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Using Cover Crops to Suppress Horseweed

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Figure 1. Horseweed across various growth stages. Left to right: rosette, bolt, and flowering.

Horseweed (*Conyza canadensis*), also known as marestail, is a very widespread and problematic weed in Virginia crop production. Yield loss from horseweed of up to 46% has been reported in cotton with a density of 20 to 25 plants m^{-2} (Steckel and Gwathmey 2009). Horseweed can produce up to 200,000 seeds per plant, which are wind-dispersed, allowing for long distance dispersal between fields and across farms (Andersen 1993; Bhowmik and Bekech 1993). This species is often difficult to control due to herbicide resistance. Currently in Virginia, horseweed is resistant to glyphosate (SOA group 9) and there are likely populations that are resistant to ALS herbicides (SOA group 2) (Anonymous 2019). In the Mid-Atlantic region, resistance to paraquat (SOA group 22) has also been reported (Heap 2019). In soybeans, there are only a few effective herbicide options to control horseweed postemergence.

Cover Crops for Weed Management

With herbicide resistance becoming more prevalent, making control more difficult, and an overall desire for more sustainable practices, cover crops are becoming more popular as a weed management tool. Cover crops have the ability to reduce erosion, increase soil organic matter, introduce new soil channels to aerate the soil, and suppress weeds.

Winter cover crops suppress weeds at two different timings: first, while they are actively growing, where they will compete with weeds for resources such as sunlight, water, and nutrients, and second, after the cover crop is terminated. Some cover crop species, such as cereal rye, yellow mustard, and rapeseed, can exude allelopathic chemicals that negatively impact weed establishment while they are actively growing and those chemicals can linger in the soil early into the cash crop season. Once terminated, cover crops can create a mulch layer on the soil surface that will block germination cues and provide a physical barrier to prevent weed growth (Mirsky et al. 2013). Small grain or grass cover crop species have higher carbon-to-nitrogen ratios compared to legume and brassica cover crop species. Nitrogen immobilization can occur if a cover crop residue has a C:N ratio of greater than 30:1 (Herbert et al. 2017). Therefore, some grass cover crops may suppress weeds by N stress, but also have potential to stress the cash crop.

Horseweed has two germination periods, in the fall and in the spring of the year (Bhowmik and Bekech 1993; Main et al. 2006). With multiple germination timings, control can become much more complicated. With these two timings of weed suppression, winter cover crops have a unique ability to target both germination periods of horseweed.

To achieve weed suppression using cover crops, gaining biomass is particularly important. To do this, it is important to have a healthy stand. Planting the cover crop with a drill is recommended over broadcasting seed. Also, provide time to allow the cover crop to gain as much biomass as possible before termination. Plant earlier or better yet, delay termination to help expand the season and maximize biomass. Our research indicates that most cover crop species maximize biomass by about May 1st in Virginia. Greater biomass creates a thicker mulch layer that will take longer to break down, extending the weed suppression period.

Cover crop species selection is also important when using cover crops to suppress weeds. Poor candidates are species that typically winter-kill, such as forage radish, field pea, and spring oats, because they won't survive the winter to be able to gain biomass until cover crop termination in the spring (Virginia NRCS). Typically, cereal rye is known to gain the most biomass and therefore is one of the best cover crop species for weed suppression.

Research Results

Research experiments were conducted in Blacksburg and Blackstone, Virginia over two years to determine if cover crop species could suppress horseweed and what species or mixtures were the most effective. Two fall-applied residual herbicides were included in the experiments for comparison.

Treatments (cover crops or herbicides) and seeding or application rate are included in Table 1. These treatments were either planted or applied in the fall, approximately late September to mid-October. Horseweed densities were collected in mid-March to determine if the cover crop was suppressing horseweed through the winter. After the cover crops were terminated by rolling, the plots were split in half to plant corn and soybean. Six weeks after termination, visible horseweed suppression ratings were taken from 0 (no suppression) to 100 (complete suppression) compared to the no cover check. At the end of the season, prior to harvest, horseweed biomass samples and crop yield were taken.

Across cover crop treatments, the cereal rye alone and cereal rye-containing mixtures obtained greater biomasses, 6,800 to 7,200 lbs per acre, compared to the two legume species, crimson clover and hairy vetch, in monoculture, 3,000 lbs per acre.

Table 1. Cover crop monoculture and mixture seeding rates and herbicide rates used in this study.

Treatment	Species 1	Species 2	Species 3	Species 1 Seeding Rate	Species 2 Seeding Rate	Species 3 Seeding Rate
				---------------lbs per acre-------------		
1	Cereal Rye	---	---	112	---	---
2	Crimson Clover	---	---	20	---	---
3	Hairy Vetch	---	---	25	---	---
4	Forage Radish	---	---	8	---	---
5	Cereal Rye	Crimson Clover	---	45	14	---
6	Cereal Rye	Hairy Vetch	---	45	18	---
7	Cereal Rye	Forage Radish	---	62	4	---
8	Cereal Rye	Forage Radish	Crimson Clover	34	2	12
9	Cereal Rye	Forage Radish	Hairy Vetch	34	2	15
	Herbicide Product	Application Rate	Herbicide Active Ingredient			
		oz per acre				
10	Canopy	3	Metribuzin + Chlorimuron-ethyl			
11	Valor	3	Flumioxazin			
12	Nontreated check (no cover or herbicide)					

In mid-March, all cover crop species had a horseweed density of >1 plant per square foot compared to the nontreated check, which had 8.8 and 2.4 plants per square foot in Blacksburg and Blackstone, respectively (Figure 2). There was no difference in horseweed density between cereal rye-containing cover crop treatments and legume monocultures or between monocultures and mixtures indicating that all cover crop treatments, except forage radish alone, suppressed horseweed up to 97% compared to the no cover crop check.

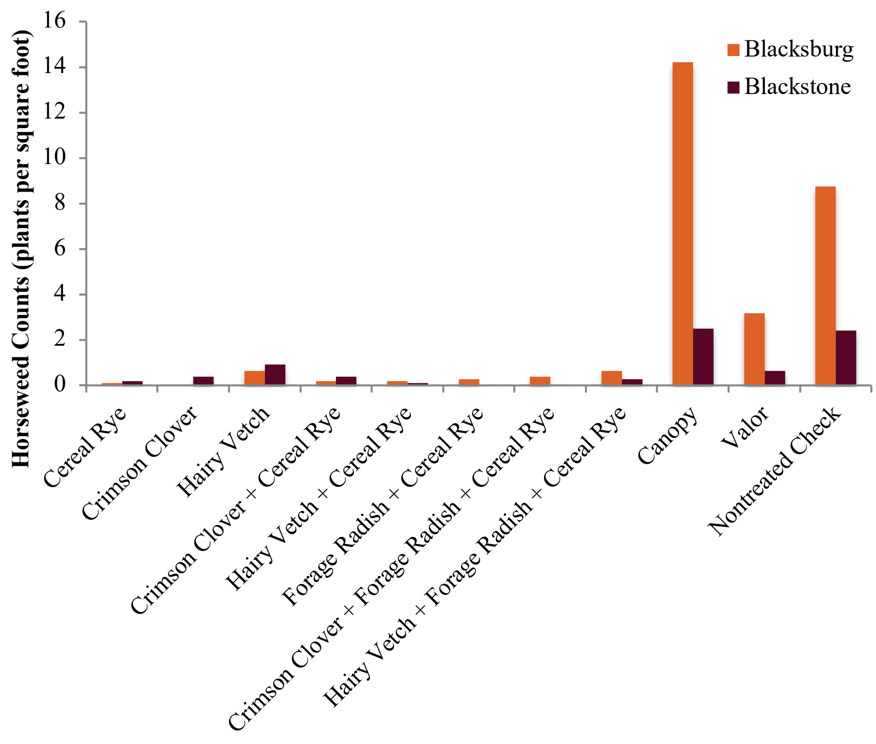

Figure 2. Horseweed counts taken in mid-March that show the impact in horseweed density from actively growing cover crops and fall-applied herbicides.

Figure 3. Comparison of horseweed populations between a no cover plot and a cover crop mixture of cereal rye and hairy vetch.

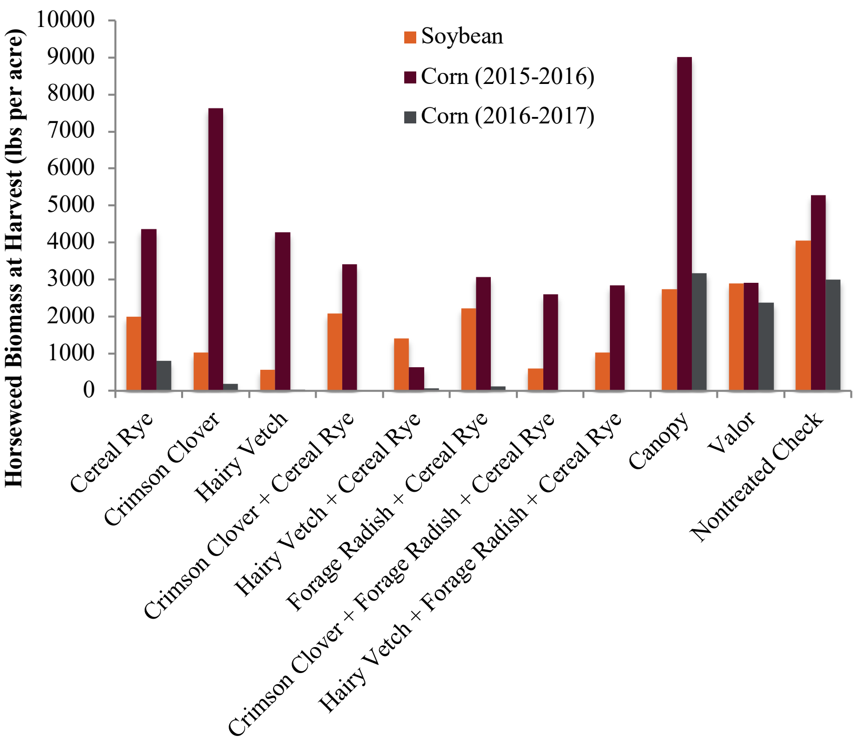

Figure 4. Horseweed biomass collected just prior to corn and soybean harvest.

Six weeks after cover crop termination, horseweed suppression varied by corn and soybean and year, ranging from 55 to 95% suppression of horseweed (Figure 3). There were no differences in suppression between the cereal rye-containing cover crop treatments and legume monocultures. Horseweed suppression in one site-year from cover crop treatments reached 95%. However, this wasn't always the case, so this research demonstrates that cover crops can be used as part of a weed management program for horseweed but alone will not provide season long suppression.

Prior to corn and soybean harvest, horseweed biomass was collected. Horseweed biomass was reduced 66 to 95% in the cover crop treatments compared to the nontreated check in the soybean experiments and two site-years of the corn study (Figure 4). This was not consistent across all studies. In the 2016-17 corn studies, there was more biomass collected from the crimson clover treatment than the nontreated check.

Yield in corn was more affected by the horseweed suppression from the cover crops compared to the soybean yield. There was a loss of 10.6 bushels per acre when horseweed was not controlled in the cover crop treatments, whereas the loss was much greater when there was no cover crop treatment to provide horseweed suppression, 36.7 bushels per acre. In soybeans, there was no difference in yield loss that can be attributed to horseweed suppression from the cover crop treatments.

The fall-applied herbicide treatments, Canopy (metribuzin + chlorimuron) and Valor (flumioxazin), were not as effective at controlling horseweed as the cover crop mixtures. When taking horseweed counts in March, Valor and Canopy performed similarly to the nontreated check. In Blacksburg, where there was more horseweed pressure, Canopy resulted in greater horseweed density than the nontreated check. In this instance, Canopy controlled other winter annual weeds, which reduced competition and allowed horseweed to thrive (Figure 5). At 6 weeks after cover crop termination, Valor suppressed horseweed more than Canopy but neither provided greater suppression than any of the cover crop treatments.

Figure 5. Fall-applied residual herbicides, like Canopy (metribuzin + chlorimuron) shown here, can decrease winter annual weed pressure and reduce the competition for resources allowing horseweed to germinate and grow unchecked.

Management Implications

Our research shows that cover crops can be used as a weed management tactic to suppress horseweed prior to planting and early in the cropping season. This, combined with other benefits of cover crops, is substantial. However, cover crops weren't able to provide season-long suppression of horseweed. Once the cover crop mulch degrades, horseweed is able to germinate and grow, therefore alternative weed control methods should be used to control horseweed after this point in the season. It is also important to use an effective burndown herbicide to control horseweed prior to planting. If the opportunity to control horseweed prior to planting a cash crop is missed, it will be difficult to control during the cash crop growing season.

While cereal rye is often chosen when growers want weed suppression, this research shows that for horseweed suppression, growers could incorporate legumes with cereal rye as well as use legume cover crop species alone. This allows for more flexibility when choosing a cover crop species or mixture because species can be chosen for other agronomic benefits, such as N fixation, without sacrificing weed suppression. For any cover crop to suppress weed, it is important to gain as much biomass as possible.

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