

Development of New Herbicide Options for Weed Control in Potato Production

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Introduction

Weed control in potatoes is essential for production of high yielding marketable tubers. Herbicide options in potatoes are often limited. Several herbicides currently registered for use in other crops show promise for use in potatoes. Spartan (sulfentrazone) and Valor (flumioxazin) represent a herbicide mode of action that is not currently used in potatoes and offer more effective hairy nightshade control than current herbicide programs. Outlook (dimethenamid-p) is similar to Dual but controls a larger spectrum of weeds. Trials were conducted to evaluate new herbicides for weed control in potatoes.

Methods

Five trials were conducted at the Malheur Experiment Station to evaluate new herbicides for weed control efficacy and crop tolerance in potatoes. All trials were sprinkler irrigated. Potatoes were planted April 17 and 18 in a silt loam soil with pH 7.6 and 1.4 percent organic matter (OM). 'Russet Burbank' seed pieces were planted every 9 inches in 36-inch-wide rows. Seed pieces were treated with Tops MZ + Gaucho at seed cutting. Experimental plots were four rows wide and 30 ft long. Plots were sidedressed with fertilizer (60 lb N, 25 lb Mg, 8.0 lb Zn, 1.0 lb B, 1.0 lb Mn, and 1.0 lb Cu/acre) on April 26 and beds were reshaped with a Lilliston cultivator on May 7. Preemergence herbicides were applied on May 9 or May 10 and incorporated with overhead irrigation on May 10. Postemergence herbicide applications were made on May 29. Treatments were applied with a CO₂-pressurized backpack sprayer delivering 20 gal/acre at 30 psi. Plots were irrigated with sprinklers according to crop requirements throughout the season. Potatoes were sprayed with Ridomil plus Bravo (June 14) and Dithane (June 22) to prevent late blight and with sulfur dust (July 14 and 28) to control powdery mildew. Potato injury and weed control were evaluated throughout the growing season and tuber yields were taken by harvesting the center two rows of each plot. Potatoes were harvested on September 5, 6, and 7. Potatoes were graded for yield and size on September 10-13 and 16-18.

Potato Response and Weed Control with Spartan and Valor Combinations

Spartan was applied alone at rates from 0.063 to 0.25 lb ai/acre and at 0.125 lb ai/acre in combination with other herbicides. Valor was applied alone at rates from 0.047 to 0.125 lb ai/acre and at 0.094 lb ai/acre in combination with other herbicides. Spartan and Valor were applied in combinations with Eptam, Dual Magnum, Outlook, and Prowl. Spartan and Valor treatments were compared to Eptam, Dual Magnum, Outlook, and Prowl alone, and to tank mixtures of Dual Magnum plus Matrix and Dual Magnum plus Sencor. Matrix was inadvertently applied at one third the desired rate. Treatments were replicated four times. Weed biomass production was determined by harvesting weeds from 5 ft of one center row in each plot and separating the weed samples by species. Biomass samples were dried and weighed.

Weed Control with Outlook Combinations

Combinations of Outlook with herbicides currently registered for use in potatoes were evaluated for

weed control efficacy. Outlook was combined with Prowl, Sencor, Matrix, Eptam, and Prowl plus Sencor. Outlook combinations were compared with Prowl plus Sencor and Prowl plus Matrix. Treatments were replicated three times. Weed biomass production was also determined in this trial as previously described.

Potential Antagonism Between Valor and Prowl

Research in 2000 suggested that combinations of Valor with Prowl provided less control of redroot pigweed than Valor applied alone. These results indicated that Prowl may antagonize the activity of Valor. In order to test this hypothesis, Valor at two rates (0.047 and 0.94 lb ai/acre) and Prowl at two rates (0.5 and 1.0 lb ai/acre) were applied alone and in combinations. Select was applied on May 29 to control any barnyardgrass in the plots. Broadleaf weed control was evaluated early and late in the growing season. Treatments were replicated three times.

Volunteer Barley Control with Select

Barley seed was broadcast over the entire trial and incorporated with the Lilliston on May 8. Prowl (0.75 lb ai/acre) was applied on May 9 to control other weeds impacting the potatoes. Select treatments were applied on May 29 when potatoes were 8 inches tall and barley was an average of 7 inches tall. Treatments were replicated three times. Potato injury and barley control were evaluated throughout the season. Because the Prowl application did not control all the broadleaf weeds, redroot pigweed, common lambsquarters, and hairy nightshade control was evaluated at the end of the season.

Tolerance of 'Russet Burbank' Potatoes to Outlook Combinations

This trial was conducted to evaluate preemergence Outlook for crop injury at normal field use rates applied alone and in combination with products currently registered for use in potatoes. Outlook (dimethenamid-p) is an active isomer of the herbicide Frontier (dimethenamid) and has been submitted to the U.S. Environmental Protection Agency for registration on potatoes. Outlook was applied in combinations with Sencor, Prowl, or Matrix. Outlook treatments were compared with Matrix applied alone. Treatments were replicated four times. In previous years, Outlook applied alone at rates as high as four times the standard use rate did not result in reduced potato yields. All plots were hand weeded prior to row closure, but weeds emerging later in the season were not removed to avoid mechanical injury to the potato canopy. Lower yields in the untreated plots are likely due to weed competition.

Results and Discussion

Spring weather was conducive to early potato growth and the rapid canopy closure helped make soil-active herbicide treatments effective. July and August were extremely hot, resulting in less than ideal conditions for potato growth. Weed control plots were not fumigated the previous fall and plants died back from "early die" complex earlier than usual.

Potato Response and Weed Control with Spartan and Valor Combinations

Both Spartan and Valor were less effective in controlling weeds this year when compared to 2000. No significant injury from either herbicide was observed at any of the rates evaluated (data not shown). When comparing similar rates, Spartan generally provided greater control of redroot pigweed, common lambsquarters, and barnyardgrass compared to Valor (Table 1). Both products provided similar control of hairy nightshade with greater control at the higher rates. On June 7, Outlook provided greater redroot pigweed and hairy nightshade control than Dual Magnum, Eptam, and Prowl. Prowl provided greater common lambsquarters control than Outlook, Eptam, and Dual Magnum. Spartan or Valor applied in combination with Dual Magnum, Prowl, or Eptam provided greater than 90 percent control

of all broadleaf weeds, except for Valor plus Prowl, which provided only 83 percent control of redroot pigweed. At the late evaluation on August 20, hairy nightshade control with Valor and Spartan alone or in combinations was greater than the standard treatments of Dual Magnum plus Sencor or Dual Magnum plus Matrix. The lower hairy nightshade control with Dual Magnum plus Matrix is likely attributable to the low rate of Matrix applied. Hairy nightshade control was greater in plots where barnyardgrass was not controlled because the barnyardgrass prevented hairy nightshade germination and growth.

Potato yields increased with increasing weed control (Table 2). Spartan and Valor continue to show great potential for use in potatoes. Additional research needs to be done to determine why Valor provides less weed control in Ontario than in research trials in other states. Additional research also needs to identify the reason that Spartan sometimes causes potato injury.

Weed Control with Outlook Combinations

The weed pressure in this trial was significantly less than in the previous trial. All treatments provided greater than 90 percent control of all species on June 7. On August 21 control of redroot pigweed, common lambsquarters, and barnyardgrass was greater than 92 percent with all treatments (Table 3). Prowl plus Sencor provided significantly less hairy nightshade control than the other herbicide treatments. All treatments reduced weed biomass compared to the untreated control. Potato yields were not different among herbicide treatments because all treatments provided good weed control (Table 4).

Potential Antagonism Between Valor and Prowl

Valor at either rate applied alone provided greater hairy nightshade and early pigweed control than Prowl applied alone at either rate (data not shown). Prowl (1.0 lb ai/acre) provided greater common lambsquarters control than either rate of Valor. Combinations of Valor and Prowl provided control of redroot pigweed and common lambsquarters similar to that provided by each alone regardless of rates. The high rate of Valor with either rate of Prowl controlled hairy nightshade better than the low rate of Valor applied with the high rate of Prowl, but were not different from the low rate of Valor combined with the low rate of Prowl. While we were unable to identify antagonism between Valor and Prowl, the pattern of lower hairy nightshade control when low rates of Valor were combined with the high rate of Prowl suggests that some interaction may occur between the two products. Potato yield was strongly correlated with weed control and increased in all treatments when compared to the untreated check.

Volunteer Barley Control with Select

Volunteer barley was effectively controlled by all Select treatments (Table 5). Select applied in combination with Sencor provided quicker initial burndown of the barley and provided some control of broadleaf weeds. The addition of ammonium sulfate to Select also improved early control compared to Select alone. The preemergence application of Prowl did not adequately control the broadleaf weeds in plots treated only with Select as a postemergence treatment. Barley was extremely competitive with potatoes and reduced yields compared to plots where barley was controlled with Select (Table 6).

Tolerance of Russet Burbank Potatoes to Outlook Combinations

No injury was observed for any of the treatments evaluated (Table 7). Weed-free conditions were not present for all plots because additional weeds emerged after the plots were hand weeded and the potato canopy had formed. This resulted in weeds in plots without any herbicide applied. The presence of weeds in the untreated plots may have slightly suppressed yields in these plots. Yields were not different among any of the treatments evaluated. This was expected based on previous years of research with Outlook.

Table 1. Weed control on June 7 and August 20 and weed biomass on August 20 with preemergence Spartan and Valor combinations, Malheur Experiment Station, Oregon State University, Ontario, OR, 2001.

*Matrix was inadvertently applied at one third the desired rate.

Table 2. 'Russet Burbank' tuber yield and grade in response to preemergence Spartan and Valor combinations, Malheur Experiment Station, Oregon State University, Ontario, OR, 2001.

*Matrix was inadvertently applied at one third the desired rate.

Table 3. Potato injury on June 7 and visual weed control and weed biomass on August 21 with Outlook combinations, Malheur Experiment Station, Oregon State University, Ontario, OR, 2001.

Table 4. Tuber yield and quality in response to preemergence Outlook combinations, Malheur Experiment Station, Oregon State University, Ontario, OR, 2001.

Table 5. Volunteer barley control with postemergence herbicides, Malheur Experiment Station, Oregon State University, Ontario, OR, 2001.

*COC = crop oil concentrate, AMS = ammonium sulfate.

Table 6. Potato yield in response to postemergence herbicide applications, Malheur Experiment Station, Oregon State University, Ontario, OR, 2000.

Treatment*	Rate	U.S. No. 1					%	Total	Total	Total
		4-6 oz	6-12 oz	>12 oz	Total	Total				
	lb ai/acre	-----					%	-----		
Select + COC	0.125 + 1 qt	112	93	10	216	48	32	249	448	
Select + COC + AMS	0.125 + 1 qt + 2.5 lb	120	151	10	281	59	33	314	482	
Select + Sencor + COC	0.125 + 0.38 + 1 qt	127	126	7	259	57	30	290	459	
Untreated		32	13	0	45	18	8	53	169	
LSD (0.05)		50	53	13	69	19	NS	62	143	

*COC = crop oil concentrate, AMS = ammonium sulfate.

Table 7. Potato injury and yield in response to preemergence Outlook combinations, Malheur Experiment Station, Oregon State University, Ontario, OR, 2001.