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The Influence of Herbicides and Herbicide Application Timing on Weed Control in Potatoes

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Introduction:

A weed control study was conducted in 2013 and 2014 on multiple soil types to evaluate the effectiveness of herbicide combinations for controlling hairy nightshade, common lambsquarter, redstem filaree, and common mallow in potatoes. Treatments combined preemergence and postemergence herbicides with the goal of providing season-long weed control. Evaluations included weed density and percent control at multiple crop growth stages, herbicide injury, potato stand, potato yield, and potato quality. This report summarizes weed control and potato yield results. The researchers would like to thank the California Potato Research Advisory Board for funding support of the project.

Materials and Methods:

The 2013 study was conducted at the Intermountain Research and Extension Center (IREC) on mucky silty clay loam soil. The 2014 study was conducted at the Klamath Research and Extension Center (KBREC) on fine sandy loam soil. Experiments were located in fields with a history of high weed populations. The experiment design was a randomized complete block with four replications. Plots were 3 rows wide (9 ft) by 30 ft long. Herbicides were applied with a $C0_2$ backpack sprayer at 20 gallons per acre. Potatoes were planted in mid-May and harvested the first week of October both years. Potatoes were fertilized using commercial practices. Insects, nematodes, and diseases were controlled as needed.

Most treatments included a combination of preemergence and postemergence herbicides. Most preemergence treatments were applied immediately after hilling (5 to 7 days after planting) followed by 0.5 inches of water to incorporate the herbicide in the soil. Eptam was also applied pre-plant incorporated 1 to 2 days before planting. Early postemergence treatments were applied when potatoes were 3 to 6 inches tall. Late postemergence were applied when potatoes were 12 to 18 inches tall. All postemergence applications received 0.5 inches of water 12 to 48 hours after application to incorporate herbicides.

Weed density was measured by counting the number of weeds in the center row of each plot at row closure. Percent weed control was estimated at row closure and at the end of the growing season in each plot. Herbicide injury and percent weed control were visually estimated in the center row of each plot. Yield was determined by harvesting all potatoes from the center row. Potatoes were run across a grade-line to determine potato size and grade. All potatoes were inspected for external defects and cull potatoes were subtracted from marketable yield. A ten tuber sub-sample was randomly selected from each plot to determine internal defects such as hollow heart.

Results

Weed Control

Weed density and percent weed control results at row closure and the end of the season were similar for each treatment. End of the season weed control results are shown in Table 1. Treatments with the highest control of hairy nightshade, lambsquarter, purslane, redroot pigweed, and redstem filaree included Eptam (treatments 2 & 3), Outlook (4), Outlook + Prowl (5), Matrix + Metribuzin (9), and Reflex (10 & 11) applied preemergence at hilling followed by Matrix early postemergence. One postemergence application of Matrix + MSO applied early or late (12 & 14) did not provide greater than 90% control of all weed species. Matrix split-applied early and late postemergence (15) provided good control of hairy nightshade and lambsquarter at IREC, but this treatment did not provide a high level of hairy nightshade control at KBREC.

Most top-performing herbicide treatments shared the common theme of combining a preemergence herbicide(s) with Matrix plus methylated seed oil (MSO) applied early postemergence. Treatments that relied solely on postemergence applications (12, 13, 14, & 15) failed to provide greater than 90% control of all weed species. Almost all preemergence treatments (2, 3, 4, 5, 6, 7, 8, 9, 11) failed to provide greater than 90% weed control at potato emergence (data not shown) suggesting Matrix applied postemergence was critical to achieving 90% weed control regardless of the preemergence program.

Metribuzin is a long-standing popular herbicide used in potatoes because it controls several weeds that Matrix does not. In these trials, metribuzin (9 & 13) improved control of common mallow, redstem filaree, and lambsquarter compared to applying Matrix early postemergence alone. On the flipside, metribuzin actually decreased hairy nightshade control when it was mixed with Matrix and a nonionic surfactant early postemergence (13) compared to Matrix + methylated seed oil alone (12). Metribuzin applied at hilling in combination with Matrix alone postemergence (9) avoided decreasing hairy nightshade control. This treatment also maintained good control of other weeds similar to metribuzin applied postemergence.

Table 1. End of the Season Weed Control for Herbicides Tested at IREC in 2013 and KBREC in 2014.

Trt #	Herbicide	Application Timing	Product Rate/ Acre	Hairy Nightshade IREC	Hairy Nightshade KBREC	Common Lambsquarter IREC	Purslane IREC	Redroot pigweed KBREC	Common Mallow KBREC	Redstem filaree KBREC
				% Control						
1	Untreated	**	**	10	56.46	12	38	1.3	0	0
2	Eptam 7E	PPI[1]	7 pt/A	96	75.5	88	100	99.2	53.57	81.48
2	Matrix[2]	early Post	1.5 oz/A							
3	Eptam 7E	Hilling[3]	7 pt/A	98	85.71	94	100	98.42	71.42	88.88
3	Matrix[2]	early Post	1.5 oz/A							
4	Outlook	Hilling[3]	21 fl. oz/A (15 fl. oz Klamath)	98	93.87	92	100	99.73	78.57	81.48
4	Matrix[2]	early Post	1.5 oz/A							
5	Outlook	Hilling[3]	21 fl. oz/A (15 fl. oz Klamath)	99	97.95	98	100	99.47	95	96.29
5	Prowl H20	Hilling[3]	3 pt/A (2 pt Klamath)							
5	Matrix[2]	early Post	1.5 oz/A							
6	Matrix	Hilling[3]	1.5 oz/A	n/a	47	n/a	n/a	47.36	0	6.48
7	Matrix	Hilling[3]	1.5 oz/A	95	48	88	100	92.1	71.42	27.77
7	Matrix[2]	early Post	1.0 oz/A							
8	Eptam 7E	Hilling[3]	5 pt/A	96	59.18	92	100	94.73	60.71	59.25
8	Matrix	Hilling[3]	1.5 oz/A							
8	Matrix[2]	early Post	1.0 oz/A							
9	Metribuzin 75 DF	Hilling[3]	0.67 lb/A	94	77.5	95	100	97.1	85.71	100
9	Matrix	Hilling[3]	1.5 oz/A							
9	Matrix[2]	early Post	1.0 oz/A							
10	Dual	Hilling[3]	1.33 pt/A (1 pt Klamath)	98	97.95	95	100	98.15	91.42	81.48
10	Reflex	Hilling[3]	1.0 pt/A							
10	Matrix[2]	early Post	1.5 oz/A							
11	Boundary	Hilling[3]	2 pt/A	99	95.5	96	100	100	97.142	96.29
11	Reflex	Hilling[3]	1.0 pt/A							
11	Matrix[2]	early Post	1.5 oz/A							
12	Matrix[2]	early Post	1.5 oz/A	93	61.22	85	94	94.47	42.85	0
13	Metribuzin 75 DF[4]	early Post	0.67 lb/A	65	40.8	98	100	95.78	100	96.29
13	Matrix[4]	early Post	1.5 oz/A							
14	Matrix[2]	late Post	1.5 oz/A	80	11.22	65	76	81.57	50	25
15	Matrix[2]	early Post	1.5 oz/A	99	65.3	89	100	99.73	67.85	74
15	Matrix[2]	late Post	1.0 oz/A							
			95% Confidence Interval	12.5	30	13	14	10	19.5	29

1 = Pre-plant incorporated shortly before planting using a lilliston cultivator

2 = Treatment included methlyated seed oil (MSO) at 1 % v/v

3 = Hilling occurred 5-7 days after planting before weed emergence

4 = A non-ionic surfactant (NIS) at 0.25 % v/v was used instead of MSO

Potato Yield and Quality

Herbicide treatments did not cause visual injury or a reduction in potato stand compared to the untreated control at both sites (data not shown).

At IREC, all herbicide treatments had similar total yield and US # 1 yield compared to the untreated control, although some herbicide treatments increased average tuber size compared to the untreated (Table 2). The reason for increased tuber size appeared to be result of reduced weed competition and a reduction in tuber set per plant for certain herbicides.

At KBREC, all herbicide treatments had significantly higher total yield and US #1 yield compared to the untreated control (Table 2). Weed densities were higher at KBREC compared to IREC especially in the case of redroot pigweed which quickly outgrew the potatoes. Herbicide treatments that provided the highest weed control also had the highest yields with the exception of the Reflex treatments (10 and 11). Reflex treatments provided excellent weed control at KBREC, but they had lower total yield and US # 1 yield compared to treatments (15) which had the highest numeric yield in both categories. Low average tuber size was the cause for the yield reduction for Dual + Reflex (10). Low tubers per plant appeared to be the cause for yield reduction for Boundary + Reflex (11). Reflex did not cause visual herbicide injury during the growing season and factors besides herbicide injury cannot be ruled for the lower yield associated with Reflex at KBREC.

At both sites treatments with higher total yield also had a higher percentage of culls (Table 2) which is a normal trend in potatoes. Outlook (4) had a higher percentage of culls at KBREC compared to other treatments with similar yield, but Outlook at the same rate tank-mixed with Prowl H20 did not have an elevated percentage of culls. None of the herbicides at IREC elevated the percentage of culls when compared to treatments with similar total yield.

Table 2. Potato Yield, Size, and Quality for Herbicide Treatments tested at IREC in 2013 and KBREC in 2014.

				Total Yield		US # 1 Yield		Average Tuber Size		Culls (knobs, growth cracks, & mis-shaped tubers)		Tubers per plant	
Trt #	Herbicide	Application Timing	Product Rate/ Acre	IREC cwt/A	KBREC cwt/A	IREC cwt/A	KBREC cwt/A	IREC (oz)	KBREC (oz)	IREC %	KBREC %	IREC #	KBREC #
1	Untreated	**	**	341	145	241	89	5.3	4.2	6.5	3	6	2.71
2	Eptam 7E	PPI[1]	7 pt/A	360	481	271	382	5.3	9.5	9.4	9	5.48	4.8
2	Matrix[2]	early Post	1.5 oz/A										
3	Eptam 7E	Hilling[3]	7 pt/A	375	483	286	395	6.6	8.2	10.7	7	5.24	5.16
3	Matrix[2]	early Post	1.5 oz/A										
4	Outlook	Hilling[3]	21 fl. oz/A (15 fl. oz Klamath)	364	471	274	349	5.9	9	8.9	15	5.82	4.63
4	Matrix[2]	early Post	1.5 oz/A										
5	Outlook	Hilling[3]	21 fl. oz/A (15 fl. oz Klamath)	365	494	271	412	5.7	8.7	8.4	6	5.85	5.13
5	Prowl H20	Hilling[3]	3 pt/A (2 pt Klamath)										
5	Matrix[2]	early Post	1.5 oz/A										
6	Matrix	Hilling[3]	1.5 oz/A	n/a	424	n/a	344	n/a	7.2	n/a	8	n/a	5.29
7	Matrix	Hilling[3]	1.5 oz/A	379	453	280	376	5.8	8.4	7	7	5.96	4.78
7	Matrix[2]	early Post	1.0 oz/A										
8	Eptam 7E	Hilling[3]	5 pt/A	351	489	252	418	5.6	8.2	7.8	7	5.73	5.25
8	Matrix	Hilling[3]	1.5 oz/A										
8	Matrix[2]	early Post	1.0 oz/A										
9	Metribuzin 75 DF	Hilling[3]	0.67 lb/A	367	484	275	374	5.9	8.1	7.4	11	5.89	5.12
9	Matrix	Hilling[3]	1.5 oz/A										
9	Matrix[2]	early Post	1.0 oz/A										
10	Dual	Hilling[3]	1.33 pt/A (1 pt Klamath)	386	458	291	368	6.5	7.9	10	7	5.43	4.93
10	Reflex	Hilling[3]	1.0 pt/A										
10	Matrix[2]	early Post	1.5 oz/A										
11	Boundary	Hilling[3]	2 pt/A	345	449	258	380	5.8	8.9	8.4	8	5.48	4.43
11	Reflex	Hilling[3]	1.0 pt/A										
11	Matrix[2]	early Post	1.5 oz/A										
12	Matrix[2]	early Post	1.5 oz/A	363	462	266	392	6	8.4	10	7	5.63	4.77
13	Metribuzin 75 DF[4]	early Post	0.67 lb/A	343	421	246	335	5.6	8.2	8.7	12	5.62	4.66
13	Matrix[4]	early Post	1.5 oz/A										
14	Matrix[2]	late Post	1.5 oz/A	355	487	256	406	5.1	8.5	5.4	7	6.51	5.05
15	Matrix[2]	early Post	1.5 oz/A	369	509	277	428	6.4	8.6	10.8	7	5.45	5.13
15	Matrix[2]	late Post	1.0 oz/A										
			95% Confidence Interval	NS	39	NS	45	0.4	0.96	2	4	0.3	0.51

1 = Pre-plant incorporated shortly before planting using a lilliston cultivator

2 = Treatment included methlyated seed oil (MSO) at 1 % v/v

3 = Hilling occurred 5-7 days after planting before weed emergence

4 = A non-ionic surfactant (NIS) at 0.25 % v/v was used instead of MSO