

Ground Ivy Populations Respond Differently to 2,4-D or Triclopyr

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Objective	The objectives were to determine 1) if ground ivy populations vary in their morphology, 2) the response of ground ivy populations to 2,4-D and triclopyr, 3) if genetic diversity exists within populations of ground ivy, and 4) whether genotype has an effect on herbicidal control.
Rationale	Ground ivy is a stoloniferous perennial weed that can potentially develop a dense leaf canopy that shades less competitive turfgrass, resulting in thin turf. Once established, ground ivy control can be difficult and inconsistent. A survey of Indiana lawn care operators (LCO) found that 31% of the respondents' customers had ground ivy on their property. In addition, it was found that 40% of LCO encountered ground ivy populations having a non-uniform or variable response to postemergence herbicide application. It is unknown why this is so, but may be attributed to variation in herbicide resistance. Determining the variability of ground ivy response to herbicides could improve control.
How it was done	<p><i>Selection and Maintenance of Ground Ivy Populations</i></p> <p>A single population of ground ivy in eight U.S. states and one Canadian province was sampled and brought back to the greenhouse in West Lafayette, IN (Table 1). The stolons were separated and planted into individual 7-inch diameter pots (5:3 soil:peat mix) and maintained in the greenhouse with daily irrigation.</p> <p><i>Ground Ivy Morphology</i></p> <p>Measurements were taken of leaf width, petiole length, and internode length on the nine ground ivy populations.</p> <p><i>Response of Nine Ground Ivy Populations to 2,4-D or Triclopyr</i></p> <p>The nine ground ivy populations were treated with 4 lbs ai/A 2,4-D-amine or 0.8 lbs ai/A triclopyr in a carrier volume of 4 gallons/1000 ft² using an air-pressurized spray chamber. Visual ratings of phytotoxicity on a scale of 0 to 100% with 0 and 100% being uninjured and dead, respectively, were taken every 5 days for 25 days for 2,4-D or every 7 days for 49 days for triclopyr.</p> <p><i>Ground Ivy Genotype Identification and Response to 2,4-D</i></p> <p>Ground ivy DNA was isolated and analyzed using RAPD analysis to determine which plants were genetically identical or different - i.e., either clones or different genotypes. Then 52 ground ivy genotypes were sprayed with 4 lbs ai/A 2,4-D. Visual ratings of phytotoxicity on a scale of 0 to 100% with 0 and 100% being uninjured and dead, respectively, were taken every 5 days for 25 days.</p>
Results	<p><i>Ground Ivy Morphology</i></p> <p>Leaf widths, petiole lengths, and internode lengths varied among populations (Table 2). Leaf widths varied among the populations by as much as 0.4 inches. Though the IL1 and IL2 populations were found only 80 ft apart, IL1 had 15% smaller leaf widths suggesting ground ivy populations occurring naturally. The SD population had longer internodes than the other populations by 1.4 inches. Considering the difficulty in controlling ground ivy, the variation</p>

in morphology among populations may point toward inconsistency in chemical control.

Response of Nine Ground Ivy Populations to 2,4-D or Triclopyr

- Ground ivy growing in close proximity can vary in appearance.
- Leaf shape among the sampled populations varied as well. Leaves of the IL2 population had flat, elongated kidney-shaped leaves with rounded edges while leaves of the TN population had ridged, compact kidney-shaped leaves with deeply scalloped edges (Figure 1).
- Petiole length varied among populations by as much as 1.1 inches. Having longer petioles would allow populations to compete more effectively for sunlight by facilitating leaf growth above the turf canopy.
- The response to 2,4-D varied among ground ivy populations. The CA, OH, SD, and TN populations had greater than 90% injury, while the NE and NS populations had less than 60% injury (Figure 2a).
- Injury caused by triclopyr varied among ground ivy populations. Injury symptoms were severe for the CA, IL1, MI, OH, and TN populations, which showed greater than 80% injury (Figure 2b). The remaining populations, IL2, NE, NS, and SD, had less than 75% injury.
- If 2,4-D-resistant ground ivy populations were encountered by a LCO, based on the results of our experiments, switching to triclopyr would allow for improved control, but would likely not provide excellent control.
- The presence of 2,4-D- or triclopyr-resistant ground ivy populations would help explain why ground ivy is generally a difficult weed to control as well as why LCO experience variable ground ivy control. A herbicide that effectively controls ground ivy in one location may not control ground ivy in other locations. Control could vary from front yard to back yard or neighborhood to neighborhood.

Ground Ivy Genotype Identification and Response to 2,4-D

- Genotypes within the MI, NE, and OH populations responded differently, while genotypes within the IL1, IL2, NS, and TN populations responded uniformly to 2,4-D.
- Based on herbicide injury response, biotypes exist within the MI, NE, and OH ground ivy populations (Figure 3).
- Attempting to chemically control populations of varying genotypes, initially it may seem that control is being achieved as the herbicide-susceptible genotypes are being removed, yet the herbicide-resistant genotypes will remain making the overall population more difficult to control.
- It is important that the LCO be aware of sites where ground ivy is not being effectively controlled, especially after multiple herbicide applications.

Table 1. Ground ivy population collection sites, their environment, and the number of stolons collected from each population.

Population ID	Sampling location	Location description	Mowing height	Sunlight	Size of patch	Regular irrigation	Stolons collected
CA	Laytonville, CA	Garden center	in NA ^a	Full	ft ² NA	Yes	number 16
IL1	Fox Lake, IL	Home lawn	3.0	Full	150	Yes	17
IL2	Fox Lake, IL	Home lawn	3.0	Shade	100	Yes	16
MI	Williamston, MI	Home lawn	2.5	Shade	1600	No	48
NE	Mead, NE	Home lawn	2.5	Full	250	Yes	29
NS	Yarmouth, Nova Scotia	Home garden	NA	Full	25	Yes	15
OH	Columbus, OH	Research plots	2.0	Shade	100	No	23
SD	Brookings, SD	Research plots	2.5	Full	450	Yes	35
TN	Eidson, TN	Home garden	NA	Full	20	No	18

^a NA, not available

Table 2. Leaf width, petiole length, and internode length for nine ground ivy populations on February 21, 2001.

Population	Leaf width ^a	Petiole length ^a	Internode length ^a
		in	
CA	1.1 a	2.0 a	2.1 a
IL1	1.3 a	2.9 b	2.8 a
IL2	1.5 b	3.1 b	2.6 a
MI	1.2 a	2.1 a	2.5 a
NE	1.2 a	2.1 a	2.7 a
NS	1.2 a	2.0 a	2.4 a
OH	1.2 a	2.0 a	2.5 a
SD	1.3 a	2.3 a	3.9 b
TN	1.1 a	2.2 a	2.3 a
Mean	1.2	2.2	2.7

^a Mean separations followed by the same letter are not significantly different. Mean separations were performed using Fisher's protected LSD test at P = 0.05.



Figure 1. Variation in leaf size and shape between the a) IL2 and b) TN ground ivy population.

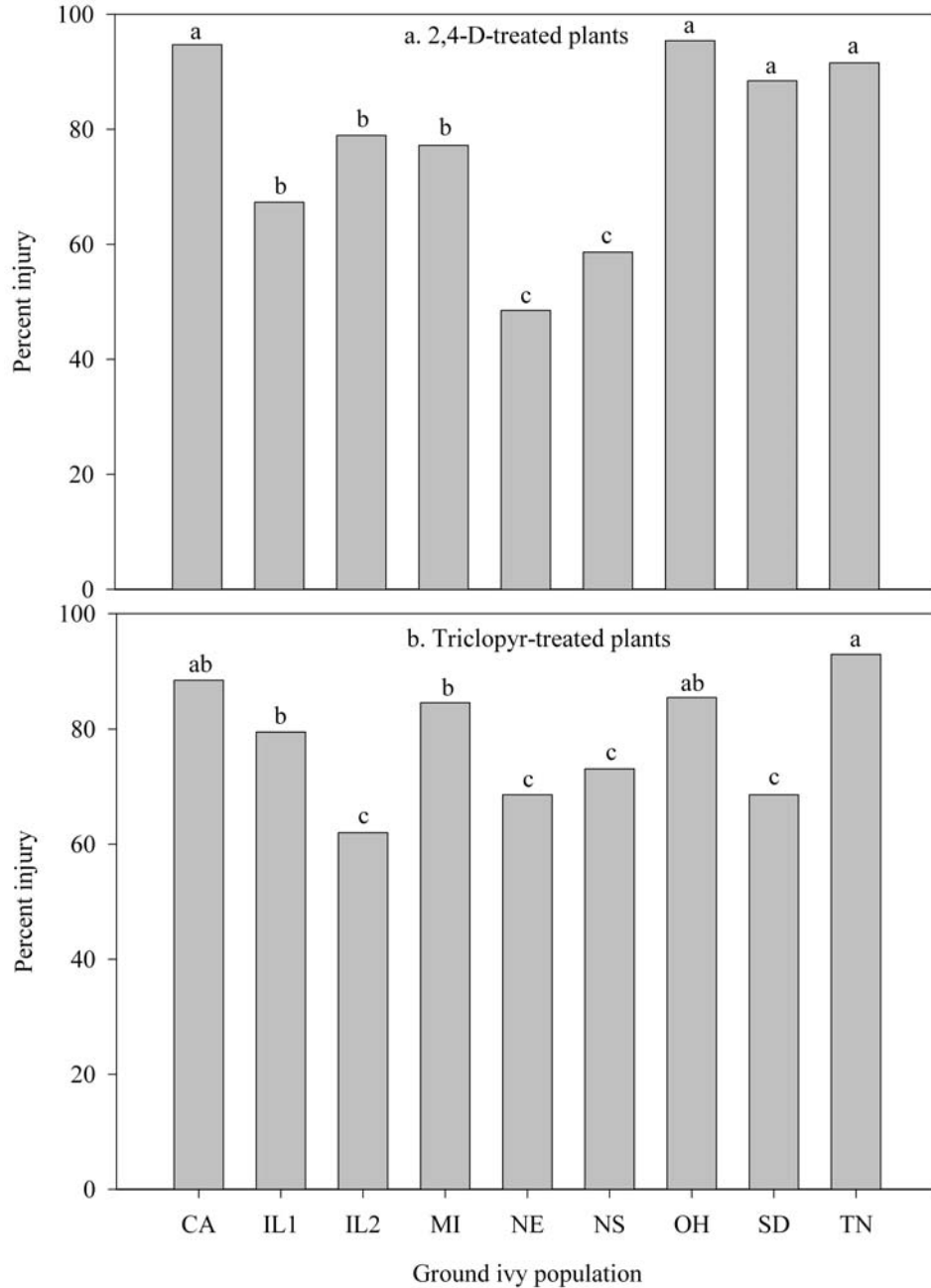


Figure 2. a) Percent visual injury due to 4.0 lbs ai/A 2,4-D application to nine ground ivy populations. Bars with the same letter are not significantly different according to Fisher's LSD test at $P = 0.05$. Bars represent a mean of 70 ratings. b) Percent visual injury due to 0.8 lbs ai/A triclopyr application to nine ground ivy populations. Bars with the same letter are not significantly different according to Fisher's LSD test at $P = 0.05$. Bars represent a mean of 98 ratings.

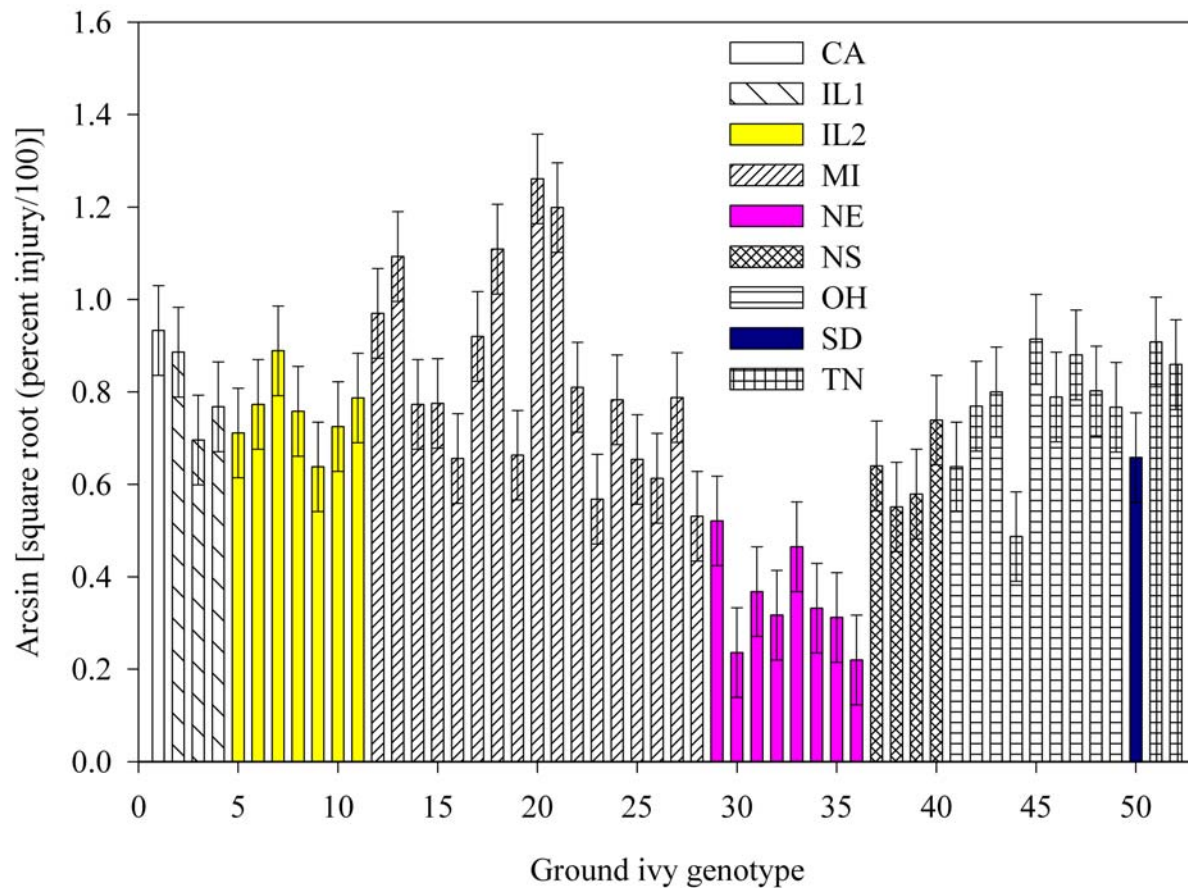


Figure 3. Injury of 52 ground ivy genotypes 25 days after treatment with 4.0 lbs ai/A 2,4-D. Error bars are based on an $LSD_{(0.05)} = 0.1940$. Bars represent a mean of 6 ratings. As presented, the y-axis would range from 0 to 100% injury if backtransformed.