



VALUE OF A ONE-TIME SWEEP APPLICATION IN MANAGING NO-TILL FALLOW

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Abstract

Farmers across the intermediate rainfall (12–16 inches of annual precipitation) cropping region of eastern Washington traditionally use a tillage-based summer fallow-winter wheat (*Triticum aestivum* L.) system in their crop rotation. By adopting conservation tillage, farmers have increased implementation of no-till (i.e., chemical herbicide) summer fallow systems to reduce erosion and increase profitability. However, they have expressed concerns regarding adequate seed zone soil moisture for fall seeding of winter wheat and consistent control of tough weeds during the fallow period. The main objective with this research project was to examine the value of a one-time “sweep” cultivation to improve seed zone moisture and kill weeds that can be troublesome with a cost-effective herbicide application (traditionally multiple glyphosate applications) compared to a true no-till fallow (NTF) system. An on-farm trial (OFT) established over four years examined the impact of a single sweep cultivator operation in fallow on seed zone soil moisture, yield, and grain quality. Weed data were not collected, but visual observations were made. The treatments were NTF and a sweep operation (Sweep) replacing the second of three herbicide applications in the NTF system. The OFT was a randomized complete block design with four replications. The Sweep did not affect seed zone moisture, grain yield, or test weight. Grain protein was less following the sweep application but did not affect the market value of the crop. The sweep, as anticipated, was an adequate weed control operation. In conclusion, the Sweep did not increase seed zone moisture, but was effective in removing weeds that can be difficult to control with glyphosate.

Background

Farmers across the intermediate rainfall (12–16 inches of annual precipitation) cropping region of eastern Washington traditionally use a tillage-based summer fallow-winter wheat (*Triticum aestivum* L.) system in their crop rotation. Tillage-based summer fallow is the process of breaking capillary action and creating an insulating dust mulch on the soil surface to preserve seed zone moisture needed to consistently establish winter wheat early. Blowing dust (Figure 1) from excessively tilled fields leads to repeated soil losses and reduced air quality (Papendick 1998).

Despite its identified advantages, conservation tillage fallow is not widely used in eastern Washington (Janosky et al. 2002). Wheat farmers generally do not practice no-till (i.e., chemical



Figure 1. Wind erosion may be created with excessive tillage in traditional summer fallow systems.

herbicide) summer fallow because of increased evaporative loss of seed zone soil moisture during the dry summer months compared to tillage fallow (Zaikin et al. 2007). Our objective was to examine the value of a one-time “sweep” cultivation to improve seed zone moisture and kill weeds that can be troublesome (Figure 2) with multiple applications of primarily glyphosate herbicide application compared to a true NTF system. This practice is also designed to minimize or delay the development of weed biotypes resistant to herbicides, for example, glyphosate, which is currently the most widely used herbicide for fallow management.



Figure 2. Prickly lettuce (*Lactuca serriola* L.) is one of the species of “hard to kill” weeds in a NTF systems that the cooperators are having difficulty controlling with glyphosate herbicide. This plant is showing glyphosate damage but will continue to grow and produce seed if not controlled.

Methods

An OFT 5 miles north of Almira, WA was carried out over four crop years to examine the impact of a single sweep cultivator operation in fallow on seed zone soil moisture, yield, and grain quality (Figure 3). Weed data were not collected but visual observations were made. All treatments were harrowed in early spring for residue management. The treatments were NTF and Sweep replacing the second of three glyphosate herbicide applications in the NTF system (Figure 4).

During the last two years of the OFT a third “early” sweep treatment was incorporated into the study to evaluate the timing of the sweep application (Table 1).



Figure 3. A 10-inch sweep on an 8-inch shank spacing was run two inches deep to sever weeds not fully controlled by glyphosate application.



Figure 4. The OFT was a randomized complete block design with four replications each of the four years. Plot size was 43 feet wide and at least 600 feet long each year. The study site was harrowed each spring to help with residue management.

Table 1. Timing of sweep application, seeding date, and harvest date of a series of large OFTs carried out over four years at an OFT north of Almira, WA.

Year	Sweep Date	Seeding Date	Harvest Date
1	July 11, 2005	Sept. 10, 2005	Aug. 17, 2006
2	July 15, 2006	Sept. 8, 2006	July 31, 2007
3	July 2, 2007 (early) July 16, 2007	Sept. 10, 2007	Aug. 8, 2008
4	July 1, 2008 (early) July 15, 2008	Sept. 13, 2008	Aug. 21, 2009

The sweep was 10 inches wide on a FlexiCoil cultivator frame with an 8-inch shank spacing. It was run shallow (2 inches) to sever weed stems from their roots and stop the capillary process in the soil to reduce evaporation of seed zone moisture (Figure 5a). Both treatments were seeded to winter wheat with a ConservaPak direct seed drill (Figure 5b). The plots were harvested with the cooperators’ combine (Figure 5c). Cultivars, seed rate, and fertility varied between years but remained constant between treatments. The OFT was a randomized complete block design with four replications each year.



Figure 5. The cooperators establishing the sweep treatments (a), seeding the OFT with a ConservaPak no-till drill (b), and harvesting the plots (c).

Results

No differences in seed zone soil moisture (data not presented), yield, test weight, or protein were detected between the “early” sweep treatment and the traditional sweep treatment over the last two years (Table 2).

Table 2. Average grain yield, test weight, and protein from an OFT examining an “early” sweep vs. the traditional sweep operation during the fallow period north of Almira, WA between 2008–2009.

Treatments	Yield (bu/ac)	Test Weight (lb/bu)	Grain Protein (%)
“Early” Sweep	77.3	59.3	9.9
Sweep	77.4	59.2	9.9
Level of Significance	n.s. [†]	n.s.	n.s.

[†]n.s. is no significant difference between treatments.

Gravimetric seed zone soil moisture was collected in 2005 through 2008; however, results in 2006 and 2007 were compromised and not included in analysis. Samples were taken in 4-inch increments down to a depth of 12 inches. Overall seed zone soil moisture was not significantly different between fallow treatments and averaged 1.42 in/ft (Figure 6).

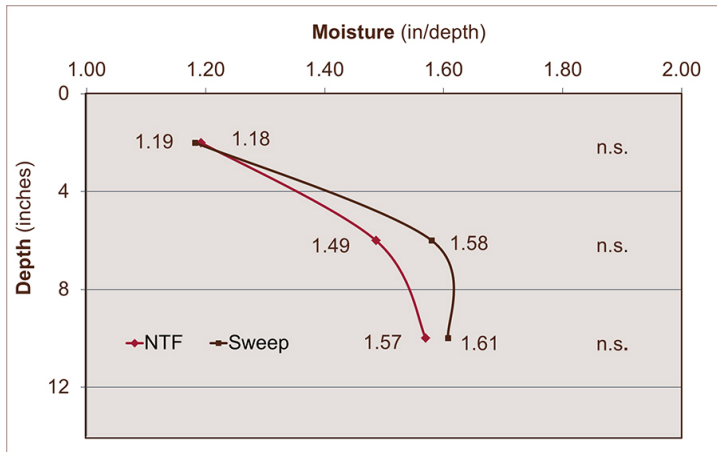


Figure 6. Seed zone soil moisture between NTF and Sweep prior to seeding in a series of OFT north of Almira, WA. Data is an average of 2005 and 2008 only as 2006 and 2007 data were compromised.

Although grain yields were different between years, there were no differences between treatments within any year. Averaged across all years, grain yield was 81 bu/ac (Figure 7). Grain test weight averaged 58.9 lb/bu and was not different between fallow treatments (Table 3). Grain protein with the NTF treatment averaged 9.8% and was significantly greater than the sweep treatment which averaged 9.4%; however, both treatments were within market acceptance. No weeds were observed in the Sweep treatment, and in each of the 4 years, no further tillage or herbicide was applied prior to seeding. In the NTF treatment, small severely injured weeds could be

observed and subsequent herbicide application may have been applied prior to seeding.

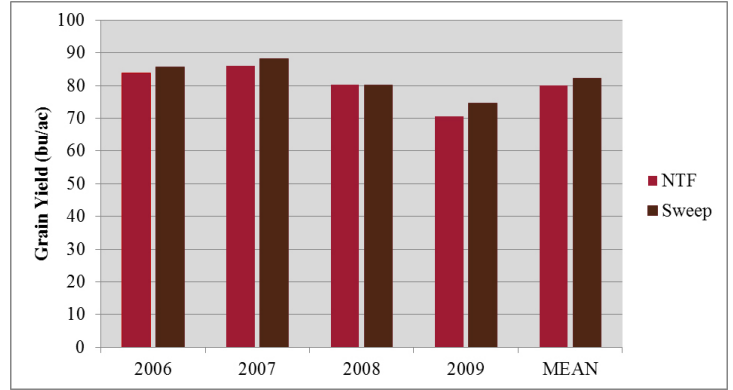


Figure 7. Average grain yield from an OFT examining winter wheat produced under NTF and Sweep during the fallow period north of Almira, WA between 2006–2009.

Table 3. Average grain test weight and protein from an OFT examining winter wheat produced under NTF and Sweep during the fallow period north of Almira, WA between 2006–2009.

Treatments	Test Weight (lb/bu)	Grain Protein (%)
NTF	58.9	9.8
Sweep	59.0	9.4
Level of Significance	n.s. [†]	0.05

[†]n.s. is no significant difference between treatments.



Figure 8. In conclusion, a single Sweep in fallow did not impact grain yield or test weight (a), but did remove difficult to control weeds (b).

Conclusions

The Sweep did not increase or decrease seed zone moisture or grain yield (Figure 8a) but was effective in removing weeds (Figure 8b) that can be difficult to control with multiple applications of primarily glyphosate herbicide application. It may be a valuable tool to help reduce the potential for herbicide-resistant weeds and maintain a conservation farming system.

Acknowledgements

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Use pesticides with care. Apply them only to plants, animals, or sites as listed on the label. When mixing and applying pesticides, follow all label precautions to protect yourself and others around you. It is a violation of the law to disregard label directions. If pesticides are spilled on skin or clothing, remove clothing and wash skin thoroughly. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

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