**Supplementary Material S1**

**Seed exclusion cage treatments**

In order to account for possible movement of wind-dispersed seeds of *V. rossicum* from un-mowed plots, as well as the surrounding un-mowed field, to mowed plots, seed exclusion cages were installed. Two types of cages were added to all mowed plots: a seed exclusion cage (caged) and a ‘sham’ cage which also excluded seeds but into which seeds were manually sown (caged-and-sown, Figure 1). Cages were not installed in the un-mowed control plots because large amounts of seeds were already naturally being deposited. If seeds were moving into plots, we would expect several response variables to be similar between un-caged and caged-and-sown treatments (with natural and manual additions of seeds, respectively) but different from the caged (seeds excluded) treatment. The experimental design (involving mowed plots only) consisted of three factors in a split plot and repeated measures design. Mowing (three or six times per season) served as the whole plot treatment and was arranged as five pairs (blocks) of the two mowing treatments in a randomized complete block design. The subplot treatment consisted of a one-way treatment structure in a randomized complete block design with three caging treatments (un-caged, caged, caged-and-sown) and repeated measures on years. All subplot treatments were present in each of 10 blocks for a total of 30 experimental units measured up to seven times.

After the final mowing but prior to follicle dehiscence, 1 by 1 by 1 m frame cages were placed over all caged and caged-and-sown subplots to exclude wind-blown seeds. Cages were constructed of 1.9 cm PVC pipes, and white knitted 50% shade cloth (Greentek, Jamesville, WI) that had been sewn into an open-bottom cube shape was clipped to the frame. Cages were secured with guy wires. Upon dehiscence of follicles (late August to early September), seed traps were installed to estimate seed additions to be made to the caged-and-sown subplots. Five 155 by 295 mm sticky cards (0.0457 m2 per card, Olson Products Inc., Medina, OH) were deployed down the middle of each mown plot at 3-m intervals. Cards were secured near the ground with sod staples and binder clips. Trapped seeds were counted in the field every other week until dehiscence was completed (late October), and new cards were installed after each counting. For each block, the mean number of seeds from ten cards was multiplied by 21.87 to convert to seeds m-2 and this number of mature seeds was immediately collected from surrounding follicles and sown in each caged-and-sown subplot. We manually added from 0 (2016, severe drought year) up to 887 seeds for the season into a subplot, depending on the year and block. Cages were removed in late October/early November, up to 10 weeks after the final mowing. Analyses were similar to those described in the primary manuscript except that mowing treatment, caging treatment, and year were fixed effects; un-mowed subplot data within a block served as a covariate, and the blocking factor was a random effect.

We could not discern any effect of seed dispersal into the mowed plots through the use of exclusion cages, e.g., no differences in stem counts (< 10 cm) and small root crown counts. Differences associated with caging were inconsistent with expectations apart from the greater canopy heights inside cages compared with outside cages (Tables 1-3). Differences by year are discussed in the primary manuscript.



**Figure 1.** Generic plot design for long-term mowing study of *Vincetoxicum rossicum.*

**Table 1.** Analysis results for reduced models of the effect of Mowing (3x or 6x) and Caging (un-caged, caged, caged + sown) on *Vincetoxicum rossicum* densities and growth over six years, with un-mown control plots serving as a covariatea.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Factor | Stems m-2 | | | | Canopy height | | Root crowns 0.0625 m-2 | | | | | |
|  | <10 cm | | >10 cm | |  |  | Small | | Medium | | Large | |
| Mow | 0.001,22 | 0.999 | 0.771,4 | 0.430 | 2.161,19.4 | 0.157 | 0.051,4 | 0.836 | 0.021,4 | 0.904 | 0.841,22 | 0.369 |
| Cage | 2.692,22 | 0.090 | 1.362,173 | 0.260 | 20.822,19.4 | **<0.001** | 0.772,173 | 0.466 | 6.612,191 | **0.002** | 4.272,115 | **0.016** |
| Year | 21.066,134 | **<0.001** | 27.806,173 | **<0.001** | 6.082,26.9 | **0.007** | 31.176,173 | **<0.001** | 13.896,191 | **<0.001** | 42.034,115 | **<0.001** |
| Covar | 0.151,126 | 0.701 | 1.021,173 | 0.314 | 4.011,25.5 | 0.056 | 0.611,173 | 0.436 | 0.361,191 | 0.547 | 1.681,115 | 0.198 |

a Values given under each plant parameter are: F-value with subscripted numerator and denominator degrees of freedom and P-value. For each plant parameter, non-significant interaction terms (P>0.05) were iteratively removed beginning with the full model.

**Table 2.** Analysis results for reduced models of the effect of Mowing (3x or 6x) and Caging (un-caged, caged, caged + sown) on percent ground cover for *Vincetoxicum rossicum* and other categories over six years, with un-mown control plots serving as a covariatea.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Factor | % *Vincetoxicum rossicum* | | % Broad-leaf | | % Grass | | % Woody | | % Bare ground | |
| Mow | 0.811,25.2 | 0.377 | 0.061,3.98 | 0.826 | 0.291,3.99 | 0.617 | 0.431,25 | 0.516 | 0.071,4 | 0.803 |
| Cage | 0.402,25.2 | 0.676 | 3.722,17.6 | **0.045** | 0.382,36.3 | 0.687 | 0.642,25 | 0.535 | 0.172,18 | 0.846 |
| Year | 17.625,121 | **<0.001** | 33.575,112 | **<0.001** | 8.235,134 | **<0.001** | 0.985,138 | 0.433 | 26.355,116 | **<0.001** |
| Covar | 19.111,100 | **<0.001** | 1.331,14.1 | 0.269 | 0.091,36.6 | 0.766 | -- | -- | 2.441,65.4 | 0.123 |

a Values given under each plant parameter are: F-value with subscripted numerator and denominator degrees of freedom and P-value. For each plant parameter, non-significant interaction terms (P>0.05) were iteratively removed beginning with the full model.

**Table 3.** Effect of caging on selected plant parameters where *Vincetoxicum rossicum* infestations were repeatedly mowed over six yearsa.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Root crowns 0.0625-m-2 | |  |  |
| Cage treatment | Medium | Large | % cover, broad-leaf | Canopy height (cm) |
| Caged | 7.4 ± 1.2 ab | 2.4 ± 0.6 a | 5.8 (4.2-7.8) b | 17.0 ± 1.2 a |
| Caged-Sown | 5.6 ± 0.9 b | 1.2 ± 0.3 b | 7.2 (5.3-9.7) ab | 15.2 ± 1.0 a |
| Un-caged | 10.4 ± 1.7 a | 2.5 ± 0.6 a | 9.6 (7.1-12.8) a | 10.0 ± 0.7 b |

a Mean ± SE or mean (95% confidence interval). For each column, individual means followed by the same letter are not significantly different (F-protected LSD test with Bonferroni correction, *P* > 0.05).