EVALUATION OF POWERED-ROD BASED PACKING SYSTEMS FOR AIR SEEDERS

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Introduction

A powered rod attachment for an air seeder has several potentially attractive features: 1) additional weed control at seeding, 2) levels seedbed, 3) may provide some packing, 4) may bring recently buried residue back to the surface.

Objective

Compare the performance of an air seeder using a harrow-packer drawbar packing system with that using several powered rod-based packing systems for seeding spring wheat into conventional summerfallow and directly into wheat stubble.

Methods

Preliminary evaluation was made in 1989 in cooperation with 7 producers within 10 miles of Swift Current, SK. The preliminary evaluation focused on 2- and 4-inch wide shank-mounted packers (Dutch Industries, Regina, SK). The test was expanded in 1990 to include large (0.1 acre) research plots at the Agriculture and Agri-Food Canada Swift Current Research Centre. Due to funding limitations, the evaluation continued at the Research Centre only for 1991-93. Soils ranged from loam to clay loam.

A 33-ft Morris air-seeder (Morris Industries, Yorkton, SK) was used at the cooperator sites while a 16-ft air seeder based on a Morris heavy duty cultivator with a modified granular herbicide applicator was used at the Research Centre. Both implements had a 16 inch sweep on a 12 inch shank spacing.

Seeding rate of spring wheat was 60 lb/ac on both stubble and fallow. Target seeding depth was 2 inches.

40 lb/ac of 11-55-0 was applied with the seed. 42 and 142 lb/ac of 34-0-0 were broadcast on fallow and stubble, respectively, before seeding.

Packing Systems

H HP Air seeder-mounted spring-tooth harrows followed by an operation with a spring tooth harrow and spiral coil packer on a single drawbar. Coil packers weighed 175 lb/ft. Seeded using a Morris broadcast seed boot which produced a 10 to 12 inch wide band.

PR Hydraulically powered rod (Victory Equipment, Lethbridge, AB) mounted behind air seeder turning at 100 rpm in the reverse direction to travel. The 1-inch diameter rod operated at approximately a 1.5 to 2 inch depth. Seeded using a broadcast seed boot.

PRHP Powered rod plus an operation with the harrow-packer drawbar.

PRRP Powered rod with rear-mounted gangs of 2-inch wide rubber-tired packers (Dutch Industries). Packers were 6 inches apart so they packed on the rows left by splitter seed boots (Victory Equipment). Gang mounting was shop-fabricated. Force on each packer was 35 lb.

PRVP Powered rod followed by rear-mounted gangs of 2-inch wide steel V-shaped packers (Victory Equipment). Packers were 6 inches apart so they packed on the seed rows left by spitter seed boots. Gang mounting was shop-fabricated. Force on each packer was 50 lb.

PRST Powered rod plus an operation with a "Stubble Treader" rotary harrow (New Noble Distributors, Nobleford, AB). Rotary harrow operated at 0^{o} angle and reverse to normal rotation to increase packing action. Seeded with a broadcast seed boot. Rotary harrows weighed 62 lb/ft.

Measurements

Soil erodibility was estimated from measured residue and soil aggregates using the method of Bisal and Ferguson (1970, Can. J. Soil Sci. 50:31-34).

Soil bulk density was determined from multiple measurements with undisturbed soil cores after seeding.

Seeding depth of emerged plants was determined from the chlorophyll-free coleoptile length.

Grain yield estimated from multiple square metre samples.

Results and Discussion

We rated soil moisture conditions at seeding as very good to excellent. Data for 1991 is not reported because heavy rain between seeding operations eliminated their comparative value. Growing season precipitation during May, June, and July was approximately 7 inches in 1990, 1992, and 1993 -- slightly above normal for the Brown soil zone.

Because of similar moisture conditions, wheat growth and packing system performance were similar in all years. Performance on cooperators' fields was similar to that at the Research Centre. We report data primarily from the Research Station as it gives a better idea of the variation between years and from place to place within one field.

In our preliminary test in 1989, we found that shank-mounted packers left a ridged seed bed which produced an uneven stand. We stopped evaluation of shank-mounted packers in favour of rear-mounted gangs of wheeled packers.

The harrow-packer drawbar left the soil in the most erodible condition (Figure 1). The powered rod alone and the rotary harrow left numerous large clods and buried little residue, thereby minimizing the wind erosion risk. The powered rod and trailing gang-mounted packer systems had less erosion risk than the harrow-packer drawbar because they left many large clods between packers and did not bury much surface residue.

Figure 1. Estimated wind speed at the soil surface before wind erosion starts. Lines above bars show the standard deviation.

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Soil bulk density is a measure of compaction (Figure 2). The powered rod (PR) and the powered rod plus rotary harrow (PRST) left the soil relatively loose over the seed (0-2 inch depth). The powered rod did not appear to provide any additional packing in the 2-4 inch depth compared to harrow-packer drawbar packing.

The on-row packing provided by the rear-mounted gang packers (PRRP and PRVP) gave the seedlings the shortest path to soil surface (Figure 3). However, the splitter boot produced a 2 to 3 inch wide seed row so the 2-inch packers did not always pack the entire row width. The depth from which seedlings must emerge with the harrow-packer drawbar is variable depending whether the seed is under or between surface indentations produced by the coil packer.

All packing systems provided a stand density sufficient to attain yield potential dictated by water and nutrient supply. Therefore, grain yields on either fallow or stubble were not significantly affected by the packing system (Figure 4). Experience on cooperators' fields in 1990 confirm on a range of soils that there was no yield response to the packing system.

We expect that packing system effects on yields would have been different had we experienced less favourable conditions. For example, the powered rod alone leaves the surface loose with many large clods. Emergence was sometimes delayed by several days because the seedlings had to grow around the clods. Such factors may reduce yields when the seedling is stressed by drought or when the delay allows weeds to emerge a few days before the crop.

High packing pressures are needed to crush the larger soil clods and pack the resulting finer soil over the seeds when the soil is relatively dry and hard. Based on our observations for stubble seeding, we believe none of the air-seeder packing systems evaluated had sufficient packing pressures for all possible seedbed conditions. In this regard, air drills, which can put more weight on rear packers, offer an important advantage over air seeders.

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Figure 2. The powered rod (RD) and the powered rod plus rotaty harrow (PRST) left the soil relatively uncompacted over the seed. Lines at the top of bars show standard deviation. Results for seeding on fallow shown.

Figure 3. The splitter seed boot with on-row packing (PRRP and PRVP) provided the seedlings with the shortest average path to sunlight. Lines at the top of bars show the observed range.

Figure 4. There were no significant differences in wheat yields among packing systems for either stubble or fallow. Lines at the top of bars show the standard deviation.

Conclusions

In our tests, shank-mounted packers produced an uneven plant stand due to soil ridging.

Of the packing systems evaluated, the harrow-packer drawbar left the soil most susceptible to wind erosion.

A seed splitter boot with rear-mounted gangs of packer wheels confined packing to the seed row which leaves much of the soil surface resistant to wind erosion. The cloddy condition between rows may reduce weed emergence.

A powered rod mounted behind the air seeder provided a level seedbed, good residue conservation, and good early weed control for crops which can be seeded at least 2 inches deep. Additional packing will generally be needed after the rod to crush the larger clods and firm the seedbed.

In our tests, the rotary harrow after a powered rod provided little packing.

In the years with good moisture that we experienced, spring wheat yields were unaffected by the packing system. For drier seedbed conditions, developing optimal packing systems for air seeders remains a challenge.

The mention of trade names is for informational purposes and does not constitute endorsement by either the authors or Agriculture and Agri-Food Canada.

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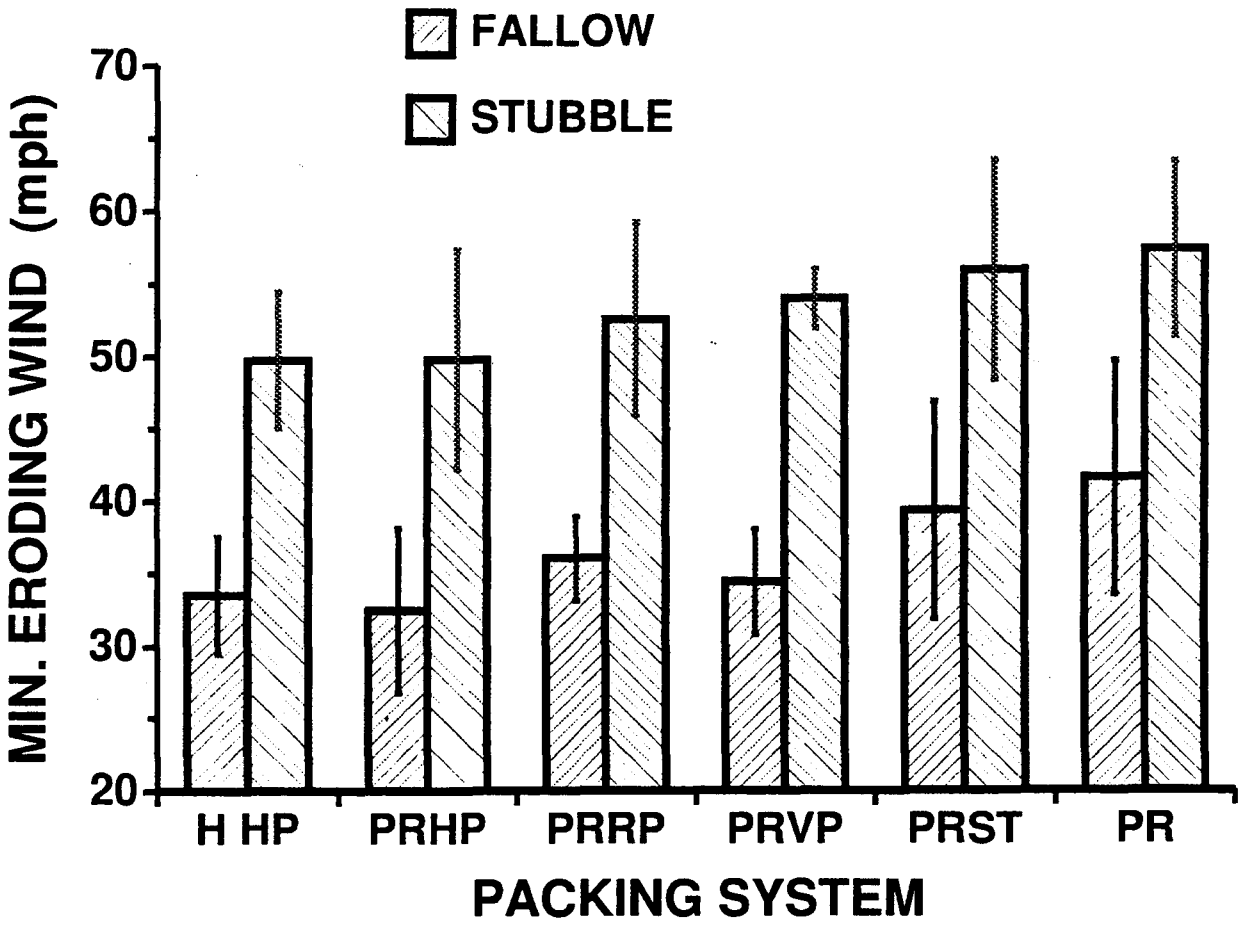

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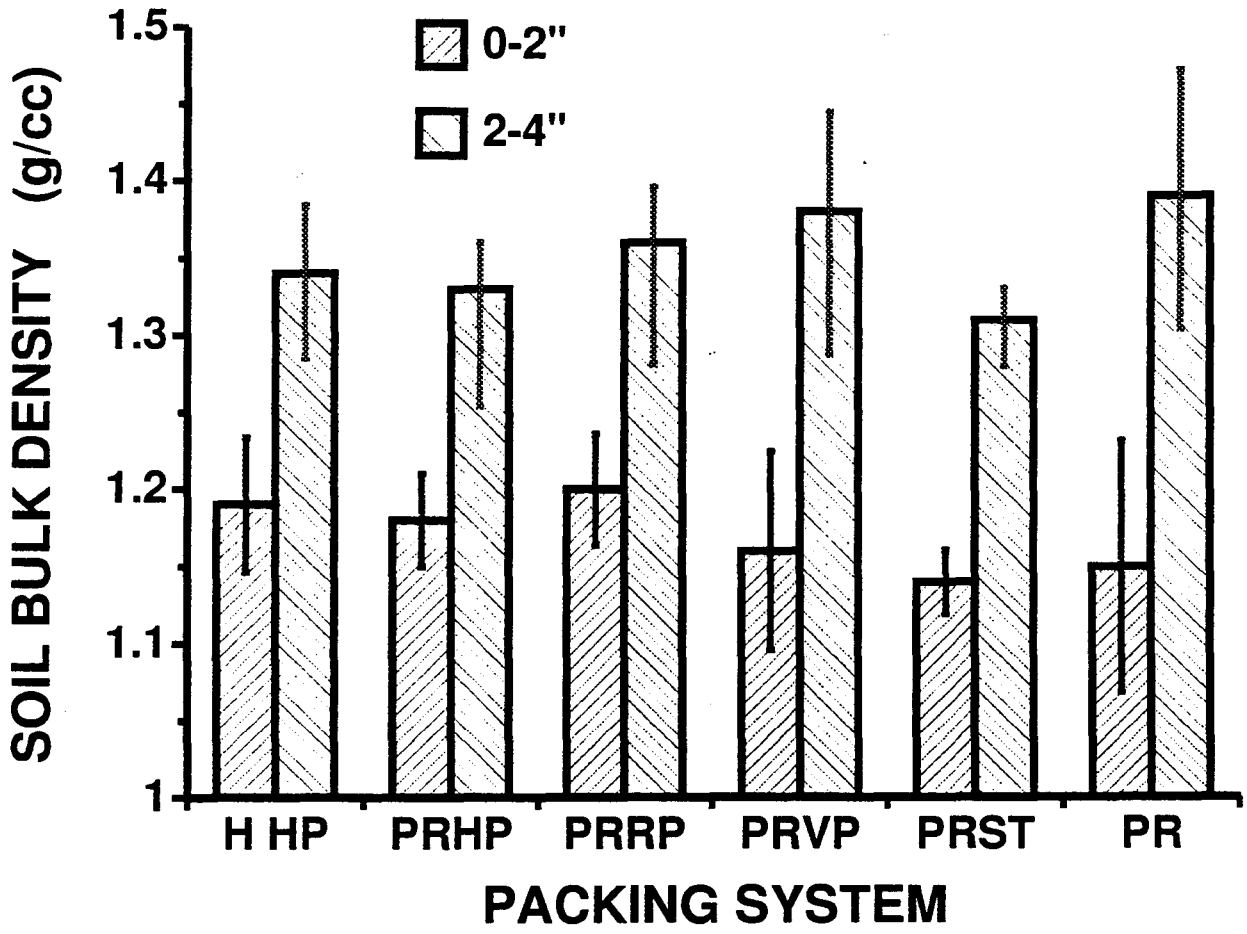

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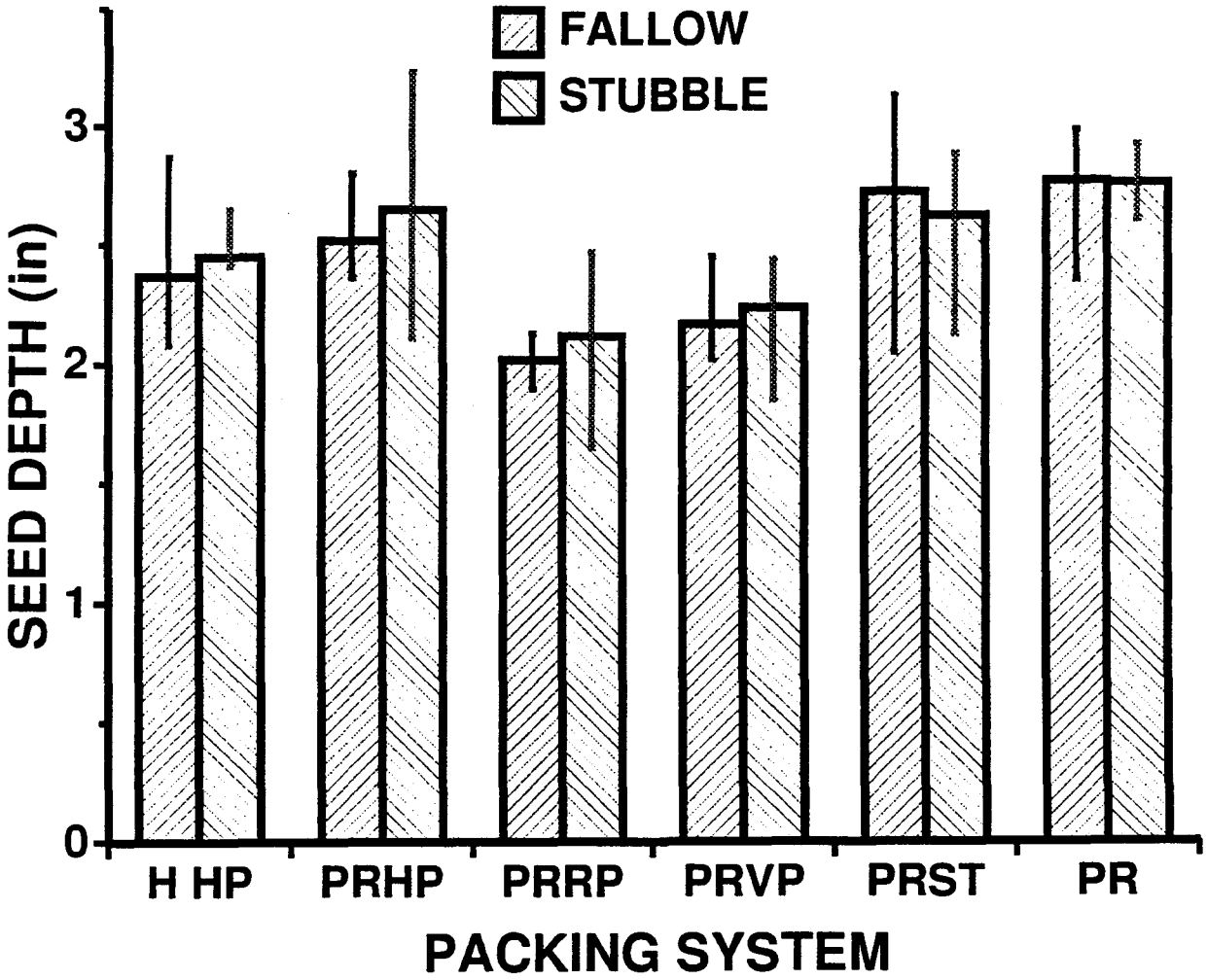

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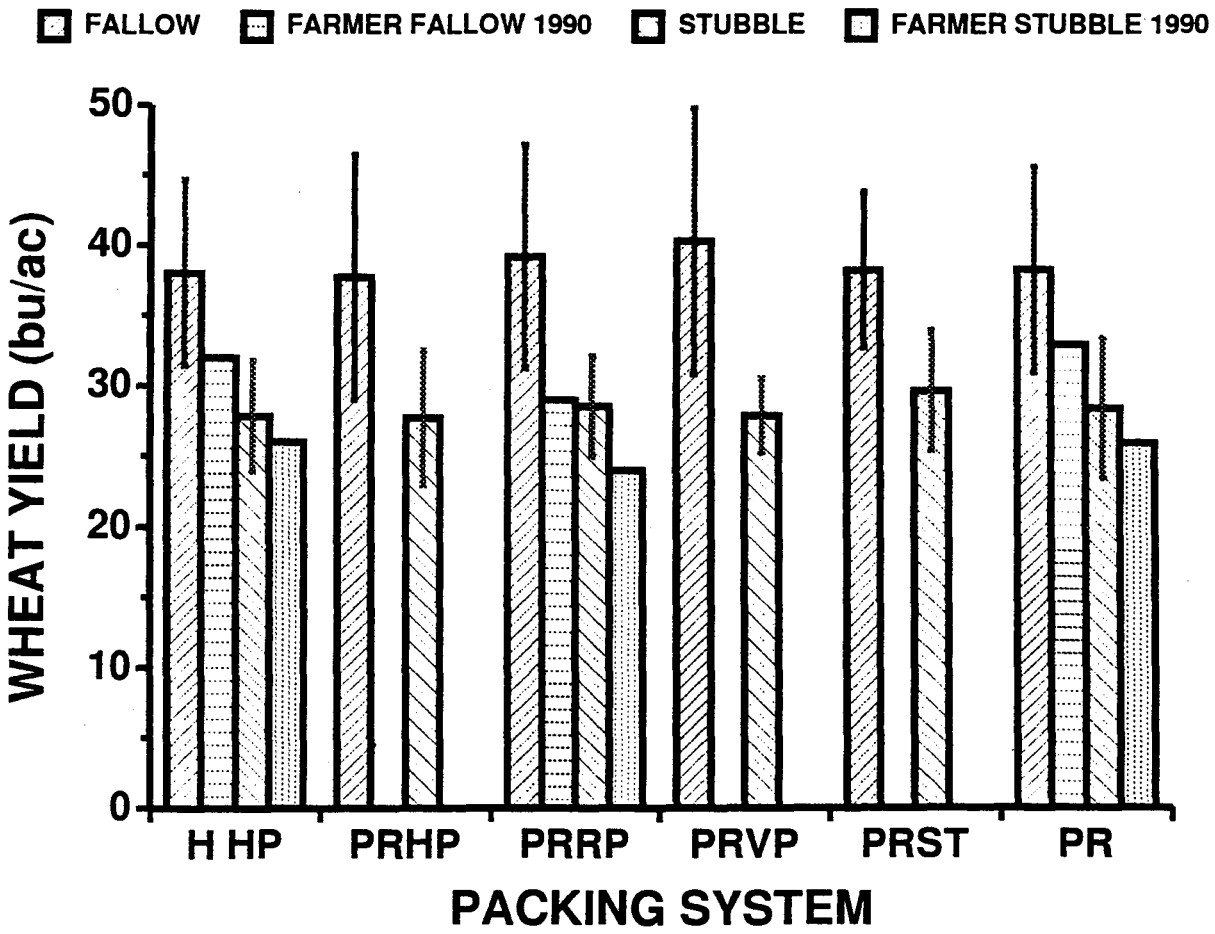

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