Cultural and Chemical Control of Ground Ivy
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Objective The objectives of this research were to evaluate nitrogen fertility programming, preemergence herbicides, and postemergence herbicides for ground ivy control.

Rationale Ground ivy is a creeping perennial weed in turf in the cooler climates of northeastern and midwestern United States. During summer and fall, populations rapidly increase in size through vegetative propagation along stolons. Eventually the turf site is populated with patches of ground ivy, resulting in a non-uniform turf stand. Once established, controlling ground ivy is challenging for the lawn care industry. In a survey of lawn care operators (LCO) in Indiana, 49% of respondents reported poor or fair control of ground ivy and 40% reported non-uniform control. Additionally, 86% indicated repeated herbicide applications were necessary for successful ground ivy control, further suggesting chemical control of ground ivy is challenging. Time, money, and effort spent on controlling ground ivy is considerable since 31% of the LCO customers had ground ivy on their property. However, there has been little research focusing on ground ivy control. Extensive rooting from ground ivy stolons makes mechanical control difficult. Nitrogen application, irrigation, and mowing have been attempted to limit encroachment of weeds other than ground ivy, but there are no reports of cultural control of ground ivy. Both preemergence and postemergence herbicides have been used successfully for decades to control grassy or other broadleaf weeds, but ground ivy control remains challenging and inconsistent.

How It Was Done

Conditions Common to Experiments
All experiments were conducted for one year and performed twice on different but adjacent sites at the W.H. Daniel Turfgrass Research Center in West Lafayette, IN. Field plots (5 by 5 ft) were located in full sun in a low-maintenance stand of Kentucky bluegrass that had not been fertilized the previous 2 years. Plots were irrigated as needed to prevent drought stress and mowed three times per week at 2.5 inches with clippings returned. All herbicide treatments were applied in 4 gal/1000 sq ft water with a CO_2-pressurized backpack sprayer using a three-nozzle (TeeJet XR8002VS) boom at 40 psi.

Nitrogen fertility study
Fertilizer treatments were applied to plots containing uniform stands of ground ivy beginning on 15 May 2000 and 14 May 2001. Treatments were a 3 by 3 factorial with three annual nitrogen rates (2, 4, or 6 lbs/1000 sq ft) and three application schedules (heavy spring, heavy fall, or equal spring, summer, and fall) and an untreated control was included for comparison. Fertilizer and scheduled rates are given in Table 1. Fertilizer application dates were: 15 May ± 1, 25 July ± 2, 18 Sept. ± 2, 17 Oct. ± 2, 15 Nov. ± 2, 23 Mar. ± 2, and 23 Apr. ± 1. On each application date, total nitrogen was applied as 50% (by N content) urea (46N–0P–0K) and 50% sulfur-coated urea (32N–0P–0K). While percent ground ivy cover was visually estimated every 4 weeks for 1 year during each experiment, only data collected 12 months after initial treatment (MAIT) for each experiment is presented.

Preemergence herbicide study

Three 4-inch-diameter by 3-inch-deep plugs of ground ivy were transplanted into plots on 14 May 1999 and 10 May 2000. One week later, the following preemergence herbicides were applied at the highest-labeled rate or at one-half the highest-label rate for Kentucky bluegrass: prodiamine at 1.5 or 0.8 lbs ai/A, dithiopyr at 0.5 or 0.3 lbs ai/A, isoxaben at 1.0 or 0.5 lbs ai/A, or pendimethalin at 3.0 or 1.5 lbs ai/A. Cover of ground ivy was rated visually at 6, 12, and 26 weeks after treatment (WAT). Treatments were a 2 by 4 factorial with two rates and four herbicides, and an untreated control was included for comparison.

Postemergence herbicide study

Ten postemergence herbicide combinations were sprayed at the highest-labeled rate or at one-half the highest-label rate for Kentucky bluegrass on plots containing dense, uniform stands of ground ivy on 30 Oct. 1999 and 15 Oct. 2000 (Table 2). Cover of ground ivy was rated visually at 3, 6, and 30 WAT. Treatments were a 2 by 9 factorial with two rates and nine herbicides, and an untreated control was included for comparison.

Results

Nitrogen fertility study

- Nitrogen application schedule had no effect on ground ivy cover when measured 12 MAIT (Table 3). Therefore, nitrogen application at any time of the year will help reduce ground ivy cover. However, cool season turf benefits most from fall-applied nitrogen, which results in better foliar color retention in the late fall as well as increased shoot density and root growth.
- Annual nitrogen rates above 2 lbs/1000 sq ft decreased ground ivy cover (Table 3). Raising nitrogen rates from 0 to 6 lbs/1000 sq ft/year decreased ground ivy cover by 32%. However, 6 lbs nitrogen/1000 sq ft/year for Kentucky bluegrass would be excessive, potentially reducing stress tolerance, and increasing mowing requirements and susceptibility to certain diseases. However, increasing nitrogen from 0 to 4 lbs/1000 sq ft/year reduced ground ivy cover 24% which would be an acceptable nitrogen rate for most home lawns.
- Other researchers have found increasing nitrogen rates in turf reduces crabgrass or dandelion. However, higher fertilization rates can increase bermudagrass and broadleaved dock. Therefore, the effects of increased nitrogen application on weed-turf competition are dependent on the specific weed and turf species involved.
- Increasing nitrogen likely improved the competitiveness of Kentucky bluegrass in our study, thus reducing ground ivy cover. Reducing ground ivy cover with increased nitrogen is simple, inexpensive, and can be an effective tool in a comprehensive ground ivy control program.

Preemergence herbicide study

- Only isoxaben reduced ground ivy cover throughout our studies (Table 4). At 26 WAT, ground ivy cover was reduced 34% by 1.0 lb ai/A isoxaben and 16% by 0.5 lb ai/A isoxaben compared to the control plots. Ground ivy stolons in plots treated with 1.0 lb ai/A isoxaben developed roots that were short, stubby, black, and had not penetrated the soil.

- Prodiamine, pendimethalin, and dithiopyr had no effect on ground ivy cover, and the rooting behavior of ground ivy in these treatments was similar to that of the untreated control.
- It is not surprising that most of the treatments did not have an effect on ground ivy cover. Prodiamine, dithiopyr, and pendimethalin are typically regarded as preemergence herbicides for annual grassy weed control even though their labels indicate that certain broadleaf weeds germinating from seed can also be controlled. Ground ivy is a perennial and little effect would be expected on rooting and spread from preemergence annual grass herbicides like prodiamine, dithiopyr, and pendimethalin. However, since the herbicides are often used on lawns, it is important to understand potential positive or negative affects on ground ivy.
- Ground ivy is difficult to control likely due to its ability to quickly reestablish after postemergence herbicide treatment. If all nodes along a stolon are not controlled, the surviving nodes have the potential to produce new roots and stolons. Complete postemergence herbicide coverage of ground ivy is impossible since nodes near the apical meristem exist that have rooted but have not yet pushed leaves above the turf canopy. Isoxaben could limit these developing nodes' rooting ability, reducing reestablishment and improving control from both cultural control methods and postemergence herbicides.

Postemergence herbicide study

- As expected, the full-labeled rate provided better control than the half-labeled rate on four of six rating dates. At 30 WAT, the full-labeled rate provided 11% and 20% less cover than the half-labeled rate in 1999 and 2000, respectively. Therefore to maximize ground ivy control, application of the full-labeled rate of the herbicide is necessary.
- Triclopyr + clopyralid, triclopyr, MCPP + 2,4-D + dicamba (5:10:1), both formulations of 2,4-D, and fluroxypyr reduced ground ivy compared to the control on four of the six rating dates (Table 5).
- MCPP + 2,4-D + dicamba (8:2:1), dicamba, and quinclorac reduced ground ivy cover on only one of the six rating dates. Considering how little control resulted from dicamba in our study, there appears to be little benefit from using dicamba alone or in a tank mix with other herbicides for ground ivy control.
- Clopyralid had no effect on ground ivy throughout our study.
- Herbicide combinations that include either triclopyr, 2,4-D, or fluroxypyr provided maximum ground ivy control.
- Ground ivy control generally improved between fall and the following spring. For instance, at 3 WAT in 2000, triclopyr reduced ground ivy slightly compared to the untreated control and significantly less than 2,4-D-ester. However, triclopyr reduced ground ivy cover to only 3% by the following spring (30 WAT), and this cover was similar to that produced by 2,4-D-ester. Thus, the efficacy of slower-acting herbicides such as triclopyr might not become apparent until the following spring.
- While 2,4-D is generally thought to not provide good ground ivy control, in our study it performed well. At 30 WAT in both years, 2,4-D dramatically reduced ground ivy cover. Raising the 2,4-D:MCPP ratio from 1:4 to 2:1 improved ground ivy control, especially in the second year, also suggesting that 2,4-D is highly active on ground ivy.

Summary

- Based on the results of our experiments, a ground ivy control strategy can be developed for cool-season turf. First, the turf site should receive an annual nitrogen application of 4 lbs/1000 sq ft to improve or maintain turf density. Second, a one-time application of 1.0 lb ai/A isoxaben in the spring will coincide with the beginning of the lateral growth habit of ground ivy stolons, severely curtailing its ability to spread. Third, a postemergence herbicide product containing 2,4-D combined with triclopyr and/or fluroxypyr should be applied in the fall at the highest labeled rate for a given turfgrass species. Proper nitrogen fertility programming, preemergence herbicide application, and postemergence herbicide application can improve ground ivy control.

Table 1. Annual nitrogen rate and application schedule for the nitrogen fertility study.

	Application schedule			Nitrogen application rate and schedule						
Annual nitrogen rate	Spring	Summer	Fall	Mar.	Apr.	May	July	Sept.	Oct.	Nov.
lbs/1000 sq ft	% total annual nitrogen			lbs/1000 sq ft						
0	---[z]	---	---	---	---	---	---	---	---	---
2	67	---	33	0.45	0.45	0.45	---	0.66	---	---
2	33	33	33	---	---	0.66	0.66	0.66	---	---
2	33	---	67	---	---	0.66	---	0.45	0.45	0.45
4	67	---	33	0.90	0.90	0.90	---	1.33	---	---
4	33	33	33	---	---	1.33	1.33	1.33	---	---
4	33	---	67	---	---	1.33	---	0.90	0.90	0.90
6	67	---	33	1.33	1.33	1.33	---	2.00	---	---
6	33	33	33	---	---	2.00	2.00	2.00	---	---
6	33	---	67	---	---	2.00	---	1.33	1.33	1.33

[z] Nitrogen not applied.

Table 2. Postemergence herbicides and application rates used in the postemergence herbicide study to control ground ivy.

Herbicide	Full rate	Half rate
	lbs ai/A	
Triclopyr + clopyralid	0.5 + 0.2	0.3 + 0.1
Triclopyr	1.0	0.5
Clopyralid	0.5	0.3
MCPP + 2,4-D (amine) + dicamba	0.7 + 0.3 + 0.1	0.4 + 0.1 + 0.1
MCPP + 2,4-D (amine) + dicamba	0.5 + 1.0 + 0.1	0.3 + 0.5 + 0.1
Dicamba	1.0	0.5
2,4-D (amine)	2.0	1.0
2,4-D (ester)	2.0	1.0
Quinclorac	0.7	0.4
Fluroxypyr	0.3	0.1

Table 3. Effect of annual nitrogen application schedule and rate on ground ivy cover in Kentucky bluegrass turf 12 months after initial treatment.

	Ground ivy cover[z]
	%
Nitrogen application schedule	
Untreated	72 b
Spring	50 a
Summer	51 a
Fall	46 a
Nitrogen rate (lbs/1000 sq ft)	
0	72 b
2	59 b
4	48 a
6	40 a

[z] Within variables, means followed by the same letter are not significantly different according to Fisher's LSD(0.05) test. Data are averaged over two years.

Table 4. The effect of herbicide and rate on ground ivy cover in Kentucky bluegrass at 6, 12, and 26 weeks after treatment.

	Ground ivy cover								
	6 WAT[z]			12 WAT			26 WAT		
	Rate			Rate			Rate		
Herbicide	Half	Full	Mean	Half	Full	Mean	Half	Full	Mean
					%				
Prodiamine	9[y]	8	8	18	18	18	43	48	45
Dithiopyr	9	6	7	18	14	16	41	37	39
Isoxaben	5	2	3	11	4	7	26	8	17
Pendimethalin	9	6	7	16	17	16	40	41	40
Mean	8	5		16	13		38	33	
Control[x]	8	0		19	0		42	0	
LSD(0.05) for comparing H means		2			4			6	
LSD(0.05) for comparing R means		1			NS			NS	
LSD(0.05) for comparing H × R means		NS			NS			5	

[z] Weeks after treatment.
[y] Means of six replications. Data averaged over two years.
[x] For comparison.

Table 5. Ground ivy cover in Kentucky bluegrass turf after treatment in Oct. with postemergence herbicides.

	% Ground ivy cover[z]					
	1999			2000		
	3 WAT	6 WAT	30 WAT	3 WAT	6 WAT	30 WAT
Herbicide						
Triclopyr + clopyralid	41 bc	46 d	29 b	53 c-e	48 de	10 bc
Triclopyr	42 c	43 bc	27 ab	44 b-d	26 b-d	3 ab
Clopyralid	32 bc	34 ab	44 cd	75 f	79 f	66 de
MCPP + 2,4-D (amine) + dicamba (8:2:1)	40 a-c	43 c	47 cd	73 ef	72 f	53 d
MCPP + 2,4-D (amine) + dicamba (5:10:1)	39 a-c	35 a-c	35 bc	51 cd	40 cd	16 c
Dicamba	31 a	36 a-c	37 bc	76 f	65 ef	60 de
2,4-D (amine)	34 a-c	37 a-c	32 b	27 ab	12 ab	5 a-c
2,4-D (ester)	34 a-c	33 a	18 a	15 a	4 a	1 a
Quinclorac	35 a-c	39 a-c	38 bc	64 d-f	70 f	61 de
Fluroxypyr	35 a-c	38 a-c	29 b	37 bc	25 bc	10 bc
Control	36 a-c	37 a-c	54 d	73 ef	85 f	76 e
Application rate						
Full-labeled rate	36 a	38 a	28 a	42 a	31 a	14 a
Half-labeled rate	36 a	39 a	39 b	61 b	56 b	34 b
Control	36 a	37 a	54 c	73 c	85 c	76 c

[z] Within variables, means followed by the same letter are not significantly different according to Fisher's LSD(0.05) test.