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The Influence of Weather on the Response of Potato Cultivars to Metribuzin[1]

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Abstract. **The response of 11 cultivars of potato (*Solanum tuberosum* L.) to preemergence, preemergence + postemergence, and early postemergence applications of metribuzin [4-amino-6-*tert*-butyl-3-(methylthio)-*as*-triazin-5 (4H)-one] was studied over a 5-year period (1973–1977). Postemergence sprays applied at temperatures over 21°C increased injury and decreased yields. 'Belleisle', 'Early Rose', 'Kennebec', 'Netted Gem', 'Red La Soda', 'Red Pontiac' and 'White Rose' were more sensitive to metribuzin at these temperatures than 'Epicure', 'Norgold Russet', 'Norland', and 'Warba'. Cultivars responded to the amount of sunshine before, during, and after spraying with metribuzin. When the weather was very cloudy on the 3 days before and on the day of spraying and then sunny for the next 3 days, metribuzin injured 'Belleisle', 'Netted Gem', 'Red Pontiac', and 'Warba'. 'Belleisle', 'Epicure', 'Norland', 'Red La Soda', 'Red Pontiac' and 'White Rose' when grown under stress caused by lack of water, were more sensitive to the herbicide than the other cultivars under test. 'Epicure', 'Netted Gem', 'Norgold Russet', 'Norland' and 'Warba' grown in wet soil were more sensitive to preemergence applications than other cultivars. Cultivars differed in their tolerance to metribuzin and were classified as follows: 'Norgold Russet' and 'Epicure', most tolerant; 'Kennebec', 'Early Rose', 'Netted Gem', 'Red La Soda' and 'Norland', intermediate; and 'Belleisle', 'Red Pontiac', 'Warba' and 'White Rose', most susceptible.**

Metribuzin provides broad spectrum weed control for potatoes, but crop tolerance varies. Ivany (3) found that metribuzin applied preemergence and early postemergence to potatoes had no effect on marketable and total yields of 'Irish Cobbler', 'Netted Gem', 'Kennebec' and 'Sebago'. Sieczka (8), however, reported that potato yields varied from year to year after postemergence application of metribuzin at 1.12 kg/ha. Phatak (4) found that shading potatoes up to 3 days before and/or after spraying increased the degree of injury, indicating that metribuzin is more likely to be tolerated if applied during sunny weather. Rioux (7) stated that rainfall distribution appeared to influence phytotoxicity of metribuzin on barnyard grass and potatoes by either increasing the amount of herbicide in solution or by reducing light. Phatak and Stephenson (5) reported that injury to tomatoes was greatest under conditions of low light intensity prior to and high light after application of metribuzin to the foliage. Pritchard and Warren (6) found that a day of 76% actual shade reduced the tolerance of tomato, jimsonweed, and velvetleaf to metribuzin and 3 days of shade further reduced plant tolerance to the herbicide. They concluded that weather conditions before postemergence applications of metribuzin determine the appropriate timing of the application and herbicide dose.

The purpose of this study was to investigate the effects of weather on the response of 11 potato cultivars to rate and time of metribuzin application.

Materials and Methods

Field trials were conducted over 5 years (1973–1977) to determine the effects of metribuzin applied preemergence at 0.84 and 1.12 kg/ha, as a split application (preemergence plus postemergence) at 0.28 + 0.28 and 0.56 + 0.56 kg/ha, and postemergence (at least 60 days before harvest) at rates of 0.56, 0.84, 1.12, 1.68, 2.24, and 3.36 kg/ha. All treatments were applied with a tractor-drawn power plot sprayer with a 2.3-m spray width. Metribuzin was applied in water at 450 liters/ha at a pressure of 2.5 kg/cm^2. The dates of planting, spraying, and harvesting the potatoes are presented in Table 1. Cultivars included in the experiment were: 'Belleisle', 'Early Rose', 'Epicure', 'Kennebec', 'Netted Gem' ('Russet Burbank'), 'Norgold Russet', 'Norland', 'Red La Soda', 'Red Pontiac', 'Warba' and 'White Rose'. Uniform whole tuber foundation-grade seed potatoes averaging 45 g in weight were planted with a precision planter at 30 cm spacing and 18 cm depth. Fertilizer 6-13-12 (N-P-K) at 1120 kg/ha was drilled in at planting. Prior to planting 0-0-18-11 (N-P-K-Mg) at 340 kg/ha was broadcast and incorporated in the soil. Good grower practices were followed for pest control with a copper foliage spray at 1.7 kg/ha being applied up to 6 times per season for late blight [*Phytophthora infestans* (Mont.) De Bary] control and endosulfan (6, 7, 8, 9, 10, 10-Hexachloro-1, 5, 5a, 6, 9, 9a-hexahydro-6, 9-methano-2, 4, 3-benzodioxathiepin-3-oxide) at 1 kg/ha for tuber flea beetle (*Epitrix tuberis*, Gent.) control.

Table 1. The dates when potatoes were planted and harvested and when Preemergence (PreE) and Postemergence (PostE) metribuzin sprays were applied for the years 1973 to 1977.

Year	Date planted	Treatment dates		Date harvested
		PreE	PostE	
1973	May 30	June 1	June 29[z]	Sept 11–17
1974	May 29	June 6	July 4	Sept 16–20
1975	May 29	June 5	July 2	Sept 23–29
1976	May 20	May 21	June 18	Sept 7–15
1977	May 30 – June 3	June 7	June 22	Sept 13–19

[z]Split application 1973 PreE June 1 and PostE July 4; 1977 PreE June 7 PostE June 28.

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The experimental design, repeated each year, was a completely randomized split-plot, with herbicide treatments as main plots and potato cultivars as subplots with 4 replications. A subplot consisted of a single 7.6 m row (26 plants). The soil was a silty loam with 4.2 to 4.6% organic matter and a pH of 5.5 to 5.8. Sprinkler irrigation was used when necessary.

The following growth factors were measured: plant height, foliage injury, yield, and tuber dry matter content.

Weather data recorded were maximum and minimum temperatures, amount of sunshine, and rainfall. Daily average for hours of sunshine, temperature, and precipitation were determined for 3 days before spray application and for 3 days after metribuzin application (Table 2). The selection of the 7-day period was based on the work of Phatak and Stephenson (5) and Silva and Warren (9). Response each year of the various potato cultivars to metribuzin was related to the weather for the 7-day periods and for the growing season.

For each cultivar and type of application, the lowest rate at which a significant (P=5%) decrease in the growth factors could be detected was determined by Williams' method (10, 11) based on the appropriate analyses of variance for the split plot design.

Results

1973. The weather at the time of the preemergence spraying was dry. The growing season was cool and dry (Table 2). Three days prior to the application of the postemergence metribuzin in split applications, the weather was sunny with maximum temperatures averaging above 21°C; the day of application was without sunshine, maximum temperature was 18°, and rainfall was 15.2 mm; the 3 days following spraying were cool and very cloudy with a total of 6.1 mm of rain. The weather was sunny and dry before application of the rest of the postemergence treatments with maximum temperatures above 21°. On day of metribuzin application, the weather was cloudy and cool. The 3 days after spraying were partially sunny, with maximum temperatures averaging 20° with 0.3 mm of rain.

The preemergence and split metribuzin applications did not affect plant height of any cultivar (Table 3). The lowest rate of postemergence applied metribuzin that a decrease was detectable in top growth was 0.84 kg/ha in 'Netted Gem' and 'Kennebec', 1.12 kg/ha in 'Early Rose', 1.68 kg/ha in 'Red Pontiac', 2.24 kg/ha in 'Warba' and 3.36 kg/ha in 'Epicure' and 'Red La Soda'. Top growth of 'Norgold Russet' and 'Norland' was not affected by metribuzin application.

Preemergence and split applications of metribuzin did not affect the yield of any cultivar. Postemergence applications at 0.84 kg/ha reduced marketable (Table 4) and total yield (Table 5) in 'Warba'. Marketable yield of 'Early Rose' was reduced by 1.12 kg/ha and total yield by 0.84 kg/ha. Both marketable and total yields of 'Epicure' were reduced by applications of 1.68 kg/ha. Total and marketable yields of 'Netted Gem' and 'Red La Soda' were affected by the 2.24 kg/ha application. Marketable yield of 'Red Pontiac' was reduced by the 2.24 kg/ha treatment while total yield was reduced with 1.68 kg/ha. With 'Kennebec', only the 3.36 kg/ha treatment affected marketable yield but again the 2.24 kg/ha application reduced total yield. The marketable yields of 'Norland' and 'Norgold Russet' were not affected by treatment but 3.36 kg/ha reduced total yields.

Dry matter content of the tubers of all cultivars was not affected by any treatment.

1974. Weather at the time of preemergence applications was wet, with 63 mm of rainfall during the 3 days prior to spraying and 17 mm on the day metribuzin was applied (Table 2). The 3 days prior to application of the split and postemergence treatments were very cloudy and 24 mm of rain fell. The day of spraying was cloudy with a trace of rain. The 3 days following spraying were sunny with higher temperatures.

Plant injury due to metribuzin application was greater in 1974 than in 1973. Plant height was reduced significantly in all cultivars treated postemergence at 1.68 kg/ha (Table 3). 'Netted Gem' was affected by all treatments and 'Norgold Russet' was affected by most treatments.

The preemergence application of 1.12 kg/ha reduced marketable yield (Table 4) in 'Warba', and the split applications and all postemergence treatments reduced both the marketable and total yields (Table 5). Total yield of 'Netted Gem' was reduced by all postemergence treatments. Marketable yields were erratic. 'Norland' appeared less tolerant than in 1973; postemergence treatments of 1.12 kg/ha and higher caused a significant decrease in marketable yield. Both marketable and total yields of 'Early

Table 2. Daily average for hours of sunshine, temperature (max/min °C), and precipitation (mm) recorded 3 days before, 3 days after, and on the day metribuzin was applied for the years 1973 to 1977.

	1973			1974			1975			1976			1977		
Time	Sun (hr)	Temp (°C max/min)	Rain (mm)	Sun (hr)	Temp (°C max/min)	Rain (mm)	Sun (hr)	Temp (°C max/min)	Rain (mm)	Sun (hr)	Temp (°C max/min)	Rain (mm)	Sun (hr)	Temp (°C max/min)	Rain (mm)
Preemergence		*June 1*[z]			*June 6*			*June 5*			*May 21*			*June 7*	
3 days before	10.8	22/11	0.0	2.9	15/9	21.0	2.0	17/13	6.4	7.6	17/6	0.0	10.6	26/12	0.5
spray day	1.2	12/9	0.0	1.0	13/9	17.0	6.4	19/12	3.6	12.0	21/4	0.0	9.8	25/13	0.0
3 days after	6.0	18/8	0.0	12.8	19/7	0.0	7.2	18/9	0.1	1.5	14/9	3.8	12.0	21/9	0.0
Split application		*July 4*			*July 4*			*July 2*			*June 18*			*June 28*	
3 days before	9.8	23/9	0.1	0.0	16/12	8.0	11.8	24/8	0.6	5.7	19/12	14.8	5.3	20/11	Trace
spray day	0.0	18/14	15.2	1.5	17/13	Trace	9.2	24/12	0.3	10.8	26/12	1.0	6.8	21/13	0.0
3 days after	1.0	16/10	2.0	11.4	20/8	0.1	12.5	29/13	0.1	10.3	21/10	1.4	9.7	22/11	Trace
Posteemergence		*June 29*			*July 4*			*July 2*			*June 18*			*June 22*	
3 days before	9.4	23/12	0.0	0.0	16/12	8.0	11.8	24/8	0.6	5.7	19/12	14.8	3.4	20/12	7.6
spray day	3.1	18/7	0.0	1.5	17/13	Trace	9.2	24/12	0.3	10.8	26/12	1.0	9.4	21/14	Trace
3 days after	6.7	20/10	0.1	11.4	20/8	0.1	12.5	29/13	0.1	10.3	21/10	1.4	5.1	20/12	2.5

[z]Date metribuzin applied

Table 3. Metribuzin rate (kg/ha) at which reduction in plant height of potato cultivars was observed during 1973 to 1977.

Year	Belleisle[z]	Warba	Red Pontiac	White Rose[y]	Netted Gem	Red La Soda	Norland	Early Rose	Kennebec	Epicure	Norgold Russet
					Preemergence metribuzin rates						
1973	N/A	—	—	N/A	—	—	—	—	—	—	—
1974	N/A	1.12	—	—	0.84	—	0.84	—	—	1.12	0.84
1975	—	0.84	—	—	—	—	—	—	—	—	—
1976	1.12[x]	—	—	—	—	—	—	—	—	—	—
1977	—	—	—	—	—	—	—	—	—	—	—
					Split application						
					Pre- + Postemergence metribuzin rates						
1973	N/A	—	—	N/A	—	—	—	—	—	—	—
1974	N/A	0.56+0.56	—	0.28+0.28	0.28+0.28	—	0.56+0.56	—	—	0.56+0.56	0.56+0.56
1975	0.28+0.28	0.28+0.28	0.28+0.28	0.56+0.56	0.56+0.56	0.56+0.56	—	—	—	0.28+0.28	—
1976	0.28+0.28	0.28+0.28	0.28+0.28	0.56+0.56	0.56+0.56	—	—	0.56+0.56	0.28+0.28	—	0.56+0.56
1977	0.28+0.28	0.56+0.56	—	—	—	—	0.56+0.56	0.56+0.56	—	0.56+0.56	—
					Posteemergence metribuzin rates						
1973	N/A	2.24	1.68	N/A	0.84	3.36	—	1.12	0.84	3.36	—
1974	N/A	0.84	0.84	0.56	0.56	0.84	0.84	0.84	1.68	0.84	0.84
1975	0.56	0.56	0.56	0.56	0.56	1.12	—	0.84	—	0.56	—
1976	0.56	0.84	0.56	1.68	1.12	1.68	2.24	0.56	1.68	1.68	0.84
1977	0.56	0.56	0.56	0.56	2.24	0.84	0.56	0.56	1.12	0.56	1.12

[z]Belleisle grown during 1975 to 1977
[y]White Rose grown during 1974 to 1977
[x]The lowest metribuzin rate (kg/ha) is shown at which a significant (P=.05) plant height decrease could be detected as determined by Williams' (10,11) method.

Rose' were reduced by postemergence applications at 1.68 kg/ha and higher and 'Red Pontiac' by 2.24 kg/ha and higher. Total yield of 'White Rose' was reduced by applications at 2.24 kg/ha and higher, while marketable yield was reduced only by 3.36 kg/ha. No treatment significantly affected yield of 'Red La Soda' although there was a trend for the 2.24 and 3.36 kg/ha treatments to reduce marketable yield. Again, as in 1973, the yields of 'Norgold Russet', 'Epicure', and 'Kennebec' were not affected by any treatment.

Metribuzin applications of 1.68 to 3.36 kg/ha tended to increase the dry matter content of 'Norgold Russet' tubers while 3.36 kg/ha caused a significant increase in the dry matter content of 'Red La Soda'. There was no effect of treatment on the dry matter content of tubers of any of the other cultivars.

1975. Weather conditions during the 7-day period for the split and postemergence treatments was hot and sunny and daily maximum temperatures averaged 24°C or over (Table 2). Rainfall during the period totalled 2.4 mm. 'Warba' was sensitive to met-

Table 4. Metribuzin rate (kg/ha) at which reduction in marketable yield of potato cultivars was observed during 1973 to 1977.

Year	Belleisle[z]	Warba	Red Pontiac	White Rose[y]	Netted Gem	Red La Soda	Norland	Early Rose	Kennebec	Epicure	Norgold Russet
					Preemergence metribuzin rates						
1973	N/A	—	—	N/A	—	—	—	—	—	—	—
1974	N/A	1.12	—	—	—	—	—	—	—	—	—
1975	0.84[x]	—	—	—	—	—	—	—	—	—	—
1976	1.12	—	—	—	—	—	—	—	—	—	—
1977	—	—	—	—	—	—	—	—	—	—	—
					Split application						
					Pre- + Postemergence metribuzin rates						
1973	N/A	—	—	N/A	—	—	—	—	—	—	—
1974	N/A	0.28+0.28	—	—	—	—	—	—	—	—	—
1975	0.28+0.28	0.28+0.28	0.28+0.28	0.56+0.56	0.28+0.28	—	—	—	—	—	—
1976	0.56+0.56	—	—	—	—	—	—	—	—	—	—
1977	0.28+0.28	0.56+0.56	0.28+0.28	0.28+0.28	—	0.56+0.56	0.28+0.28	—	—	—	—
					Posteemergence metribuzin rates						
1973	N/A	0.84	2.24	N/A	2.24	2.24	—	1.12	3.36	1.68	—
1974	N/A	0.56	2.24	3.36	2.24	—	1.12	1.68	—	—	—
1975	0.56	0.56	0.56	0.56	0.56	0.84	2.24	1.12	0.84	3.36	—
1976	0.84	1.68	3.36	3.36	3.36	3.36	—	—	—	—	—
1977	0.56	—	0.56	0.56	1.68	1.12	0.56	2.24	—	2.24	—

[z]Belleisle grown during 1975 to 1977
[y]White Rose grown during 1974 to 1977
[x]The lowest metribuzin rate (kg/ha) is shown at which a significant (P=.05) marketable yield decrease could be detected as determined by Williams' (10,11) method.

Table 5. Metribuzin rate (kg/ha) at which reduction in total yield of potato cultivars was observed during 1973 to 1977.

Year	Belleisle[z]	Warba	Red Pontiac	White Rose[y]	Netted Gem	Red La Soda	Norland	Early Rose	Kennebec	Epicure	Norgold Russet
					Preemergence metribuzin rates						
1973	N/A	—	—	N/A	—	—	—	—	—	—	—
1974	N/A	—	—	—	—	—	—	—	—	—	—
1975	0.84[x]	—	0.84	—	—	—	—	—	—	—	—
1976	1.12	—	—	—	—	—	—	—	—	—	—
1977	—	1.12	—	—	—	—	—	—	—	—	—
					Split application						
					Pre- + Postemergence metribuzin rates						
1973	N/A	—	—	N/A	—	—	—	—	—	—	—
1974	N/A	0.28+0.28	—	—	—	—	—	—	—	—	—
1975	0.28+0.28	0.56+0.56	0.28+0.28	0.56+0.56	0.56+0.56	—	—	—	0.56+0.56	—	—
1976	0.56+0.56	—	—	—	—	—	—	—	—	—	—
1977	0.28+0.28	0.56+0.56	0.28+0.28	0.56+0.56	0.56+0.56	0.56+0.56	0.28+0.28	0.28+0.28	—	—	—
					Posteemergence metribuzin rates						
1973	N/A	0.84	1.68	N/A	2.24	2.24	3.36	0.84	2.24	1.68	3.36
1974	N/A	0.56	2.24	2.24	0.56	—	1.68	1.68	—	—	—
1975	0.56	0.56	0.56	0.56	0.56	0.84	1.68	0.56	0.56	3.36	2.24
1976	0.84	2.24	3.36	3.36	3.36	3.36	—	—	—	—	—
1977	0.56	0.56	0.56	0.56	2.24	1.12	0.56	1.12	—	0.56	—

[z]Belleisle grown during 1975 to 1977
[y]White Rose grown during 1974 to 1977
[x]The lowest metribuzin rate (kg/ha) is shown at which a significant (P=.05) total yield decrease could be detected as determined by Williams' (10,11) method.

ribuzin and all treatments reduced top growth (Table 3). This was the first year of testing of 'Belleisle', which also was very susceptible to metribuzin injury. All metribuzin treatments except the preemergence treatments caused a significant reduction in plant height. 'Red Pontiac' was more sensitive to metribuzin injury than in previous years, with all treatments except the preemergence causing a growth reduction. 'White Rose', 'Netted Gem', 'Early Rose', and 'Epicure' were very sensitive to metribuzin as measured by top growth. No metribuzin treatment affected vine growth of 'Kennebec', 'Norland' or 'Norgold Russet'.

All treatments, including the preemergence applications, caused a significant decrease in yield in 'Belleisle' (Tables 4, 5). 'Netted Gem', 'Red Pontiac', and 'Warba' were next in sensitivity; the split applications caused reduced yields in these cultivars. Total yields of 'White Rose' and 'Kennebec' were reduced in response to the split application of 0.56 kg/ha preemergence + 0.56 kg/ha postemergence. 'Early Rose' and 'Red La Soda' were also more sensitive with 0.56 kg/ha postemergence affecting total yield in 'Early Rose' and the 0.84 kg/ha reducing both total and marketable yields in 'Red La Soda'. 'Norland' was less sensitive to metribuzin than in 1974 with only applications at 1.68 and 2.24 kg/ha affecting total and marketable yields, respectively. Again, 'Epicure' and 'Norgold Russet' were most tolerant, only the 3.36 kg/ha application affected yields of 'Epicure' and no treatment affected marketable yield of 'Norgold Russet', although total yield was reduced by the 2.24 kg/ha treatment.

There was a trend for most treatments except those applied preemergence to reduce the tuber dry matter content in 'Belleisle', 'Kennebec', 'Netted Gem', 'Red La Soda', 'Warba' and 'White Rose'. 'Early Rose' was only affected by applications of 2.24 and 3.36 kg/ha. No treatment affected the dry matter content in 'Epicure', 'Norgold Russet', 'Norland' and 'Red Pontiac'.

1976. Cloudy, cool, wet (44.5 mm of rain) weather characterized the 3 days prior to postemergent spray applications. The day of spray application was sunny and warm with the temperature rising to 26°C. The 3 days following spraying were sunny with daily maximum temperatures averaging 21°. The growing season was cool and wet.

Top growth was reduced considerably in all sensitive cultivars. All cultivars were injured by at least 2 or more metribuzin treatments (Table 3). Only 'Belleisle' was affected by the preemergence treatments. Top growth of 'Belleisle', 'Warba', 'Red Pontiac', and 'Kennebec' was reduced by the split application at 0.28 + 0.28 kg/ha. Top growth of 'Early Rose', 'Norgold Russet', 'Netted Gem', and 'White Rose' was reduced by the split application at 0.56 + 0.56 kg/ha. All postemergence applications of metribuzin reduced top growth of 'Belleisle', 'Early Rose', and 'Red Pontiac'. Top growth of 'Warba' and 'Norgold Russet' was reduced by the 0.84 kg/ha application, 'Netted Gem' by1.12 kg/ha, and 'Epicure', 'Red La Soda', 'Kennebec', and 'White Rose' by 1.68 kg/ha. Plant height of 'Norland' was reduced only by applications of 2.24 and 3.36 kg/ha.

Plant injury was not reflected in yield decreases. This was possibly due to the cool, wet growing season, which tended to compensate for any top injury. 'Belleisle' was the least tolerant to metribuzin, followed by 'Warba'. Yields of 'Belleisle' were reduced significantly by the preemergence application at 1.12 kg/ha and split application at 0.56 + 0.56 kg/ha and by the postemergence application at 0.84 kg/ha (Tables 4, 5). Yields of 'Warba' were only affected by applications of 1.68 kg/ha and higher. Only the 3.36 kg/ha application caused a yield reduction in 'Netted Gem','Red Pontiac', 'Red La Soda', and 'White Rose'. No treatment reduced yields of 'Early Rose', 'Epicure', 'Kennebec', 'Norland', and 'Norgold Russet'.

There was no effect of treatment on dry matter content for any cultivar.

1977. The weather at the time of the postemergence applications in the split treatments was similar to that in 1976, i.e. cloudy progressing to sunny after sprays applied (Table 2). The day of

spraying was cooler and with fewer hours of sun than in 1976. The weather at the time of the postemergence applications was generally cloudy before and after spraying. The day of spraying was sunny and the maximum temperature was 21°C. Rainfall totalled 23 mm prior to application and 7.4 mm after. The weather during the latter part of the growing season was dry and sunny, and no irrigation was applied. The cultivars generally were less tolerant to metribuzin applications than they were in 1976, but 'Netted Gem', 'Red La Soda', and 'Kennebec' were exceptions. Considering all parameters, 'Belleisle', 'Warba', 'Red Pontiac', 'White Rose', 'Norland', and 'Epicure' tolerated only the preemergence treatments; 'Early Rose' tolerated the preemergence and split applications. The postemergence treatment at 1.12 kg/ha caused vine damage in 'Norgold Russet' and 'Kennebec' but yields were not affected and 'Netted Gem' tolerated the 1.68 kg/ha treatment.

All treatments except those applied preemergence reduced top growth of 'Belleisle' (Table 3). 'Warba', 'Epicure', 'Early Rose', and 'Norland' tolerated only the preemergence and the split application rate of 0.28 + 0.28 kg/ha. 'Red Pontiac' and 'White Rose' tolerated only the preemergence and split applications. Top growth of 'Red La Soda' was reduced by postemergence treatments of 0.84 kg/ha and higher. 'Kennebec' and 'Norgold Russet' were injured by applications of 1.12 kg/ha and 'Netted Gem' of 2.24 kg/ha.

Marketable (Table 4) and total yields (Table 5) of 'Belleisle', 'Norland', and 'Red Pontiac' were reduced by all except the preemergence treatments. Marketable yield of 'White Rose' was reduced by all except preemergence treatments while total yield was reduced by all except preemergence treatments and the low rate of the split applications. All postemergence applications reduced total yield of 'Epicure' but only the 2.24 kg/ha and higher applications reduced marketable yield. Total yield of 'Warba' was reduced by all treatments except 0.84 kg/ha applied preemergence and the split application of 0.28 + 0.28 kg/ha, while marketable yield was only affected by the split application of 0.56 + 0.56 kg/ha. Total yield of 'Early Rose' was reduced by the split applications and postemergence treatments at 1.12 kg/ha and higher. Top growth of 'Red La Soda' was reduced by 0.84 kg/ha postemergence (Table 3) while marketable and total yields were reduced by the 0.56 + 0.56 kg/ha split application and by 1.12 kg/ha applied postemergence. Top growth of 'Netted Gem' was reduced by 2.24 kg/ha and total yield reflected this injury. Although the plant heights of 'Norgold Russet' and 'Kennebec' were reduced by the postemergence application of 1.12 kg/ha, this injury was not reflected in decreased yields.

Only the tuber dry matter content of 'Warba' was affected by treatment. Tubers from the preemergence treated plants were significantly higher in dry matter content than those from the control plants.

Discussion

Weather conditions during 1973 were close to ideal for maximum cultivar tolerance to metribuzin (Table 2). The weather was the reverse of that found conducive to metribuzin injury by Phatak and Stephenson (5). Further, the growing season was cool and dry, and with irrigation it was an ideal potato season. In contrast, the 7-day periods (3 days before spray application, the spray day and 3 days after application) for 1974 and 1976 fit the Phatak-Stephenson model situation, i.e. the spray days were preceded by cloudy weather and the days following spraying were sunny. Both years were conducive to plant top injury. Although there was considerable injury to the potato vines in 1976, yield reduction was less than in 1974. A possible explanation for this difference in response was that the growing season for 1974 was dry and sunny while 1976 was cool and wet. The cool, wet season would promote plant top growth. In 1975 the weather prior to spraying was sunny and hot (averaging 24°C or over daily) and continued hot throughout the season. Thus it would appear that temperature had a greater effect on cultivar tolerance than sunshine (light intensity). Phatak and Stephenson (5), found that under high temperatures the reduction in fresh weight of tomatoes following metribuzin treatment was much higher regardless of light.

In most years metribuzin did not affect the tuber dry matter content. But in 1975 most treatments, except those applied preemergence, reduced dry matter content in 'Belleisle', 'Kennebec', 'Netted Gem', 'Red La Soda', 'Warba', and 'White Rose' tubers. 'Early Rose' was affected only by applications of 2.24 and 3.36 kg/ha. Callihan et al. (1) found that specific gravity was not significantly affected by metribuzin applications as high as 4.48 kg/ha (cultivar not specified).

Preemergence applications in 1974 caused considerable top growth injury in 'Epicure', 'Netted Gem', 'Norgold Russet', 'Norland', and 'Warba'. With the exception of 'Belleisle' and 'Warba' no cultivar was injured by preemergence applications in any other year. This was the only year for which wet conditions existed when preemergence treatments were applied. These results are in agreement with Cohick (2) who reported that crop tolerance to preemergence application when applied under wet conditions is sharply decreased.

In 1977 the weather during the growing season differed considerably from the previous year with the latter part of the season being dry and sunny while the 1976 season was cool and wet. Irrigation was not applied in 1977 and, in general, the cultivars showed less tolerance to metribuzin than they did in 1976. Cohick (2) reported that crop tolerance from postemergence application increases as conditions progress from wet to dry. Under very dry conditions crop tolerance to metribuzin declines, possibly because the crop plant is under stress due to lack of water.

Cultivar response to metribuzin was influenced by weather conditions. Postemergence spraying during periods when maximum temperatures surpassed 21°C resulted in reduced top growth, which generally was reflected in decreased yields. 'Belleisle', 'Early Rose', 'Kennebec', 'Netted Gem', 'Red La Soda', 'Red Pontiac', and 'White Rose' were more sensitive to metribuzin at high temperatures than the other cultivars tested. Those responding detrimentally to amount of sunshine (cloudy prior to spraying, changing to sunshine after spraying — 1974 and 1976) included 'Belleisle', 'Netted Gem', 'Red Pontiac', and 'Warba'.

Dry growing conditions in 1977 caused 'Belleisle', 'Epicure', 'Norland', 'Red La Soda', 'Red Pontiac', and 'White Rose' to be more sensitive to metribuzin treatments when compared to the other cultivars.

With an increase in soil moisture (1974) crop tolerance to preemergence treatment with metribuzin declined. Top growth was reduced in 'Epicure', 'Netted Gem', 'Norgold Russet', 'Norland' and 'Warba' but yield was reduced only in 'Warba'.

From the 5-year marketable yield averages (Table 6), the cultivars may be ranked according to tolerance to metribuzin as follows: 'Norgold Russet' and 'Epicure' were most tolerant; 'Kennebec', 'Early Rose', 'Netted Gem', 'Red La Soda', and 'Norland' were intermediate; and 'Belleisle', 'Red Pontiac', 'Warba', and 'White Rose' were most susceptible.

Table 6. Effect of metribuzin application on marketable yields (kg/m^2) of 11 potato cultivars, 5-year average (1973 to 1977).

Metribuzin treatments (kg/ha)	Belleisle[z]	Warba	Red Pontiac	White[y] Rose	Netted Gem	Red La Soda	Norland	Early Rose	Kennebec	Epicure	Norgold Russet
Weeded check	2.91	3.03	4.32	3.32	3.06	4.23	3.02	2.82	3.79	2.64	2.33
Preemergence											
0.84	2.59	2.82	4.15	3.39	3.35	4.30	2.91	2.73	3.72	2.69	2.44
1.12	2.20[x]	2.80	4.31	3.24	2.92	4.45	3.11	3.14	3.67	2.80	2.63
Split application (Pre- + Postemergence)											
0.28+0.28	2.07	2.69	3.94	3.20	2.72	4.24	2.81	2.78	3.56	2.51	2.49
0.56+0.56	1.69	2.32	3.59	2.98	2.86	3.99	2.77	2.75	3.53	2.39	2.42
Postemergence											
0.56	1.73	2.33	3.65	2.73	2.88	4.00	2.80	2.70	3.40	2.41	2.44
0.84	1.73	2.33	3.63	2.87	2.86	3.99	2.80	2.70	3.34	2.41	2.44
1.12	1.30	2.27	3.48	2.92	2.68	3.92	2.61	2.40	3.30	2.44	2.42
1.68	0.74	1.84	3.35	2.77	2.40	3.81	2.70	2.35	3.37	2.40	2.29
2.24	0.36	1.40	2.93	2.41	2.44	3.54	2.53	2.09	3.31	2.27	2.08
3.36	0.29	0.95	2.22	1.92	2.11	3.07	2.27	1.84	2.98	2.21	2.16

[z]Belleisle 3 yr average
[y]White Rose 4 yr average
[x]Underlining indicates the lowest metribuzin rate at which a significant (P=.05) marketable yield decrease could be detected as determined by Williams' (10,11) method.

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