Weed Control In Field-Grown Holly[1]

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Abstract

Two separate experiments were conducted over a 3-year growing period to examine control of grass and broadleaf weeds in three cultivars of *Ilex*. The effect of application timing and number of applications of a tank mixture of Surflan (oryzalin) + Princep (simazine) [2.2 + 0.9 kg ai/ha (2.0 + 0.75 lb ai/A)] were examined in the first study. Maximum season-long control was obtained with any treatment that contained a minimum of two herbicide applications, with the first applied in March and the second in July. The performance of various 2-way combinations of Surflan, Princep and Goal was examined in the second experiment. Acceptable weed control was obtained with any combination that contained broadleaf and grass-active herbicides. Inspection of data across both studies indicates that timing of application is of greater importance than the specific herbicides used.

Index words: nursery crops, herbicides, oryzalin, oxyfluorfen, Princep

Herbicides used in this study: Surflan (oryzalin), 4-(dipropylamino)-3,5-dinitrobenzenesulfonamide; Princep (simazine), 6-chloro-N,N'-diethyl-1,3,5-triazine -2,4-diamine; Goal (oxyfluorfen), 3-chloro-1-(3-ethoxy-4-nitropheneoxy) -4-(trifluoromethyl)benzene.
Species used in this study: *Ilex* x *meserveae* 'China Girl'; *Ilex.* x *aquipernyi* 'San Jose', and *Ilex aquifolium* x *cornuta* 'Nellie R. Stevens'.

Significance to the Nursery Industry

Weed control is a major problem in the production of field-grown woody landscape crops in the Southeastern United States. This research demonstrates that proper timing of herbicide application appears to be as important to weed control as the choice of herbicides. Two applications of Surflan (oryzalin) + Princep (simazine) [2.2 + 0.9 kg ai/ha (2.0 + 0.75 lb ai/A)], the first in March and the second in July, were necessary for maximum weed control. One application did not provide season-long control, and a third application provided no further improvement in weed control. Herbicide combinations in which Goal (oxyfluorfen) [≥ 0.9 kg/ha (0.75 lb/A)] was used in lieu of Princep (simazine) were also effective, and were not injurious to the three Ilex species.

Introduction

Weed control in field-grown nursery crops and landscape beds generally requires the application of herbicide combinations, as well as multiple applications of these combinatins during a growing season. Beste and Frank (4), in Maryland reported that a combination of Devrinol (napropamide), Goal (oxyfluorfen), and Ronstar (oxadiazon), applied twice per season to field-grown azalea, controlled greater than 99% of the weeds at the end of the growing season. In contrast, a single application provided only 63–77% weed control. Akers et al. (2), working in Illinois, reported that Roundup (glyphosate) applied preplant, followed by Princep alone or in combination with either Surflan, Enide (diphenamid), Lasso (alachlor), or Devrinol, resulted in season-long weed control in field-grown nursery crops. In Connecticut, Ahrens (1) reported November applications of Princep alone at 1.8 to 2.7 kg ai/ha (1.5 to 2.5 lb ai/A), or at 1.8 kg ai/ha when in combination with other herbicides, provided over 95% control of weeds as rated in late May of the following year.

Information on the use of herbicides in nursery crop production in the Southeastern United States is limited. Compared to northern locations, achieving satisfactory weed control is more difficult since the growing season is longer, and warmer soil temperatures may hasten herbicide dissipation. Wehtje et al. (14) working in Alabama, evaluated several herbicide combinations applied twice annually and reported that Surflan + Princep at 2.2 + 0.8 kg ai/ha provided acceptable weed control in field-grown photinia and boxwood. The first objective of this research was to examine how time of Surflan + Princep application affected weed control in field-grown *Ilex* in the Southeast.

Goal has been demonstrated to provide excellent weed control in selected woody crops. The 2% granular has been evaluated extensively in container production and reported to be safe to a wide range of woody plants (3,4,6). Fretz et al. (9) compared the 2E and 2G formulations, and reported the 2E formulation was significantly more injurious to woody plants. Davis and Minton (7) reported injury from application of Goal 2E to 3 of 13 plant species. Three *Ilex crenata* cultivars were not injured. Over-the-top application of Goal 1.6E to container-grown euonymus caused foliar injury and inhibited growth of transplanted cuttings (11). Weller et al. (13) compared Goal formulations in container nursery crops and reported the EC formulation to provide superior weed control but greater injury than either the granular or wettable powder formulation. Derr (8) reported pretransplant applications of Goal to be safe to four nursery species and effectively controlled annual weeds for up to four months in container-grown nursery crops. Caviness et al. (5) reported container-grown azaleas to be more sensitive to foliar treatment of Goal than were Japanese holly. Gilliam et al (10) showed mid-summer application of Goal to be non-injurious when applied over-the-top of 4 field-grown woody plants. This lack of injury was attributed to the semi-dormant state that plants enter during an environmentally stressful period of the year. The second objective was to evaluate multiple applications of Goal on three species of field-grown *Ilex* for efficacy and weed control.

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Materials and Methods

Two experiments with separate objectives were conducted simultaneously. The first experiment examined the effect of herbicide application timing, and the second evaluated the preformance of various hericide combinations.

Procedures common to both experiments. Three *Ilex* cultivars were chosen for this experiment because of large acreage plantings in north Alabama. Uniform liners of: *Ilex* x *meserveas* 'China Girl', *I.* x *aquipernyi* 'San Jose', and *I. aquifolium* x *cornuta* 'Nellie R. Stevens' were planted on March 12, 1985, in a Hartsells fine sandy loam soil (fine-loamy, siliceous, thermic, typic Hapludults) at the Sand Mountain Substation, Crossville, Alabama. The research area was uniformly infested with large crabgrass [*Digitaria sanguinalis* (L.) Scop], entire leaf morningglory (*Ipomoea hederacea* L. var. *integriuscula* Gray), and prickly sida (*Sida spinosa* L.). Plots were 3 × 4.6 m (10 × 15 ft) with plants spaced 0.9 × 1.1 m (3 × 3.6 ft). Fertilizer was broadcast applied prior to planting, and annually thereafter in November using a 13N-5P-11K granular fertilizer, which resulted in 67N-28P-55K kg/ha (60-25-49 lb/A). There were 4 replicates with 4 plants per replicate in a randomized block design.

Herbicides were applied with a tractor-mounted, compressed-air boom-type sprayer operating at 220 kPa (32 psi) and delivering 140 liters/ha (15 gal/A) of water. Initial herbicide treatments were applied over-the-top 2 weeks after planting. Treatments were reapplied according to the pertinent treatment schedule.

Data collected included crop injury (0 = no effect, 100 = death), percentage weed control (0 = no control, 100 = total control), and hand hoeing times were determined in mid-July each year just prior to the second application, and in early October each year (end of the growing seson). Plots were uniformly weed-free prior to the second application. Growth indices [(height + width + width)/3] were taken in early October each year. All data were subjected to analysis of variance, and the treatment means separated by Duncan's multiple range test.

Both experiments had 2 control treatments. The first was hand weeded in July just prior to the second herbicide application, and again at the end of the growing season in early October. The second control was hand weeded only at the end of the growing season.

Experiment 1. Surflan + Princep at 2.2 + 0.9 kg ai/ha (2.0 + 0.75 lb ai/A) was applied 5 times: March; March-July; March-July-November; March-November; and July-November.

Experiment 2. Six different herbicide combinations (Table 2), were evaluated under a common schedule (March-July).

Results and Discussion

Experiment 1. Maximum season-long broadleaf weed control was obtained with all treatments that contained a minimum of 2 Surflan + Princep applications that included the March + July treatments (Table 1). An additional herbicide application in November (i.e. a total of 3 applications) offered no further improvement of control. Other treatments that had 2 applications (i.e. March-November or July-November) also provided maximum control at one or more rating periods. However, only the March-July application obtained maximum control for the duration of the growing season. Broadleaf weed control in 1986 and 1987 exhibited a similar trend to that which was established in 1985. However, treatments that were marginal in performance in 1985 tended to be more effective in 1986 and 1987. This may be attributable to increased crop competition and residual herbicide effects (14). These data also show that during the first year in production when crop competition is minimal, maximum herbicide inputs are necessary. Furthermore, the data indicate that during the second and subsequent years herbicide inputs may be decreased.

Grass control followed a similar pattern that was observed with broadleaf control. In 1985, two applications of Surflan + Princep resulted in maximum grass control. A third application of Surflan + Princep in November did not improve control when compared to the March + July application. In all years, all herbicide treatments were effective in providing the maximum level of grass control.

Hoeing times were generally reflective of weed control ratings (Table 2). Application of Surflan + Princep in March-July resulted in minimum hoeing times. Hoeing time, as averaged over all treatments, decreased each year. This trend probably reflects increased crop competition and residual herbicide activity.

Maximum growth indices of 'China Girl' holly when oryzalin at 2.2 kg/ha and Princep at 0.9 kg/ha was applied

Table 1. Experiment 1. Weed control as influenced by timing of Surflan + Princep [2.2 + 0.9 kg/ha (2.0 + 0.8 lb/A)] to 3 field-grown Ilex.

	Broadleaf weed control						Grass weed control					
	1985		1986		1987		1985		1986		1987	
Time of application	7/18	9/19	7/15	10/7	7/1	9/30	7/18	9/19	7/15	10/7	7/1	9/30
	(%)											
M[z]	78ab[y]	78bc	80ab	88abc	100a	95ab	74a	71b	100a	100a	98a	100a
M-J	76ab	90a	84ab	97ab	100a	100a	80a	96a	100a	100a	100a	100a
M-J-N	84a	88a	93a	99a	100a	99a	84a	97a	100a	100a	100a	100a
M-N	70ab	68bc	93a	78c	100a	95ab	90a	81b	100a	100a	96a	100a
J-N	0c	85ab	60bc	95ab	100a	100a	0c	90a	85a	99a	100a	100a
HW	63b	64c	49c	84bc	36b	90b	20b	70b	24b	58b	88b	30b
NW	0c	0d	0d	0d	0c	0c	0c	0c	0c	0c	0c	0c

[z]M = March, J = July, N = November, HW = hand weeded, NW = nonweeded.

[y] Means within columns followed by the same letter or letters are not significantly different at the 5% level as determined by Duncan's multiple range test.

Table 2. **Time required to remove remaining weeds from plots at the end of the growing season (early October).**

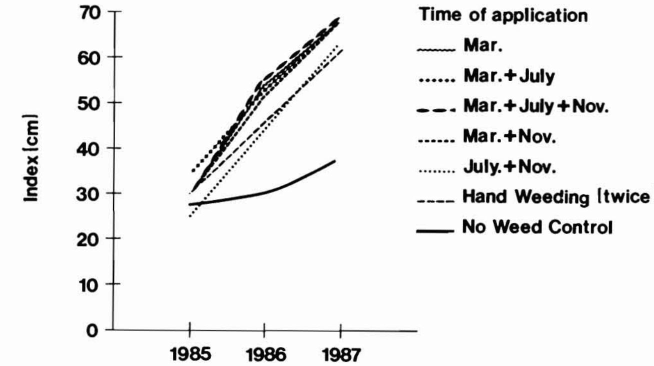
Treatment		1985	1986	1987
		Year		
Experiment 1: Application timing of S + P (2.2 + 0.9 kg/ha)			minutes/plot	
M[z]		7.8b[y]	2.2bc	0.6c
M-J		2.9c	0.4c	0.2c
M-J-N		2.6c	0.2c	0.2c
M-N		6.5b	3.0bc	0.7c
J-N		4.1bc	0.9c	0.3c
HW		10.7ab	7.7b	5.2
NW		29.1a	38.2a	11.1a
Experiment 2: Various herbicide combinations applied M-J				
Herbicide	Rate kg/ha			
S + P[y]	2.2 + 0.9	2.9c	0.4c	0.2c
S + P	3.1 + 1.1	1.1c	0.1c	0.2c
G + P	1.1 + 0.9	1.5c	0.4c	0.3c
G + P	2.2 + 0.9	1.6c	0.0c	0.3c
S + G	2.2 + 0.9	2.5c	0.0c	0.3c
S + G	4.5 + 1.1	1.3c	0.1c	0.2c
HW		10.7b	7.7b	5.2b
NW		29.1a	38.2a	11.1a

[z]M = March, J = July, N = November, HW = hand weeded, NW = non weeded, S = Surflan, P = Princep, G = Goal.

[y] Means within columns followed by the same letter or letters are not significantly different at the 5% level as determined by Duncan's multiple range test.

in March (Figure 1). Applying Surflan + Princep in July-November resulted in reduced growth indices throughout the study. These data demonstrate the importance of early season weed control in reducing weed crop competition. Similar plant size among March-based treatments during the third year tends to confirm that if adequate weed control practices are maintained, fewer herbicide applications are necessary in the later crop years.

Experiment 1



Experiment 2

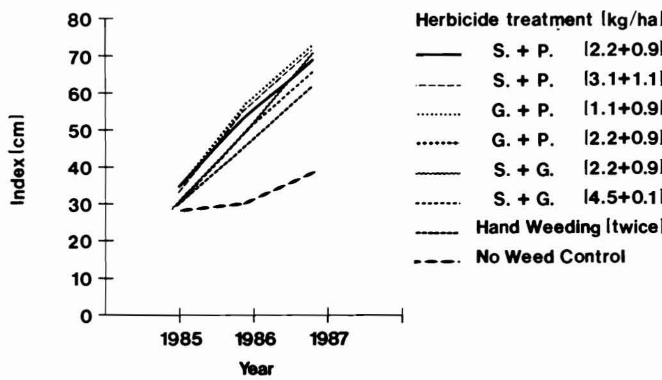


Fig. 1. **Growth index of 'China girl' holly as influenced by (Experiment 1) time of application(s) of Surflan + Princep (2.2 + 0.9 kg/ha); and by (Experiment 2) various herbicide combinations applied in March and again in July; G = Goal, P = Princep, S = Surflan.**

Experiment 2. Across all years, all the herbicide treatments provided the equivalent maximum level of both broadleaf and grass weed control. No differences between

Table 3. **Experiment 2. Weed control in field-grown nursery stock as influenced by herbicide combinations applied in March-July.**

Herbicide	Rate kg/ha	Broadleaf weed control 1985 7/18	1985 9/19	1986 7/15	1986 10/7	1987 8/27	1987 9/30	Grass weed control 1985 7/18	1985 9/19	1986 7/15	1986 10/7	1987 7/1	1987 9/30
							(%)						
S + P[z]	2.2 + 0.9	86b[y]	90a	84a	97a	100a	100a	80a	96a	100a	100a	100a	100a
S + P	3.1 + 1.1	83ab	91a	93a	100a	100a	100a	87a	96a	100a	100a	100a	100a
G + P	1.1 + 0.9	82ab	93a	90a	99a	100a	100a	61b	95a	87a	100a	100a	100a
G + P	2.2 + 0.9	93a	97a	91a	100a	100a	100a	93a	100a	98a	100a	98a	100a
S + G	2.2 + 0.9	91ab	90a	88a	100a	100a	100a	92a	100a	100a	100a	100a	100a
S + G	4.5 + 1.1	93a	97a	95a	100a	100a	100a	88a	99a	100a	100a	100a	100a
HW		63c	64b	49b	84a	36bc	90b	20c	70b	24b	58b	88b	30b
NW		0d	0c	0c	0c	0c	0c	0d	0c	0c	0c	0c	0c

[z]P = Princep, S = Surflan, G = Goal, HW = hand weeded, NW = nonweeded.

[y] Means within columns followed by the same letter or letters are not significantly differently at the 5% level as determined by Duncan's multiple range test.

individual treatments were detected. The only exception was Goal + Princep (low rate), in which grass control at the first rating in 1985 was less than the other treatments (Table 3). This was expected since both of these herbicides are primarily active against broadleaf species.

No crop injury resulted from the mid-season applications of Goal. This is in agreement with previous work (10). *Ilex* typically exhibits episodic growth patterns (15) characterized by periodic stem elongation. Mertens and Wright (12) reported that less than ideal conditions may reduce shoot growth until satisfactory conditions prevail. Under non-irrigated field conditions during the summer months in the Southeastern United States, less than ideal growing conditions may exist. Elongated stems harden off and remain in that condition until favorable conditions occur. The application of Goal-containing herbicide combinations during July over a 3-year period caused no injury to 3 field-grown *Ilex*. Other woody crops have responded similarly in the Southeastern United States (10).

Data from both experiments indicate that application timing is of greater importance than herbicide selection. Provided the combination contains both a broadleaf and grass-active herbicide, and rates are sufficient, acceptable weed control can be obtained. The critical factor was the time of application. None of the herbicides evaluated had sufficient residual activity to provide control for the entire season with a single application. These data concur with that of Beste and Frank (4), which showed that two applications per season were necessary for acceptable weed control in field-grown azalea. An initial application in March served to eliminate much of the weed competition during the period of spring growth. A second application extended control through the remainder of the season. These data also suggest that chemical weed control needs are greatest during the first year following planting.

(*Ed. note*. This paper reports the results of research only, and does not imply registration of a pesticide under ammended FIFRA. Before using any of the products mentioned in this research paper, be certain of their registration of appropriate state and/or federal authorities.)

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