Fall-applied Preemergent Herbicides in a Missouri Vineyard Do Not Control Annual Weeds the following Season

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Abstract. Nine preemergent herbicides were applied at maximum label rate in Fall 1986, 1987, and 1988 to a 'Catawba' grape (*Vitis labrusca* L.) vineyard in the Missouri Ozark region. The untreated controls showed 30% total weed cover by 28 Apr. 1987, 21 May 1988, and 18 Apr. 1989. In 1988, less rain fell early in the growing season; thus, weed cover in the untreated controls was delayed until late in the season. The herbicides norflurazon, oryzalin, and oxadiazon gave the longest period of acceptable grass control. Dichlobenil, diuron, oxyfluorfen, and simazine gave the longest period of acceptable broadleaf control. Most of the herbicides lost residual activity by early summer. For this reason, fall preemergent herbicide application cannot be relied on to give season-long control the following year in southern Missouri. Chemical names used: 2,6-dichlorobenzonitrile (dichlobenil); *N'*-(3,4-dichlorophenyl)-*N,N*-dimethylurea (diuron); *N,N*-diethyl-2-(1-naphthalenyloxy)-propanamide (napropamide); 4-chloro-5-(methylamino)-2-(3-(trifluoromethyl)phenyl)-3(2H)-pyridazinone (norflurazon); 4-(diisopropylamino)-3,5-dinitrobenzenesulfonamide (oryzalin); 3-[2,4-dichloro-5-(1-methylethoxy)phenyl]-5-(1,1-dimethylethyl)-1,3,4-oxadiazol-2-(3H)-one (oxadiazon); 2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene (oxyfluorfen); 3,5-dichloro-*N*-(1,1-dimethyl-2-propynyl)benzamide (pronamide); and 6-chloro-*N,N'*-diethyl-1,3,5-triazine-2,4-diamine (simazine).

A common practice in Missouri grape vineyards is to maintain bare soil under the trellis with grass sod in the row middles. This bare soil strip usually is maintained by a preemergent herbicide applied in early spring (March-April). However, it may be advantageous to apply herbicide before this. Frequently, warm fall and early winter periods, along with ample soil moisture, promote germination of winter annual weeds that can become well established under the grapevine trellis by the following spring. In addition, wet conditions during early spring can prevent timely application of herbicide. Thus, a weed problem can develop and the grower is forced to use postemergent herbicides that can injure vines if improperly used (Kennedy

et al., 1979). The preferred method of weed control in Missouri is preemergence application supplemented with postemergent herbicide spot treatment when needed. Most preemergent herbicides registered for use on grapes can be applied from fall through early spring, before weed emergence, but residual activity can be shorter following wet winters (Crop Protection Chemical Reference, 1989). In this situation, the benefits of fall herbicide application become minor in comparison to loss of weed control during the growing season. The objective of this study was to test the longevity of fall-applied preemergent herbicide for controlling winter and spring annual weeds.

The experiment was conducted from Fall 1986 through Summer 1989 in a 'Catawba' grape vineyard at the State Fruit Experiment Station at Mountain Grove in the Ozark region of southcentral Missouri. Grapevines were trained to an Umbrella Kniffin system and balance pruned (Jordan et al., 1981). The vineyard was not irrigated and yield was not taken due to low general vigor and var-

iability between vines. Soil type was a Viraton cherty silt loam with 2.2% organic matter and pH 6.8. The experiment was designed as a randomized complete block with four replications. Each replicate was 10 grapevines (1.2 × 24.4-m area) with vines spaced at 2.4 m within rows and 3.1 m between rows. Herbicides were applied to both sides of the trellis row with a single, flat fan nozzle spraying a 60-cm swath overlapping 10 to 15 cm in the center. Spray volume was 561 liter-ha⁻¹. Vegetation between rows was tall fescue (*Festuca arundinacea* Schreb.) grass sod that was kept mowed. In late Nov. or early Dec. 1986, 1987, and 1988 the herbicides (Table 1) were applied at maximum label rate. Simazine was applied in fall and in spring. Herbicides were applied to the same vines in 1986 and 1987 and to different vines in 1988. Untreated controls received no herbicide application during the 3 years of the experiment. The percentage total weed, grass weed, and broadleaf weed cover was estimated visually the 4th week of every month from April through August. The number of days of acceptable weed control ($\leq 30\%$ cover) were interpolated between the observation dates. An analysis of variance ($P = 0.05$) was done within years, and with years combined as replications. Results are tabulated as days of acceptable annual weed control beyond the untreated control (Table 1). Least significant difference ($P = 0.05$) was used for mean separation.

Predominant annual broadleaf weed species in the vineyard were Carolina geranium (*Geranium carolinianum* L.), common chickweed [*Stellaria media* (L.) Cyrillo.], common ragweed (*Ambrosia artemisiifolia* L.), corn speedwell (*Veronica arvensis* L.), henbit (*Lamium amplexicaule* L.), horseweed [*Conyza canadensis* (L.) Cronq.], purslane speedwell (*Veronica peregrina* L.), shepherdspurse [*Capsella bursa-pastoris* (L.) Medic.], Virginia pepperweed (*Lepidium virginicum* L.), and yellow rocket (*Barbarea vulgaris* R. Br.). Annual grass weeds were smooth crabgrass [*Digitaria ischaemum* (Schreb. ex. Schweig.) Schreb. ex. Muhl.], and yellow foxtail [*Setaria glauca* (L.) Beauv.]. The perennial broadleaf weeds were dandelion (*Taraxacum officinale* Weber), highbush blackberry (*Rubus argutus* Link.), horsenettle (*Solanum carolinense* L.), and mouseear chickweed (*Cerastium vulgatum* L.).

By 30 days after fall herbicide application, cumulative rainfall was 57 mm in 1986, 203 mm in 1987, and 97 mm in 1988. By 30

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Table 1. Days of acceptable annual weed control ($\leq 30\%$ cover) beyond the untreated control for fall-applied herbicide to a Missouri grape vineyard, 1987-89.

Herbicide and formulation	Rate (kg a.i./ha)	1987			1988			1989			1987-89		
		Total	Grass	Broad-leaf	Total	Grass	Broad-leaf	Total	Grass	Broad-leaf	Total	Grass	Broad-leaf
Dichlobenil 4G	6.7	19	6	154	34	0	88	51	0	135	34	0	126
Diuron 80W	5.4	57	49	154	28	0	88	89	0	126	58	4	123
Napropamide 50WP	4.5	36	52	47	19	69	0	19	0	21	24	37	23
Norflurazon 80WP	5.4	91	138	143	51	37	48	51	5	58	64	60	83
Oryzalin 75WP	6.7	92	140	138	55	88	24	68	5	82	71	78	81
Oxadiazon ² 50WP	4.5	41	35	130	24	27	24	26	0	31	30	21	62
Oxadiazon ² 2G	4.5	42	62	92	50	88	18	6	10	6	32	54	39
Oxyfluorfen 1.6E	2.2	41	30	154	39	0	88	44	0	80	41	2	107
Pronamide 50W	4.5	36	29	128	13	42	24	15	0	19	21	19	57
Simazine 80W	5.4	25	13	154	22	0	88	68	0	129	38	0	124
Simazine ³ 80W	5.4	18	6	154	39	0	88	80	0	135	45	0	126
LSD ($P \approx 0.05$)		12	14	32	14	33	34	25	NS	37	16	23	24

²Oxadiazon not registered for use on grapes.

³Applied in spring.

days after the one spring application, cumulative rainfall was 73 mm in 1987, 166 mm in 1988, and 51 mm in 1989. These were adequate amounts to leach the pre-emergent herbicide into the soil to form a weed barrier. However, rainfall following the Fall 1987 application was excessive, and this may have reduced the herbicide residual in the weed germination zone.

The untreated controls showed 30% total weed cover by the following dates in the 3 years of the experiment: 28 Apr. 1987(118 days), 21 May 1988 (141 days), and 18 Apr. 1989 (108 days). The 3- to 4-week delay in weed cover in 1988 was probably due to the low amount of rainfall that occurred in May of that year, only 50 mm. The 10-year average for rainfall in May at the station is 126 mm. The untreated controls were completely weed-covered by the 2nd week of June in 1987 and 1989 (data not shown). They were not weed-covered in 1988 until the end of the season, likely because of low rainfall early in the 1988 growing season.

The winter annual broadleaf weeds common chickweed, corn speedwell, purslane speedwell, Virginia pepperweed, and yellow rocket were usually controlled by herbicides until early May, when summer annuals began to germinate (data not shown). In 1987 and 1988, annual grasses were the dominant cover in the untreated controls during the growing season with annual and perennial broadleaf weeds dominant in 1989 (data not shown).

Most of the herbicides gave extended control of annual broadleaf weeds in 1987, napropamide being the exception (Table 1). These periods of acceptable control were probably accentuated by the dominance of annual grasses in the untreated controls. These grasses suppressed the establishment of an-

nual broadleaf weeds (data not shown). Days of acceptable control of annual broadleaf weeds in 1988 and 1989 by the herbicides were less than in 1987 (Table 1), but several herbicides gave extended control: dichlobenil, diuron, oxyfluorfen, and simazine. The 3-year combined data showed these gave the most days of acceptable broadleaf weed control (Table 1). These herbicides are primarily active on annual broadleaf weeds (Crop Protection Chemical Reference, 1989).

In 1987 and 1988, grasses were dominant. The herbicides, norflurazon, oryzalin, and oxadiazon (2G), gave extended control of annual grass weeds in one or both years and over the 3 years (Table 1). In 1989, these same herbicide-treated plots were no better than the untreated controls. The untreated controls showed little grass cover in 1989. It is possible that randomization of the controls (and treatments) in 1989 may have contributed to this result. However, a shift in weed population from predominantly summer annual grasses in 1987 and 1988 to more annual and perennial broadleaf weeds in 1989 was observed in the untreated controls (data not shown). The perennials dandelion, high-bush blackberry, horsenettle, and mouseear chickweed became a larger part of the broadleaf population. This may be a consequence of single herbicide used the previous 2 years (Schubert, 1972; Skroch, 1970; Welker, 1984).

Diuron and simazine, herbicides that have been used for many years in Missouri, gave poor control of annual grasses over the 3 years, but annual broadleaf control was extended (Table 1). The spring application of simazine was no better than the fall application.

Fall application of herbicide in Missouri grape vineyards is not recommended on the

basis of these results. The period of acceptable annual weed control the following growing season is not enough to avoid weed competition with grapevines. It appears that growers who want to apply fall preemergent herbicide for control of winter annual weeds would need to supplement it with spring application of preemergent herbicide. An alternative is to tank-mix a postemergent herbicide with the spring-applied preemergent compound (Kennedy et al., 1979). Herbicide combination (tank-mix) and rotation (different chemical from year to year) may provide a broader weed control spectrum with less chance for a change in weed populations to occur (Hertz and Anklam, 1986; Welker and Meade, 1980).

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