Population dynamics of annual bluegrass in response to herbicides and plant growth regulators

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Introduction

Annual bluegrass (ABG) is an invasive turfgrass species. Herbicides and plant growth regulators (PGRs) are often used for control, providing limited or inconsistent results. Identifying shifts in ABG populations in response to these treatments could partially explain inconsistent control. Our objective was to determine if changes occur in genetic structure of ABG populations after implementing multiple-year season-long herbicide or PGR control programs.

Materials and Methods

Plant materials

- Treatments were applied to established golf course greens for two or three consecutive years at three different locations (West Lafayette, Indiana; East Lansing, Michigan; Lincoln, Nebraska)
- Treatments were applied within label limits, based on superintendent and label recommendations (Table 1)
- Experimental design was RCBD with eight treatments replicated three times
- 15 Samples were collected (April, 2012) from each plot and DNA was extracted (1,080 samples)

AFLP analysis

- Two EcoRI/MseI selective primer combinations were used
- AFLPswere run on an ABI3730 genetic analyzer
- Florescent labeled AFLP profiles were scored using GeneMapper 4.1 software, bins were defined in the 50-500bp range with minimum peak detection set at 2,000 RFU's
- GeneMapper software was then used to produce binary data, automatically scoring peaks as present (one) or absent (zero) based on the programs default criteria
- Binary data produced by GeneMapper was imported into Structure v. 2.3.4 for population analysis, and GenALEx v. 6.4 for AMOVA

Table 1 Herbicide and PGR treatments were made to control greens height annual bluegrass at three locations located in West Lafayette, IN, and East Lansing, MI, from 2009-2011, and Lincoln, NE, from 2010-2011 before ABG samples were collected for DNA extraction.

Trt	Product	Rate	App. frequency	App. dates	Total apps.
		kg ai ha^{-1}	weeks	--	--
1	Bispyribac (bis low)	0.012	2	May-Sep	8
2	Bispyribac (bis high)	0.025	2	Aug-Sep	4
3	HM9930	6.900	20	Apr, Aug	2
4	Paclobutrazol (pac)	0.140 0.280	2 2	Apr-May, Aug-Sep Jun-Jul	8 4
5	Flurprimodol (flur)	0.035 0.070	2 2	Apr-May May-Aug	5 7
6	Flurprimodol/TE (flur/TE)	0.132	2	Apr-Sep	12
7	Trinexapac-ethyl (TE)	0.096	2	Apr-Sep	12
8	Check				

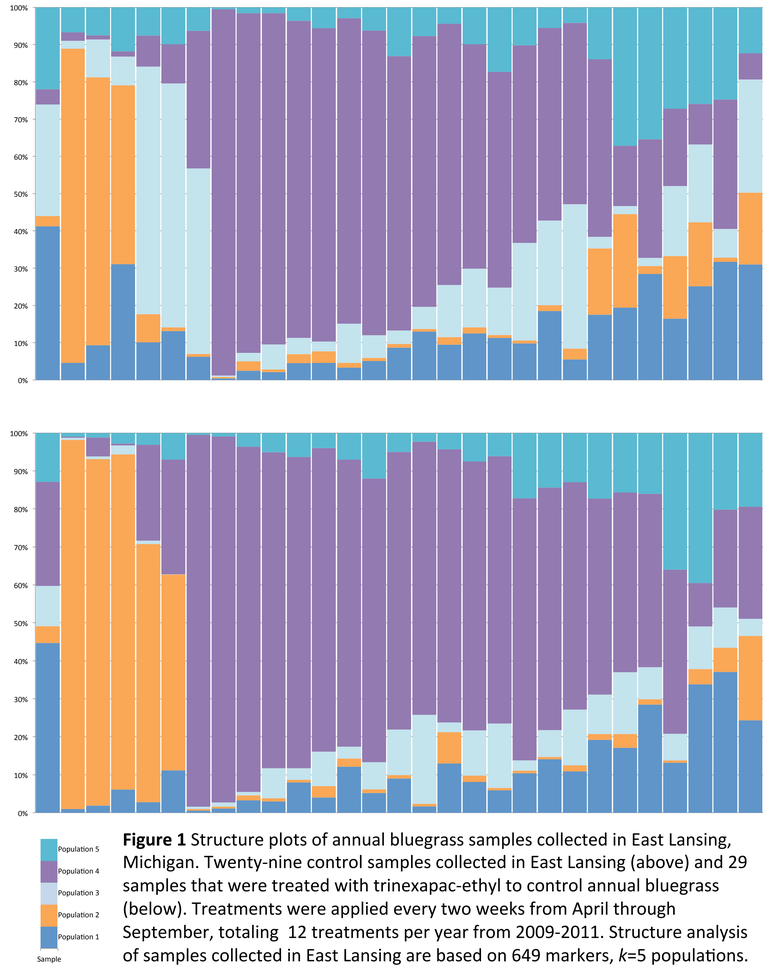

Figure 1 Structure plots of annual bluegrass samples collected in East Lansing, Michigan. Twenty-nine control samples collected in East Lansing (above) and 29 samples that were treated with trinexapac-ethyl to control annual bluegrass (below). Treatments were applied every two weeks from April through September, totaling 12 treatments per year from 2009-2011. Structure analysis of samples collected in East Lansing are based on 649 markers, *k*=5 populations.

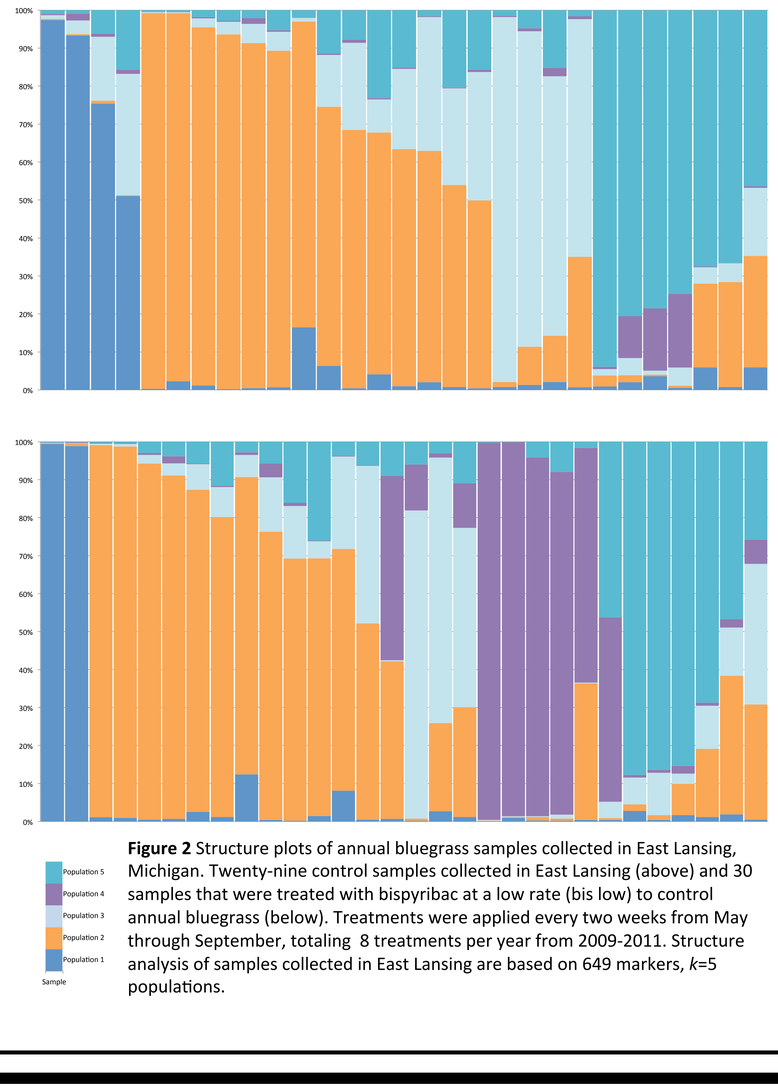

Figure 2 Structure plots of annual bluegrass samples collected in East Lansing, Michigan. Twenty-nine control samples collected in East Lansing (above) and 30 samples that were treated with bispyribac at a low rate (bis low) to control annual bluegrass (below). Treatments were applied every two weeks from May through September, totaling 8 treatments per year from 2009-2011. Structure analysis of samples collected in East Lansing are based on 649 markers, *k*=5 populations.

Table 2 Analysis of molecular variance (AMOVA) conducted by GenAlEx v 6.4 (Peakall and Smouse, 2006) and corresponding probabilities are based on 999 permutations. Locations represent untreated check plots at each location and columns represent the corresponding treatment.

Location	Bis low	Bis high	HM9930	Pac	Flur	Flur/TE	TE
East Lansing	0.044*	0.169	0.220	0.440	0.185	0.398	0.036*
West Lafayette	0.010*	0.256	0.178	0.037*	0.301	0.002*	0.001*
Lincoln	0.016*	0.032*	0.317	0.001*	0.373	0.012*	0.028*

* = P-value ≤ .05 and is significant

Results

- Using two primer combinations, 649, 745, 762 markers were produced for East Lansing, West Lafayette, and Lincoln, respectively
- Based on check plot populations in this study, populations of ABG were diverse at all locations
- Five distinct populations were discovered in East Lansing, seven in West Lafayette and six in Lincoln
- Based on AMOVA, bis low and TE applications impacted ABG populations at all three sites. Flurprimidol/TE and pac impacted the populations at West Lafayette and Lincoln, and bis high applications impacted ABG populations at Lincoln (Table 2)
- Responses by ABG populations to treatments varied depending on treatment and location
- Structure shows that ABG populations responded to treatments of herbicides/PGRs by decreasing (Figure 1; Population 3) or increasing (Figure 2; Population 4) populations after treatment
- Inconsistent control may be partially due to differences in initial populations and/or changes to populations after two to three years of applications with herbicides/PGRs

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References

Reicher, Z, M. Sousek, R. Calhoun, A. Hathaway, A. Patton, D. Weisenberger. Controlling *Poa annua* on putting green height turf in Indiana, Michigan, and Nebraska. UNL Turfgrass Extension. University of Nebraska.http://turf.unl.edu.

Evanno, G., S. Regnaut, and J. Goudet. 2005. Detecting the number of clusters of individuals using the software Structure: A simulation study. Mol. Ecol. 14:2611-2620.

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