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Preplant Control of Horseweed in Soybeans

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Introduction

Horseweed *(Erigeron canadensis)*, also known as marestail, is a troublesome weed commonly found in soybean crops in the mid-Atlantic region. This weed produces up to 200,000 seeds per plant, has become resistant to a variety of herbicides, and has a large germination window (Pittman, 2021). It is now more frequently encountered due to the increased implementation of no-till farming (Chahal & Jhala, 2019). Horseweed at 9 to 20 plants per square foot can result in a decrease in soybean yield by 71% to 98% (Bruce & Kells, 1990).

Identification

The first growth stage horseweed enters is the seedling stage followed by the rosette stage (Figure 1). Around the rosette stage is when this weed will be most susceptible to herbicides. The first set of true leaves, along with the subsequent leaves, is toothed (Figure 1). The leaves are alternating, have fine hairs, and are roughly 1-4 inches long and about 1/8-3/5 of an inch wide (Figures 1, 2, 3, & 4). The leaves are rounded on the end but pointed where they are attached to the stem (Bryson & Defelice, 2009, p. 69). The plant will then enter the bolting stage, during which it will begin its upward growth and become harder to control with herbicide use (Figure 2). After bolting, the leaves of this plant get increasingly smaller the closer to the top they are. The stems of this plant typically do not split at the base of the plant and stand straight up (Loux et al., 2006). On each plant, there will be 20 to 40 flowers that are either white or yellow and roughly 1/16 to 1/8 of an inch long (Figure 3) (Bryson & Defelice, 2009, p. 69; Loux et al., 2006).

Figure 1. Two horseweed rosettes. (Photo credit: John Brewer, Virginia Tech).

Figure 2. Multiple young horseweed plants in the bolting growth stage. (Photo credit: John Brewer, Virginia Tech).

Oftentimes, this weed can be mistaken for hairy fleabane (*Conyza bonariensis*), common whitlowgrass (*Erophila verna*), shepherd's purse *(Capsella bursa-pastoris*), or Persian speedwell (*Veronica persica*) (Loux et al., 2006; Pittman, 2021). Hairy fleabane has a more greyish appearance and can have numerous stems growing out of the rosette, while horseweed is greener and will only have one stem elongating out of its rosette.

Figure 3. Horseweed flowers. (Photo credit: John Brewer, Virginia Tech).

Figure 4. The seed head of a mature horseweed plant (left). (Photo credit: John Brewer, Virginia Tech).

Also, at final maturity, horseweed will be much taller than hairy fleabane (Pittman, 2021). Compared to horseweed, whitlowgrass has thinner and shorter leaves. Telling shepherd's purse and Persian speedwell from horseweed is as simple as looking at the leaf orientation. Persian speedwell's leaves are opposite from one another at all of its early stages, and shepherd's purse's first node will usually be opposite while its other leaves are alternating. Shepard's purse will also have deeply lobed leaves later in its development, while horseweed will have toothed leaves (Loux et al., 2006).

Weed Management Tactics

Importance of Timing

No matter the strategy being used to control horseweed, timing is everything. This plant has a very wide germination window resulting in its germination in both the fall and spring (Figure 5). Because of this, farmers should scout their soybean fields in early March so control measures can be implemented timely, prior to bolting. Catching the weed in its seedling or rosette stage (Figure 1) is crucial. During these stages, the plant is more vulnerable to chemical control compared to later growth stages. Once the weed has bolted (Figure 2), it becomes hardier and is more difficult to terminate.

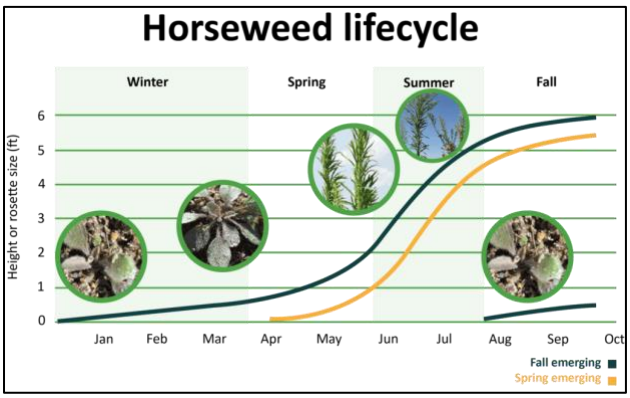


Figure 5. Horseweed's lifecycle throughout the year. (Figure credit: GROWiwm.org; adapted from Loux et al. 2006. Photo credits: Dwight Lingenfelter, Penn State, and Claudio Rubione, University of Delaware).

Mechanical Control

Mechanical weed control consists of physically removing or damaging the weed. Tillage can be an effective way to mechanically control this weed. Due to horseweed seeds' need for light to germinate, tilling can bury these seeds, reducing their likelihood of germination. Tillage alone can reduce horseweed populations 79% to 88% (Chahal & Jhala, 2019). With that being said, tillage is not always desirable depending on the system. Oftentimes, other control methods are used over tillage (Pittman, 2021).

Cultural Control

Cultural control methods for weeds are strategies that change the environment in a way that benefits the cash crop and harms weeds. In typical agricultural systems, cash crops compete with weeds, ultimately reducing their growth and germination. However, this does not always occur with horseweed because of its large emergence window. This large window allows the weed to begin its growth before the cash crop is planted. Due to this, cultural controls for this weed play a key role in its suppression. The typical cultural control

strategies for horseweed include crop rotation and the usage of cover crops (Pittman, 2021).
Crop rotation allows horseweed to be exposed to different herbicides at different timings each year and varies crop competition timings. Exposing weeds to herbicides with varying modes of action lessens the chance for herbicide resistance to develop. Research has found that a soybean-corn crop rotation minimized the quantity of horseweed within both the field and seedbank compared to continuous soybean planting (Davis et al., 2009). Crop rotations involving wheat also create competition for the weed during its lifecycle. Planting cover crops in the fall can also decrease the abundance of horseweed within a field. Cover crops suppress weeds by limiting the resources available to them and by their residue once terminated. The residue acts as a mulch, which lowers soil temperature, creating a less desirable environment, and it can physically suppress the weeds (Pittman et al., 2019). The use of cover crops reduced horseweed density by 88% to 96% prior to termination of the cover. These trials included monoculture and mixtures of cover crops (Pittman et al., 2019). Results from Wallace et al. (2019) also showed that cover crops were able to lessen horseweed density by 52% to 86% at the time of the preplant, burndown herbicide application from a range of grass cover crops and grass-containing mixtures.

Chemical Control

Herbicides play a key role in controlling horseweed in soybeans. For years, these herbicides have been what many farmers rely on to regulate the weeds within their fields. Due to this reliance, horseweed has developed resistance to various herbicide groups, including Groups 2, 5, 9, and 22 (Figure 6) (Wallace et al., 2020, pp. 240–241). In Virginia, horseweed is widely resistant to groups 2 and 9. Herbicide resistance has left fewer effective herbicides for horseweed control both in and prior to a soybean crop. Out of that number, there are even fewer herbicides that adequately control horseweed while there is a crop in the field. This is why soybean farmers in Virginia tend to apply a preplant burndown to the weed prior to bolting and to reduce the risk of damage to the crop. Common preplant burndown herbicides include dicamba, 2,4-D, glufosinate (Liberty), glyphosate + 2,4-D, saflufenacil (Sharpen), and paraquat (Gramoxone) (Pittman et al., 2021; Wallace et al., 2020).

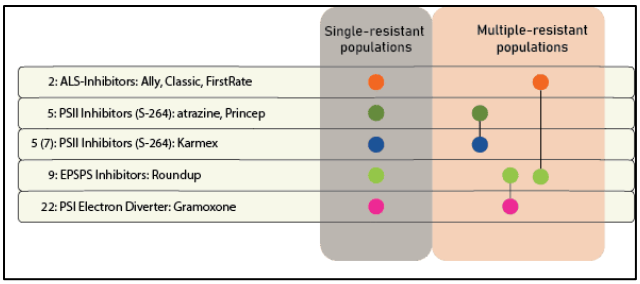
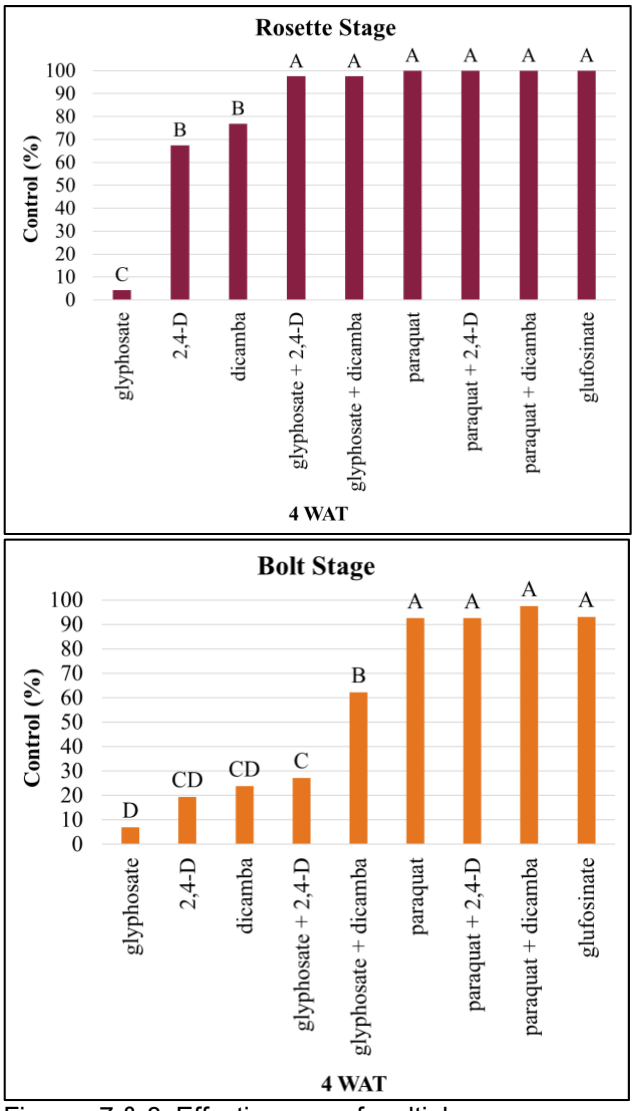


Figure 6. Herbicide-resistance within the United States. Figure adapted from Pittman, 2021. (Chart graphic by GROW, Lourdes Rubione).



Figures 7 & 8. Effectiveness of multiple herbicides/herbicide mixtures at terminating various stages of horseweed 4 weeks after treatment (WAT). Means with the same letter are not different according to Fisher's protected LSD test at α = 0.05. Figure from Flessner & Pittman, 2021.

Table 1. Various herbicides, with various rates, and their effectiveness on both small (~2 in.) and large (~ 6 in.) horseweed. Figure adapted from Askew et al., 2021.

Herbicide*	Herbicide Product Name	Rate (lbs./ acre)	Small Horse weed (~2 in)	Large Horse weed (~6 in)
Halauxifen-methyl	Elevore	0.004	89 C**	79 C
Dicamba	Clarity	0.25	91 C	77 D
2,4-D Low Rate	2,4-D	0.48	72 E	50
2,4-D High Rate	2,4-D	0.95	80 D	64 E
Glyphosate	Roundup, others	1.12	95 B	95 B
Glyphosate + halauxifen-methyl	Roundup + Elevore	1.12 + 0.004	99 A	99 A
Glyphosate + dicamba	Roundup + Clarity	1.12 + 0.25	99 A	99 A
Glyphosate + 2,4-D Low Rate	Roundup + 2,4-D	1.12 + 0.48	96 AB	98 A
Glyphosate + 2,4-D High Rate	Glyphosate + 2,4-D	1.12+ 0.95	98 AB	98 A

* Methylated seed oil at 1% vol/vol was included with halauxifen-methyl and glyphosate plus halauxifen-methyl, whereas nonionic surfactant at 0.25% vol/vol was included with 2,4-D and dicamba; no adjuvants were included with combinations of glyphosate and 2,4-D or dicamba.
** Means within a column followed by the same letter are not different according to Fisher's protected LSD test at $\alpha = 0.05$.

Research has evaluated horseweed control from various herbicides applied at the rosette and bolting growth stages (Table 1). Four weeks after application, paraquat (0.75 lbs./acre), paraquat + 2,4-D (0.75 + 1.0 lbs./acre), paraquat + dicamba (0.75 + 1.12 lbs./acre), and glyphosate (1.12 lbs./acre) were all effective at terminating roughly 90% or more horseweed when it was in the rosette (~5 in) or bolt growth stage (~18 in) (Figure 7) (Flessner & Pittman, 2021). These results are from a glyphosate-susceptible population. It is important to note that most horseweed in Virginia is glyphosate-resistant, meaning that glyphosate will not result in control. Other research shows that a glyphosate + dicamba mixture or glyphosate + 2,4-D mixture at both low and high rates was 96% or more effective in controlling horseweed four weeks after application when it was ~2 in or ~6 in tall at application (Figure 8). This same study also concluded that there was a reduction of 98% or more of ~2-inch-tall horseweed four weeks after application from glyphosate + halauxifen-menthyl mixture, glyphosate + dicamba mixture, or glyphosate + 2,4-D. There was also a reduction of at least 90% of ~6-inch-tall horseweed when glyphosate, glyphosate + halauxifen-methyl, glyphosate + dicamba, or glyphosate + 2,4-D was sprayed (Askew et al., 2021). It is important to note that this population of horseweed was glyphosate susceptible.

Key Factors of Preplant Horseweed Control

- Correct Identification
- Herbicide Application Timing
- Herbicide Used
- Herbicide Application Rate

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