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DIRECT SEEDING WINTER CANOLA INTO WHEAT STUBBLE

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Introduction

Traditional Pacific Northwest (PNW) dryland farming systems continue to degrade soil through erosion and loss of soil organic carbon (SOC). Long-term field experiments with various crop rotations and tillage practices at the Research Center near Pendleton, Oregon, show that SOC has continually declined in traditional winter wheat-fallow production systems (Rasmussen and Parton, 1994). Intensive tillage coupled with fallow promotes rapid oxidation of SOC and leaves the land vulnerable to soil erosion. Reduced tillage and elimination of fallow offer possible solutions to degradation of PNW soil. An option for maintaining SOC and reducing soil erosion is to rotate broadleaf crops with wheat in an annual cropping system.

Canola (*Brassica napus*) is a broadleaf plant that has potential as an alternate crop with cereals in the Columbia Plateau. Fall-seeded canola is preferred because the yield is typically twice the yield of spring canola in eastern Oregon (Wysocki et al., 1992). Stand establishment of fall seeded canola after wheat in annual cropping systems is a major challenge. Shallow seed placement (1/2–1 in. deep) with adequate soil moisture (1 bar) is desirable for optimum seedling emergence (Wysocki et al., 1992; Brotemarkle, 1989). Good seed germination and emergence is especially difficult to obtain because seedbed soil water is typically marginal and direct seeding into wheat residue is difficult. Wheat depletes the soil profile of available water. Water content of the seedbed is likely to be marginal for early fall seeding because the 68-yr average September precipitation at the Pendleton Research Center is less than 0.75 in. Seed placement with good seed-to-soil contact is difficult when directly seeding into cereal stubble. Drills with disc openers tuck wheat residue into the seed furrow, and hoe-type openers tend to plug with crop residue.

The objective of this research was to evaluate adjustments of direct-seeding equipment and to evaluate options for residue management to improve stand establishment of fall-seeded canola.

Methods

A replicated factorial field experiment with two levels of four factors was conducted using a Conserva Pak model CP1212A[1] no-till drill to evaluate wheat residue management and seed placement on stand establishment of canola. Factors included flailing and not flailing wheat stubble before seeding, seeding depth of 0.75 and 1.5 in., with and without coulters in front of the seed openers, and 2 and 4 in. depth of soil disturbance in front of the seed opener. The coulters were smooth, 18.5 in. diameter, and mounted on a single gang at the front of the drill. This drill had fertilizer shanks that normally were set to place fertilizer to the side and below the seed. For these studies, the fertilizer shanks were used to loosen the soil ahead of the seed openers and to move residue away from the seed furrow. These shanks were adjusted to

[1] Reference to a company name or trade name is for specific information only and does not imply approval or recommendation of a product by the USDA to the exclusion of others that may be suitable.

disturb soil 2 or 4 in. deep, and no fertilizer was applied at seeding time.

The experiment was conducted at the Pendleton Research Center in fall, 1998. Soil was a well-drained Walla Walla silt loam. Spring wheat was grown in the experimental area in 1998. About 4,300 lb/acre of crop residue in the form of standing stubble (8 to 10 in.), chaff, and raw straw were on the soil surface. Erica canola was seeded at the rate of 10 lb/acre on September 11, 1998. Three-foot-long emergence observation sites were established for individual rows in three locations for each plot. The number of emerged seedlings per foot of row was evaluated on September 24 , 28, and October 16. Gravimetric soil-water content measurements were taken with an incremental sampler (Pikul et al., 1979) on September 30 in the seed zone in 0.8-in. increments from the surface to 3 inches in two treatments. These two treatments were: 1) no coulter, 0.75-in. seeding depth, 2-in. soil disturbance in the seed furrow and stubble not flailed and 2) coulter, 1.5-in. seeding depth, 4-in. soil disturbance in the seed furrow and stubble flailed. These two treatments represented the extremes of soil disturbance in the seed furrow. Seed depth was measured by carefully excavating soil until seeds were exposed and then measuring from the soil surface to the seeds.

Results and Discussion

It was hot and dry following seeding on September 11 (Fig. 1). The average maximum air temperature was 90 °F for the first 7 d following seeding, and there was only a trace of precipitation. The pan evaporation averaged 0.3 in. per day. A light rain 3 d before seeding produced 0.4 in. precipitation, but total precipitation (including the 0.4 in.) was less than 0.5 in. from wheat harvested in July until canola was seeded. The amount of soil water was marginal for stand establishment. Precipitation totaled 0.82 in. during the remainder of September, when the seed was germinating and seedlings were emerging.

The mean soil-water contents on September 30 are shown in Table 1.

Table 1. Soil-water content in canola seed zone, Pendleton Research Center, September 30, 1998.

Depth	Soil water content
---in.---	% dry basis
0.0 - 0.8	8.2 A†
0.8 - 1.6	12.1 B
1.6 - 2.4	11.3 B
2.4 - 3.2	9.5 A

† Numbers within a column followed by the same letter are not significantly different as determined by the LSD test ($P \leq 0.05$).

There was not a significant difference (F test with $P \leq 0.05$) in soil-water content between the two treatments, but soil-water content varied with depth (Table 1). Soil water content was significantly lower in the surface increment (0 to 0.8 in.) and from 2.4 to 3.2 in. as compared to the middle increments. The highest soil-water content was 12 percent, well below the optimum soil water content of 15 percent (1 bar) for germination and emergence of canola. The hot, dry conditions following seeding created a very stressful condition for developing canola seedlings.

In spite of the harsh seedbed conditions, some treatments produced good stands (Figs. 2–5). Coulters, flailing residue, soil disturbance in the seed furrow, and seeding depth all influenced seedling emergence. Emergence was first observed on September 24. Coulters (Fig. 2), flailed stubble (Fig. 3), low soil disturbance in the seed furrow (Fig. 4), and shallow seeding

(Fig. 5) produced significantly higher (F test with $P \preceq 0.05$) stands for the observations taken on September 24 and 28 as compared to no coulters, not flailing, high soil disturbance in the seed furrow, and deep seeding. The final stand observations, taken on October 16, showed that only soil disturbance in the seed furrow and seeding depth had significantly (F test with $P \preceq 0.05$) influenced final stand establishment.

Because canola stand establishment is sensitive to seed depth, measurements were taken to determine if coulters, flailed residue and soil disturbance in the seed furrow impacted seed- placement depth. Seed depth was highly influenced by seed-furrow soil disturbance and seeding depth (Table 2). Using coulters or flailing stubble did not affect the depth of seed placement. Figure 6 shows the relationship between seed depth and plant stand established on September 28. Seeds that were placed less than one inch deep emerged rapidly, seeding 1 to 2 in. deep suppressed emergence, and seeds deeper than 2 inches failed to emerge. The seeder tended to place seeds deeper with increased soil disturbance in the seed furrow. This effect could be compensated for by manually adjusting the seeding depth. For these tests, the same drill seeding depth settings were used for all treatments.

Conclusions

Adequate stands of canola were established with a hoe-type drill seeding into a nontilled dry wheat stubble field, with marginal soil water for germination and emergence. Coulters in front of seed improve the final stand established. Seeding Openers and flailing the stubble did not less than an inch deep was necessary for maximum stand establishment. Factors that influenced seed depth were important to stand establishment. Drill-seed depth setting and soil disturbance in the seed furrow were critical drill adjustments that influenced seed depth.

Acknowledgements

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Table 2. Influence of coulters, stubble management, seeding depth, and soil disturbance in seed furrow on depth of seed placement and stand establishment of Erica canola, Pendleton Research Center, September 1998.

Treatment					
Coulter	Stubble flailed	Seeding depth	Soil disturbance	Seed depth†	Stand‡
		----------------- in. -----------------			Plants/ft^2
Yes	Yes	0.75	2	0.75	17.0
No	No	0.75	2	0.75	11.0
Yes	No	1.5	2	1.2	9.4
No	Yes	1.5	2	1.3	7.0
Yes	No	0.75	4	1.2	0.7
No	No	1.5	4	2.3	0.1
Yes	Yes	1.5	4	2.4	0.0

† Seed depth measurements taken in block 2 on Sept. 29, 1998.

‡ Mean stand observations taken on Sept. 28, 1998.

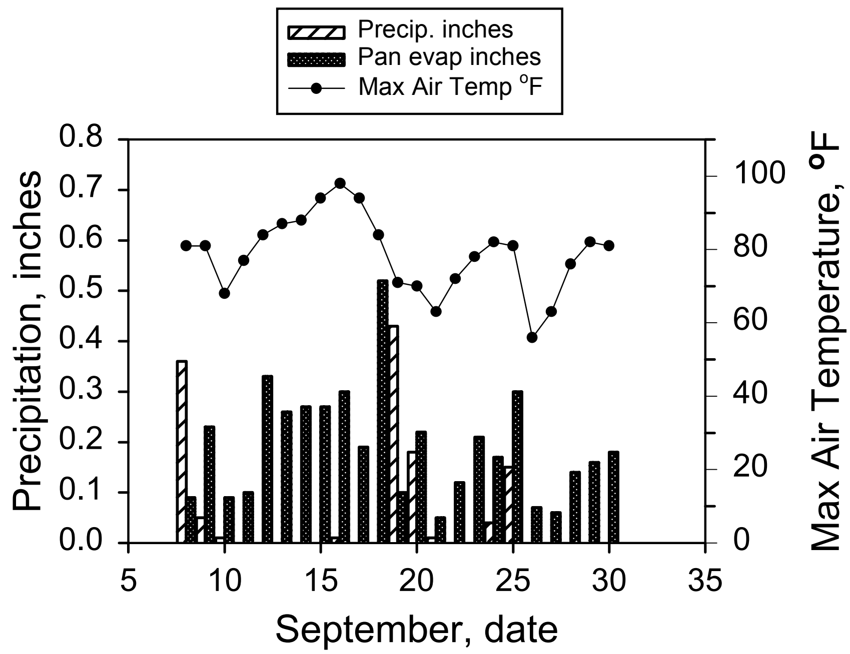

Figure 1. Precipitation, pan evaporation, and maximum air temperature, Pendleton Research Center, September 1998.

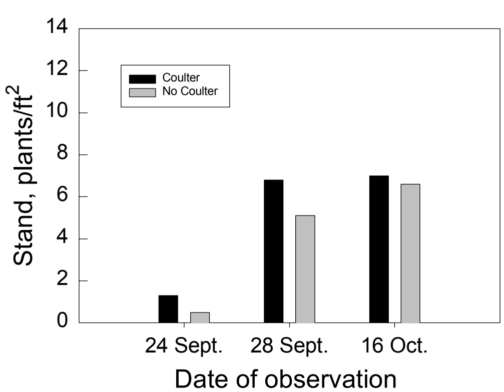

Figure 2. Effect of coulters in front of furrow openers on canola stand establishment, Pendleton Research Center, fall 1998.

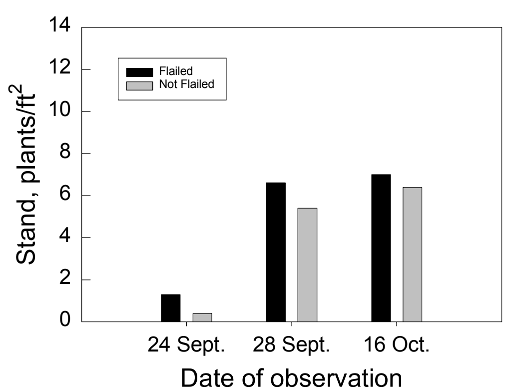

Figure 3. Effect of flailing wheat residue before seeding on canola stand establishment, Pendleton Research Center, fall 1998.

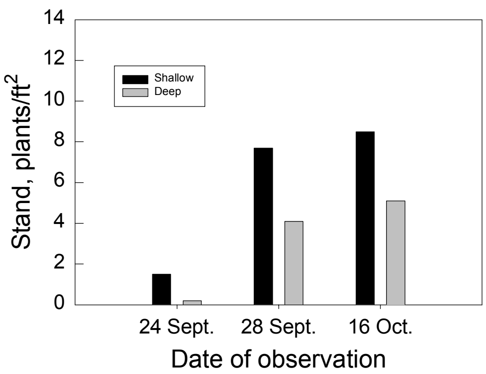

Figure 4. Effect of depth of soil disturbance in the seed furrow on canola stand establishment, Pendleton Research Center, fall 1998

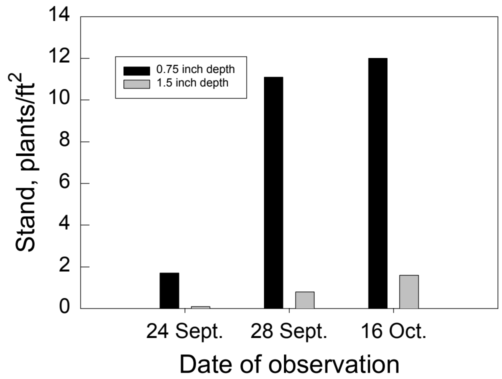

Figure 5. Effect of seeding depth (0.75 and 1.5 in. for shallow and deep seeding, respectively) on canola stand establishment, Pendleton Research Center, fall of 1998.

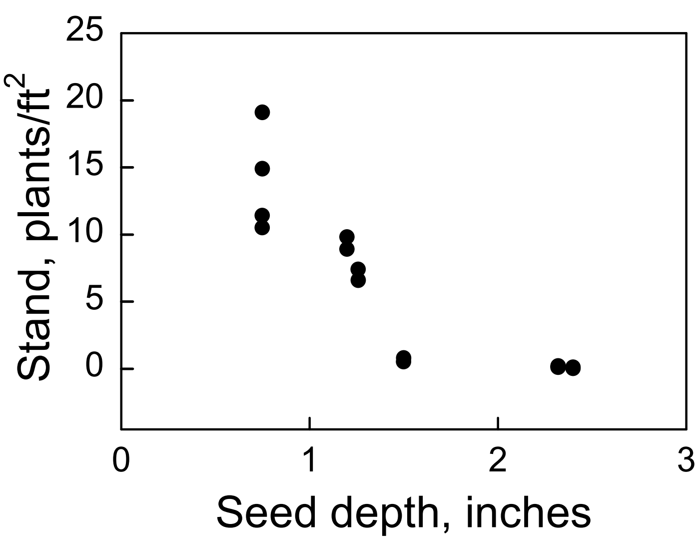

Figure 6. Effect of seed depth on canola emergence, Pendleton Research Center, September 1998.