Influence of Tillage and Herbicides in Onion

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Objectives

The main objective of this research was to evaluate the potential for strip-tillage in onion production and to understand the influence of strip-tillage on factors such as weed seed germination, soil moisture content, soil temperature, and erosion control. In addition, the effect of strip-tillage on herbicide efficacy in onion prior to the two-leaf growth stage was evaluated.

Materials and Methods

A field experiment was conducted during the 2007 and 2008 field seasons at the North Dakota State University Oakes Irrigation Research Site near Oakes, North Dakota, on an Embden loam soil. The experiment was set up as 2X4 factorial in 2007 and a strip plot with herbicide as the whole plot and tillage as the subplot in 2008. The whole plot consisted of strip-tillage or conventional tillage; the subplots consisted of herbicide treatments. The strips were made fall 2006 and 2008 and again in the spring right before planting, using a shank type unit; the conventional tillage treatment was Roto-tilled twice in the fall and again before planting. Onion cultivar Teton was planted April 20, 2007, and April 23, 2008, in double rows at a rate of 250,000 and 285,000 seeds per acre, respectively. Plots were 6 feet wide and 17 feet long with 3 foot alleyways between each replicate.

Herbicides included DCPA (Dacthal), pendimethalin (Prowl H20), oxyfluorfen (Goaltender), and bromoxynil (Buctril). DCPA and pendimethalin were applied as pre-emergence herbicides on April 30, 2007, and May 1, 2008; post-emergence applications with reduced rates of oxyfluorfen or bromoxynil (micro-rates) were made at four weekly intervals starting when annual broadleaf weeds reached the cotyledon to first true-leaf stage. The first application was made on May 16, 2007 and 2008. Pre-emerge applications were applied at 10 lbs./acre and 1.5 pt/acre for DCPA and pendimethalin, respectively. Micro-rate applications were applied at 2 oz/acre and 4 oz/acre for oxyfluorfen and bromoxynil, respectively. The entire experiment received a post-emergence application of clethodim (Select) after the onions had reached the two-leaf growth stage and an application of dimethenamid-P (Outlook) when onions were at the five-leaf stage to help minimize late-season weeds. Best management practices were used for fertility, irrigation, disease, and insect control throughout the entire experiment.

Herbicide effectiveness was evaluated through weed counts using a square foot area in the center of each plot. Visual ratings were taken seven days after the fourth micro-rate application to also evaluate weed control; a scale of 0-100 percent control was used where 0 equals no control and 100 equals complete control. Annual broadleaf weeds of most concern were common lambsquarters, redroot pigweed, and hairy nightshade. Weed counts were taken seven days after each herbicide micro-rate application.

Plots were hand harvested on September 4, 2007, and September 24, 2008. Onion bulbs were graded into four classes according to USDA standards: small (1-2 ¼ inches), medium (2 ¼-3 inches), large (3-4 inches) and colossal (4+ inches). Total marketable yield included grades medium and large.

Results

Micro-rate herbicide applications made prior to the two-leaf growth stage did not injure onions during establishment in either 2007 or 2008 field seasons (data not shown).

During the 2007 field season, tillage had an effect on the germination of common lambsquarters and redroot pigweed. There were significantly more weed seedlings in the conventionally tilled treatments than the strip-tilled treatments. Hairy nightshade was significantly reduced with the weekly applications of herbicide. Common lambsquarters weed seedlings were significantly greater in the pendimethalin

treatment. Redroot pigweed and hairy nightshade were best controlled with micro-rate applications of oxyfluorfen and bromoxynil (data not shown).

During the 2008 field season, there was little to no redroot pigweed pressure in all treatments. Common lambsquarters and hairy nightshade weed pressure was significantly reduced with the weekly applications of herbicides (Figures 1-4). DCPA had significantly greater hairy nightshade weed pressure than the other three herbicides (Figures 1 and 2). Results of 2008 showed no significant differences in tillage on weed seed germination (Figures 1-4).

In 2007 and 2008, onion yield grade did vary between tillage system and herbicide but generally was only numerically higher with the strip tillage and herbicide treatment for the various onion grades. Results of 2007 indicated a significant increase in onions graded between 3- and 4-inch diameters within the strip-tilled treatments (Table 1).

Conclusions

Yield data indicated that strip tillage has the potential to yield significantly the same as conventional tillage. With the added savings of a strip-tilled system, it may be more economical to utilize a strip-tillage system for onion production.

Figure 1. Hairy Nightshade weed counts in strip-tillage averaged across replications for 2008 field season. Weed counts were taken at 4 weekly intervals starting May 23, 2008.

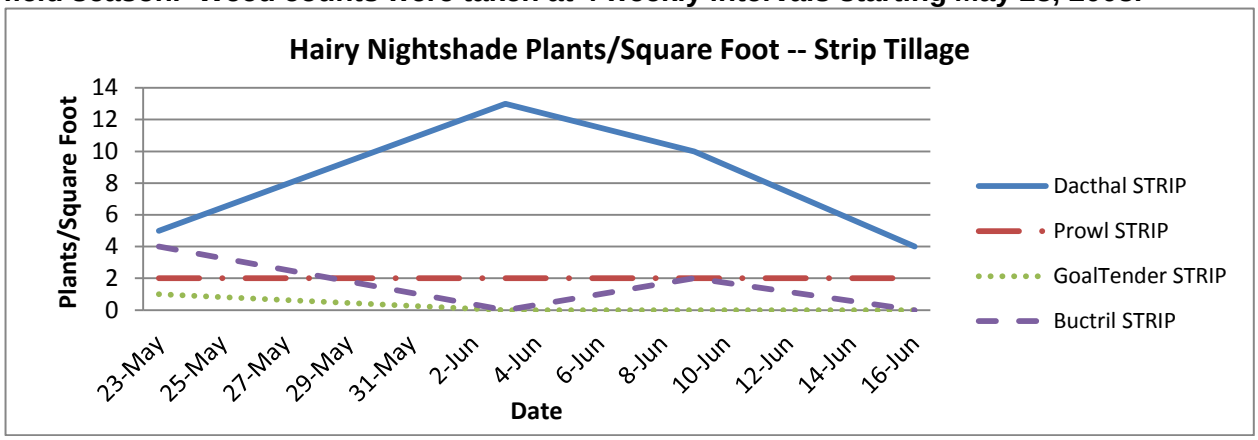

Figure 2. Hairy Nightshade weed counts in conventional tillage averaged across replications for the 2008 field season. Weed counts were taken at 4 weekly intervals starting May 23, 2008.

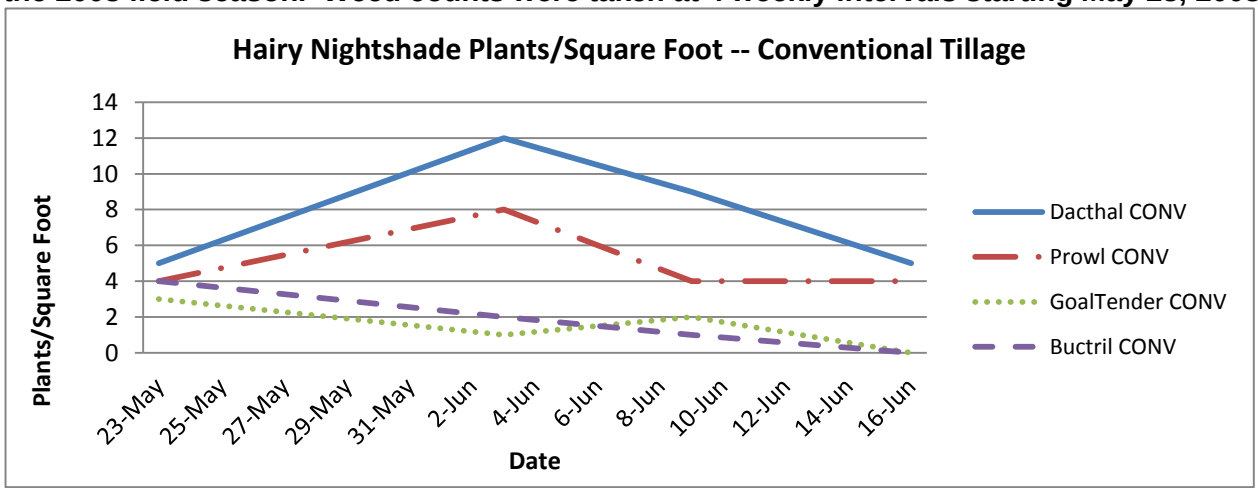

Figure 3. Common Lambsquarters weed counts in strip-tillage averaged across replications for the 2008 field season. Weed counts were taken at 4 weekly intervals starting May 23, 2008.

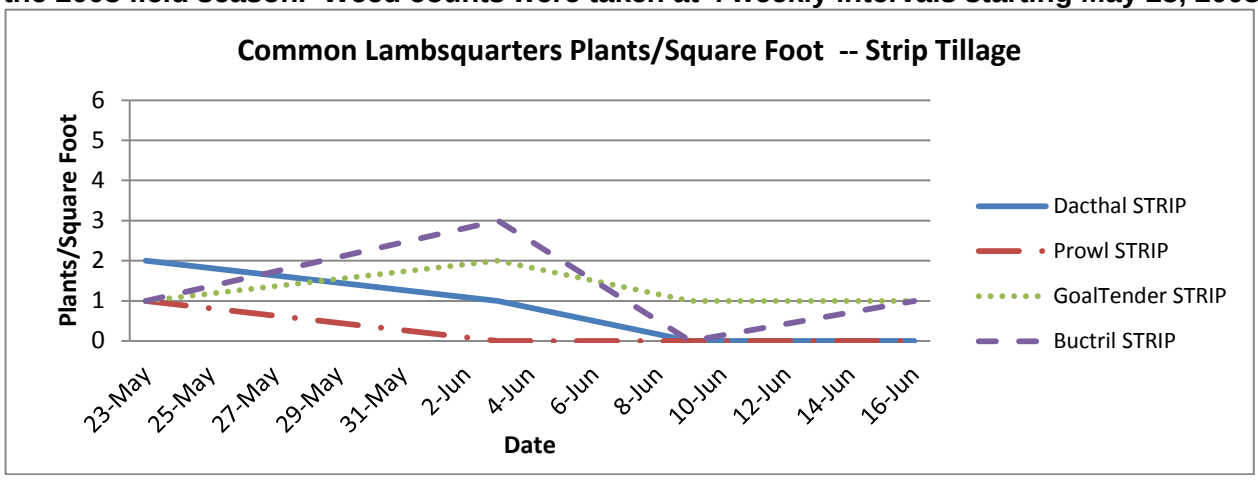

Figure 4. Common Lambsquarters weed counts in conventional tillage averaged across replications for the 2008 field season. Weed counts were taken at 4 weekly intervals starting May 23, 2008.

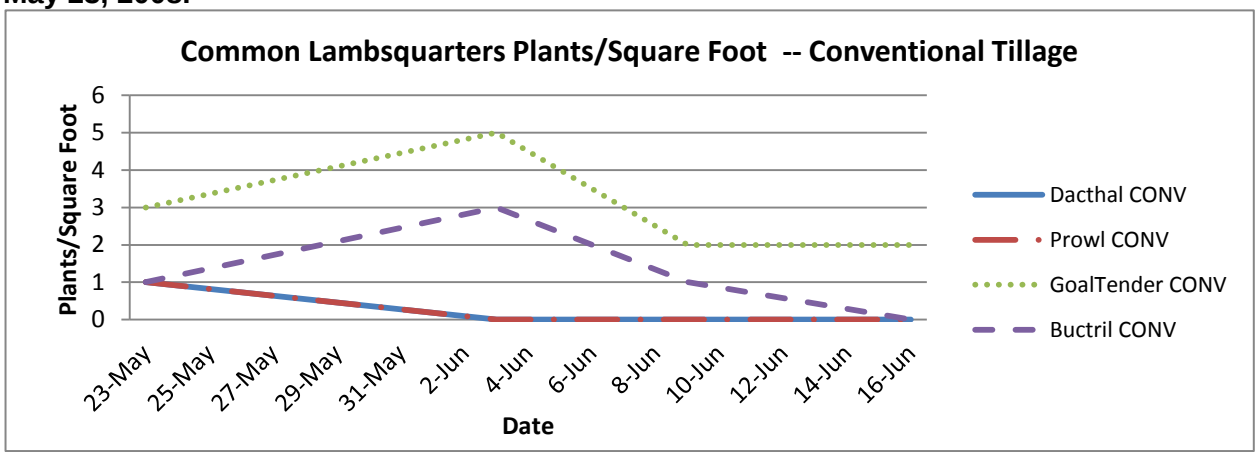

Table 1. Effect of tillage and herbicide on onion grade/yield.

		Onion Yield: kg/ha				
Tillage	Herbicide	grade: small	grade: med	grade: large	colossal	total marketable
Strip	Prowl H20	4664	20918	26964	404	47881
Conv	Prowl H20	8100	20451	23914	0	44365
Strip	Dacthal	6261	24963	24165	457	49128
Conv	Dacthal	7795	24317	25367	0	49684
Strip	Goaltender	8414	23412	15428	0	38840
Conv	Goaltender	10073	20532	7858	0	28390
Strip	Buctril	7723	21609	21483	888	43092
Conv	Buctril	10145	22174	21618	0	43791