

Grass-Selective Herbicides Improve Diversity of Sites Infested with Japanese Stiltgrass (Pennsylvania)

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During the past century, Japanese stiltgrass or Nepalese browntop (*Microstegium vimineum*) has expanded its range from a single known location near Knoxville, Tennessee to 16 eastern states extending from Texas to New York (Barden 1987, Fairbrothers and Gray 1972, Redman 1995). This rapidly spreading annual grass is capable of producing up to 1,000 seeds per plant, which are spread by water along natural or man-made corridors as well as by pedestrian or animal traffic and road grading. It mainly invades disturbed sites in forest environments, including roadsides, stream banks, roadside drainages and disturbed sites in the forest interior, where it can constrain forest regeneration and replace native plant species (Gibson and others 2002).

During summer 2003, we assessed the effect of Japanese stiltgrass on floristic diversity and the extent to which stiltgrass removal influenced that diversity at a study site in Rothcrock State Forest of central Pennsylvania. To remove the invasive, we applied four herbicides with different levels of selectivity. We hypothesized that treatments that would only control annual grasses would result in the highest post-removal plant diversity.

We tested the following herbicides and rates: sethoxydim at 0.28 lbs/acre (0.31 kg/ha), fenoxaprop at 0.08 lbs/acre (0.09 kg/ha), imazapic at 0.09 lb/acre (0.1 kg/ha), and glyphosate at 0.98 lbs/acre at (1.1 kg/ha). Sethoxydim and fenoxaprop are selective for annual grasses, while imazapic and glyphosate are broader spectrum herbicides that kill both grasses and forbs. In July 2003, prior to seedset, we sprayed each of four 175-ft² (16-m²) plots that were infested with Japanese stiltgrass with one of the herbicides, leaving a fifth plot untreated as a control. We replicated each treatment four times. Although we did not assess the treatment plots prior to herbicide application, we ensured that all the plots were homogenous, and so resembled the control plot.

Six weeks following the herbicide applications, we estimated percent cover of Japanese stiltgrass and all other species in the plots. We then calculated Simpson's diversity index. To gain some insight into the effects of the suppression treatments on the Japanese stiltgrass population dynamics, we also counted Japanese stiltgrass' inflorescence and seed number (Table 1).

We found that all herbicide treatments reduced percent cover and seed production to some degree, while at the same time restoring the community to higher diversity values. Although the only herbicide currently labeled for Japanese stiltgrass is fenoxaprop, our results indicate sethoxydim also offers a high degree of Japanese stiltgrass suppression and community restoration.

	Sethoxydim	Fenoxaprop	Imazapic	Glyphosate	Control
Seeds per m ²	0 ^c	0.415 ^c	7.626 ^{bc}	280.8 ^b	24,696 ^a
Inflorescences per m ²	0 ^c	0.046 ^c	0.738 ^c	13.82 ^b	2,602.5 ^a
Species Richness	30	29	21	21	20
Simpson's Diversity Index	0.83	0.89	0.84	0.8	0.57

Table 1. Fitness of Japanese stiltgrass (*Microstegium vimineum*), along with total species and diversity results, following herbicide application. One-way ANOVAs were performed among treatments for the two fitness variables, so significant differences are between treatments in each row of the table, $p < 0.05$. (Means followed by the same letter are not significantly different). A small value for the Simpson diversity index indicates a plant community with low species diversity.

Recent studies (Tilman 1999) support early evidence and theoretical work indicating that more diverse communities give rise to more stable ecosystems (Elton 1958). If more diverse communities are more stable and, therefore, more resistant to establishment of an invasive species, then those treatments that promote higher species diversity should be preferred. In addition, the success of the suppression strategy depends on decreasing the population size of the invasive over time. Although herbicides cannot be used extensively in forest environments due to the many restrictions that exist in natural ecosystems, their use could be targeted at stands that serve as source populations. We have found that Japanese stiltgrass establishes particularly well along corridors and in areas of high disturbance. If established populations serve as seed sources for dispersal along these corridors, then treating such source populations with grass-selective herbicides could go a long way toward managing this invasive where it has already become established, while limiting its dispersal to new sites.

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