Biology and Control of Pennsylvania Smartweed and Ladysthumb in Muck Soils

Final Report

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Take Home Message

Two experiments were established on muck soils in Willard, OH, in 2021 to evaluate: 1. emergence of Pennsylvania (*Polygonum pensylvanicum*) and ladysthumb (*P. persicaria*) smartweed species, and 2. smartweed control using different pre- and post-emergence herbicides registered for use on muck soils. Smartweed emergence began in early April and peaked the first week of June. Unfortunately, the emergence experiment, which was located on a farmer field, had to be terminated on June 24. Similar to 2020 smartweed trials in muck soils, none of the pre-emergence herbicide treatments provided good smartweed control. However, excellent post-emergence control (comparable to Roundup) was observed for Moxy 2E, Lorox and Basagran. As in 2020, all the mature smartweed plants observed were ladysthumb, rather than Pennsylvania smartweed. Further research is needed to elucidate the pattern of smartweed emergence across the entire growing season, test additional herbicides for pre- and post-emergence control, and determine if growth stage impacts post-emergence control.

Methods

Smartweed Emergence Experiment: One experiment was established at Buurma Farms Inc. in Willard, OH, to determine the seasonal emergence pattern of smartweed in muck soils. Eight 1-m^2 quadrats (Figure 1) were flagged on 5/19/21, and emerged smartweed seedlings were counted on 5/19/21, 6/1/21, 6/15/21, and 6/21/21. On each date, smartweed seedlings were pulled from quadrats after counting, and any other weed species were hand weeded. At the farmer's request, the experiment was ended on 6/24/21 (sooner than anticipated).

Smartweed Control Experiment: A second experiment was conducted in Willard to determine the response of smartweed to the recommended rates of herbicides currently registered for use on muck soils. Two smartweed growth stages were evaluated: pre-emergence (PRE) and post-emergence (POST) (3-5 leaf stage). The PRE treatments included the 4 herbicides tested in 2020 for smartweed control in muck soils (all of which provided poor control), plus 3 additional PRE herbicides (Table 1). The POST treatments included the 3 herbicides providing the best control in the 2020 smartweed trial, along with 4 additional herbicides not tested in 2020 (Table 1).

The PRE and POST plots were established at Buurma Farms (Figure 1A); however, the POST plots had to be shifted to the OSU Muck Crops Agricultural Research Station (Willard, OH) (Figure 2) just prior to treatment after the smartweed seedlings in POST plots were damaged by spray drift from a herbicide application on an adjacent field.

The Buurma Farms field was disked on 5/13/21, rolled on 5/20/21, and plots (20 ft long by 5 ft wide) were established and PRE treatments applied on 5/24/21 (Figure 1A). Smartweed plants were counted in the center 18 ft by 3 ft of each plot at 1, 2 and 4 weeks after treatment (WAT) (6/1/21, 6/8/21 and 6/21/21, respectively). All Buurma plots were terminated on 6/24/21, and POST plots moved to the Muck Crops Station (as noted above).

Replacement POST plots measuring 20 ft long by 5 ft wide were established within the alleys of an unrelated trial at the Muck Crops Station and POST treatments applied on 6/17/21. Smartweed density was relatively uniform across plots and plants averaged 5-7 leaves. Alley sections adjacent to treatment plots were used as untreated plots. Smartweed percent control (0-100% scale, with 0% control for untreated plots) was evaluated at 4 days after treatment (DAT), and 1, 2 and 4 WAT (corresponding to 6/21/21, 6/24/21, 7/2/21 and 7/13/21).

Herbicide applications were made using a backpack CO_2 sprayer with either a 2-nozzle (PRE) or 1-nozzle shielded (POST) boom calibrated to deliver 20 GPA using XR 11003 VS nozzles.

Rain was sufficient during the trial period and no supplemental irrigation was necessary.

Smartweed Species: Since it is difficult to distinguish between Pennsylvania smartweed and ladythumb in the seedling phase, smartweed seedlings were evaluated as one species. However, based on our research trials, the predominant smartweed species on the Buurma Farms and Muck Crops Station is ladysthumb. No mature Pennsylvania smartweed were observed in 2020 or 2021.

Results

Smartweed Emergence

Baseline Emergence: A significant number of smartweed seedlings were present in plots at the time of plot setup on 5/19/21 (Table 2). Most seedlings had 1 to 4 true leaves, which indicated recent emergence, but a few seedlings had 5 or more true leaves, indicating first emergence had occurred 3 or more weeks prior. This earliest emergence is likely due to an occurrence of warm days between the first and second weeks of April (Figure 3A).

Emergence after Plot Setup: Two weeks after the baseline count, a smaller number of smartweed seedlings were observed in quadrats (Table 2). Most the seedlings were at the cotyledon stage, indicating they were recently emerged, likely reflecting the combination of increasing growing degree days and 1 inch of rainfall occurring the last week of May (Figure 3). However, despite adequate growing degree days and rainfall after June 1, very little emergence occurred the remainder of June (Figure 3, Table 2). Emergence plots were terminated on 6/24/21.

Smartweed Control

Herbicide Control in PRE Plots: None of the PRE herbicide treatments provided any control of smartweed emergence at 1, 2 and 4 WAT (Table 3). These results were consistent with 2020 for the 4 repeated herbicides (Dual Magnum, Prowl H2O, Outlook, Command). Unfortunately, the 3 newly tested herbicides (Bicyclopyrone, Sencor DF and Spartan 4F) also performed poorly. By the final evaluation, most smartweed plants were taller than 5 inches, and the majority of plots also had a solid cover of common purslane.

Herbicide Control in POST Plots: Moxy 2E, Lorox, and Roundup, herbicides also tested in 2020, along with Basagran, a new addition for 2021, consistently provided the best smartweed control in POST plots for all evaluations (Table 4). Interestingly, Lorox provided only marginal POST control in 2020. Two other new herbicides for 2021, Reflex and Sharpen, provided good control initially, but only marginal control by the final evaluation. Sencor DF, which was also used as a PRE treatment, did not provide any POST smartweed control.

Table 1. List of PRE and POST herbicides and rates tested in 2021.

PRE TREATMENTS (Applied 5/24/21)			POST TREATMENTS (Applied 6/17/21)		
Trt No.	Treatment Name	Rate	Trt No.	Treatment Name	Rate
1	Untreated	.	1	Untreated	.
2	Dual Magnum*	1.3 pt/a	2	Moxy 2E*	1.5 pt/a
3	Prowl H2O*	2 pt/a	3	Lorox*	32 oz/a
4	Outlook*	21 fl oz/a	4	Roundup*	32 fl oz/a
5	Command*	64 fl oz/a	5	Basagran	1.5 pt/a
6	Bicyclopyrone	3.42 fl oz/a	6	Reflex	0.75 pt/a
7	Sencor DF	2 oz wt/a	7	Sharpen	2 fl oz/a
8	Spartan 4F	3 fl oz/a	8	Sencor DF	2 oz wt/a

Tested in 2020 Smartweed Trial

Table 2. Smartweed emergence in emergence plots by date and growth stage.

Growth Stage	Average # (per m^2) Smartweed Seedlings			
	5/19/21	6/1/21	6/15/21	6/21/21
Cotyledon	0.9	3.8	0	0
1-leaf	3.8	1.8	0	0
2	5.5	1.4	0.4	0.1
3	6.8	0.3	0	0
4	4.5	0	0	0
5	1.6	0	0	0
6	0.9	0	0	0
7	1.0	0	0	0
8	0.5	0	0	0
Total	*25.4*	*7.1*	*0.4*	*0.1*

Table 3. Smartweed response (measured as number of seedlings/m²) to PRE treatments at 1, 2 and 4 WAT.

PRE TREATMENTS (Applied 5/24/21)					
No.	Treatment	Rate	1 WAT	2 WAT	4 WAT
				# per m^2	
1	Untreated	.	4 a	5 a	3 a
2	Dual Magnum*	1.3 pt/a	3 a	5 a	3 a
3	Prowl H2O*	2 pt/a	3 a	4 a	4 a
4	Outlook*	21 fl oz/a	6 a	6 a	5 a
5	Command*	64 fl oz/a	4 a	4 a	4 a
6	Bicyclopyrone	3.42 fl oz/a	4 a	5 a	4 a
7	Sencor DF	2 oz wt/a	3 a	5 a	3 a
8	Spartan 4F	3 fl oz/a	3 a	6 a	4 a

Tested in 2020 Smartweed Trial

Table 4. Smartweed response (measured as % control) to POST treatments at 4 DAT and 1, 2 and 4 WAT.

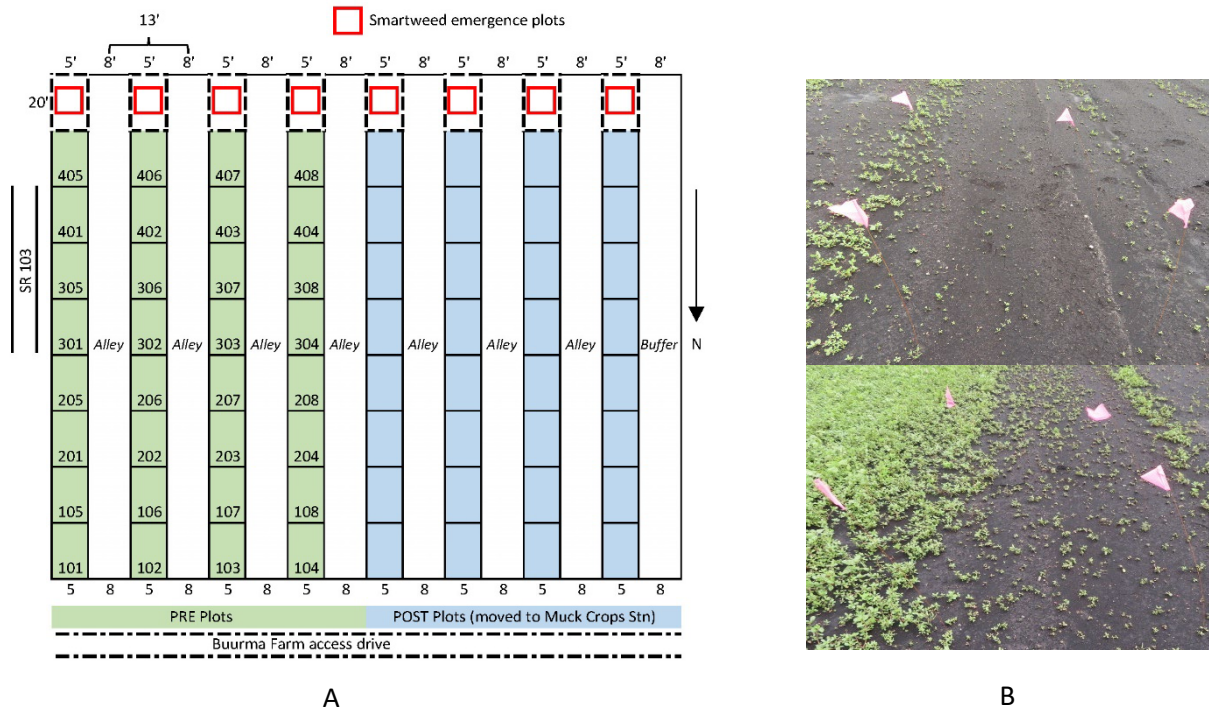| POST TREATMENTS (Applied 6/17/21)						
No.	Treatment	Rate	4 DAT	1 WAT	2 WAT	4 WAT
				% control		
1	Untreated	.	0 c	0 d	0 c	0 c
2	Moxy 2E*	1.5 pt/a	95 a	87 ab	96 a	95 a
3	Lorox*	32 oz/a	75 ab	85 ab	91 a	88 a
4	Roundup*	32 fl oz/a	59 b	70 ab	95 a	94 a
5	Basagran	1.5 pt/a	93 a	93 a	91 a	90 a
6	Reflex	0.75 pt/a	90 a	60 b	39 ab	34 ab
7	Sharpen	2 fl oz/a	84 ab	63 ab	53 ab	46 ab
8	Sencor DF	2 oz wt/a	16 c	13 c	20 b	16 bc

Tested in 2020 Smartweed Trial

Figure 1. Buurma Farms: A. Layout of smartweed emergence quadrats and PRE herbicide plots, and original layout of POST herbicide plots (prior to treatment application, smartweed seedlings in POST plots were damaged by herbicide drift from the field directly west, so POST plots were relocated on the Muck Crops Research Station); B. Closeup of quadrats established to monitor smartweed emergence.
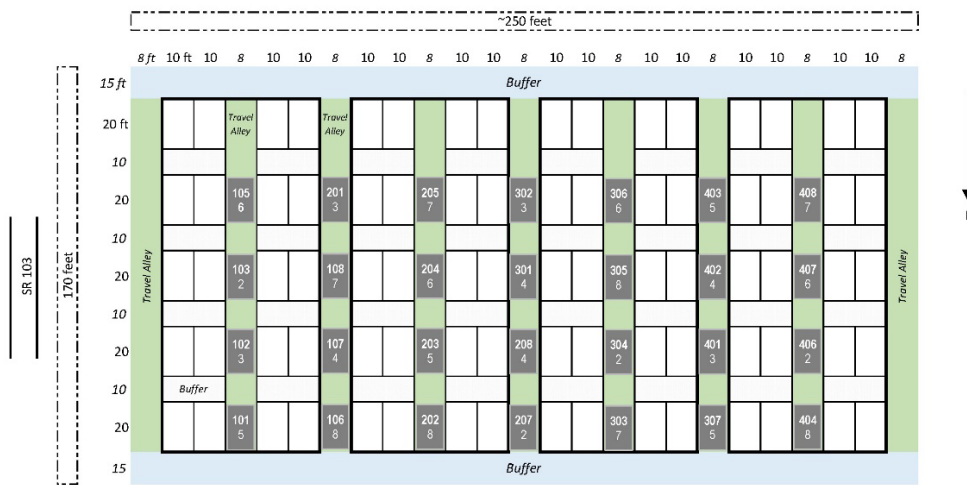

Figure 2. Muck Crops Research Station – layout of relocated POST herbicide plots (in the alleys of an unrelated OSU trial). Adjacent sections of the alleys were used as the untreated plots.
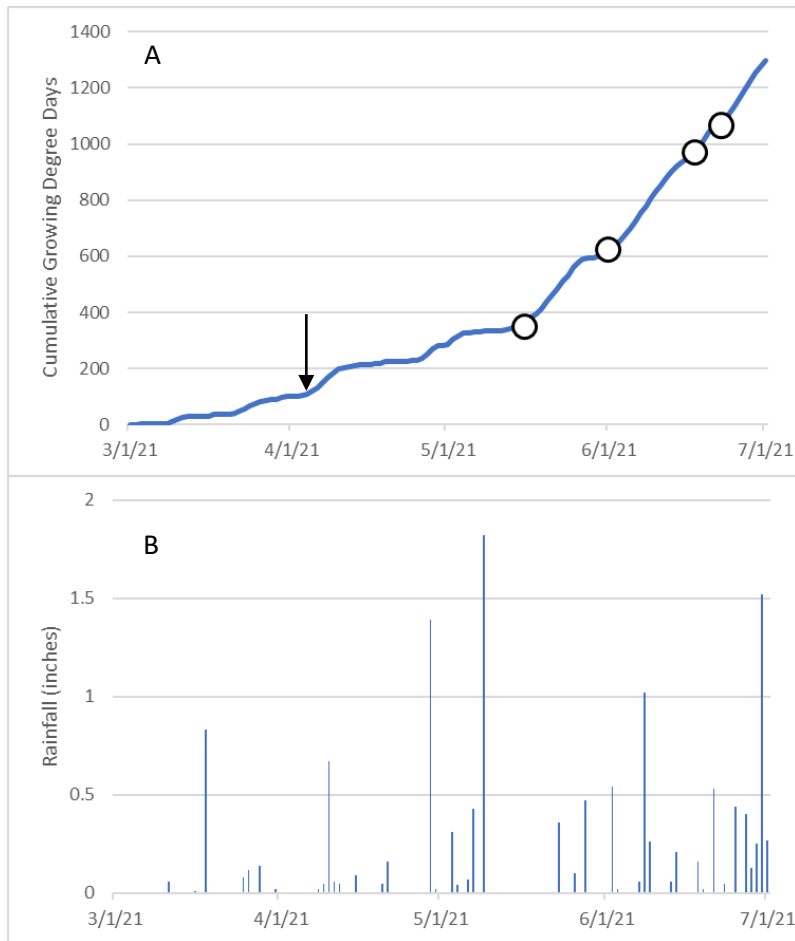
Figure 3. Cumulative growing degree days (based on the modified sine wave) (A) and daily rainfall (B) from 3/1/21 to 7/1/21 (data from the OSU weather station on the Muck Crops Research Station). Open circles approximate the dates of emergence counts, and the arrow indicates the start of warm period in April.