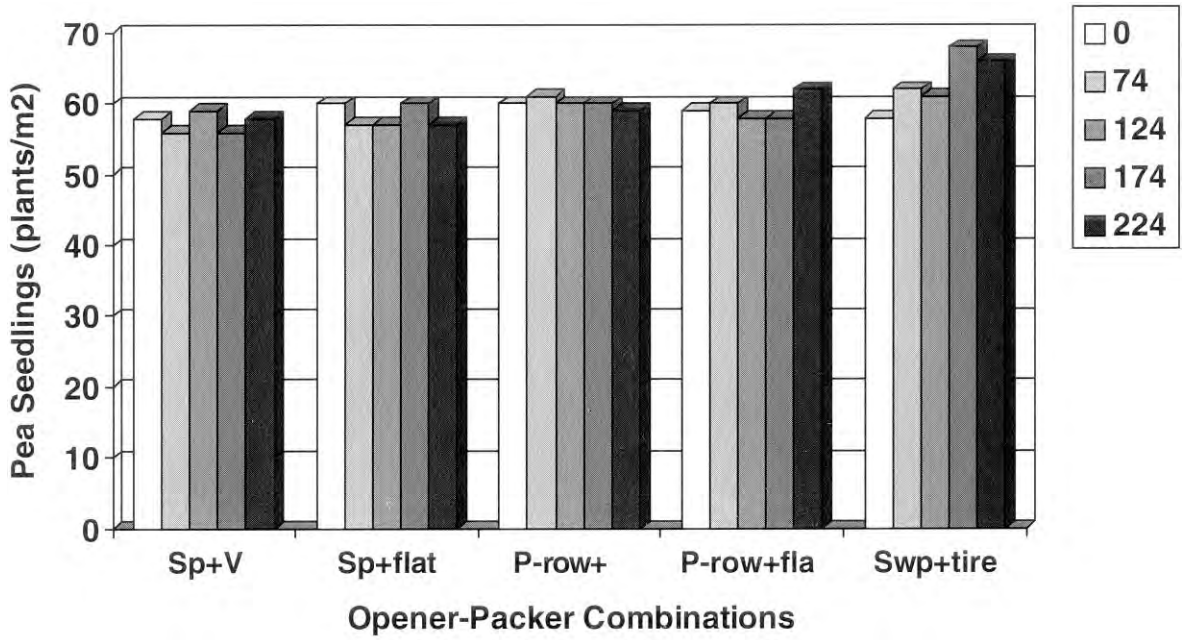
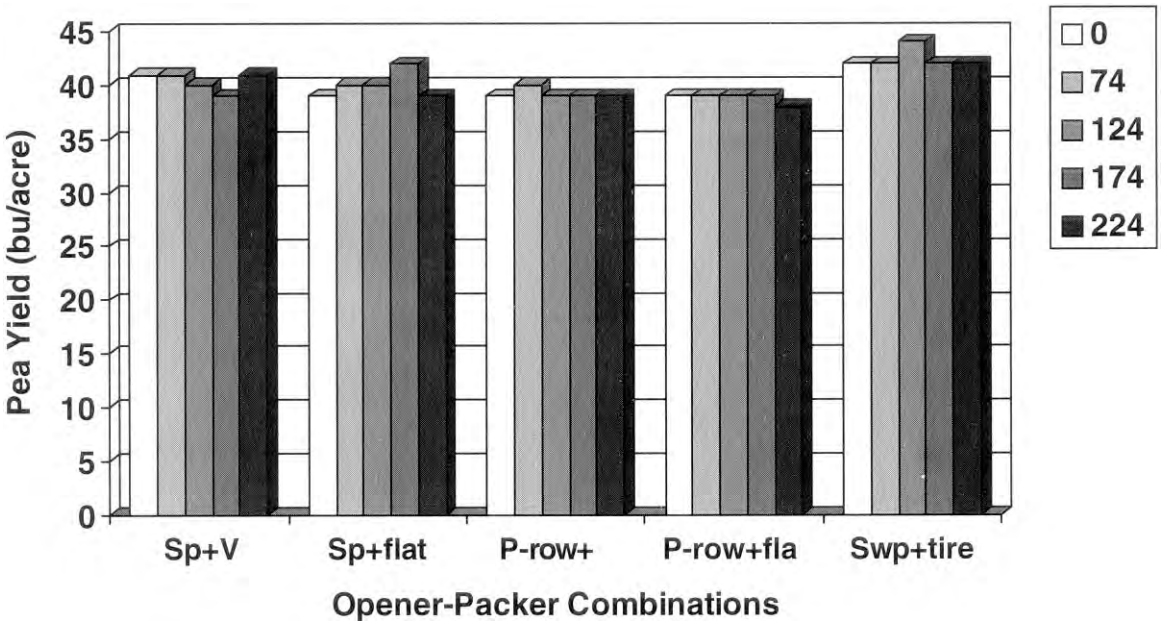


Figure 6. *Pea grain yield opener-packer by packing pressure response - mean for 9 site-years, 1997-1999.*



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