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Using Cover Crops as an Effective Weed Control Method in Southeast Kansas

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Abstract

Weed control is important to optimize crop production. This study was conducted to compare the effectiveness of different methods of fall-implemented weed control strategies. These strategies included different cover crop mixes, chemical control, and mechanical control. The cover crop mixes included four different commonly-planted winter cover crops. The chemical control was a fall-applied burndown, and the mechanical control was vertical tillage. We found cover crop mixes that contained cereal rye provided the most weed control, with the chemical control being a close second. Spring oats die during the winter because of the low temperatures. The three cover crop mixes containing spring oats still provided 50% reduction in weed biomass the following spring. However, the fall tillage increased the amount of weed biomass.

Keywords

weed control, cover crops, fall-applied herbicide, vertical tillage

Cover Page Footnote

This work is supported by the U.S. Department of Agriculture National Institute of Food and Agriculture, Hatch project 1003478, with partial grant funding from the Kansas Natural Resources Conservation Service Conservation Innovation Grant. We gratefully acknowledge the cooperation of the participating farmers in providing us access to their land and working with us to implement the treatments.

Using Cover Crops as an Effective Weed Control Method in Southeast Kansas

L.I. Chism, J.A. Dille, and G.F. Sassenrath

Summary
Weed control is important to optimize crop production. This study was conducted to compare the effectiveness of different methods of fall-implemented weed control strategies. These strategies included different cover crop mixes, chemical control, and mechanical control. The cover crop mixes included four different commonly-planted winter cover crops. The chemical control was a fall-applied burndown, and the mechanical control was vertical tillage. We found cover crop mixes that contained cereal rye provided the most weed control, with the chemical control being a close second. Spring oats die during the winter because of the low temperatures. The three cover crop mixes containing spring oats still provided 50% reduction in weed biomass the following spring. However, the fall tillage increased the amount of weed biomass.

Introduction
Weed control is critical for good crop production. Several different approaches to weed control are available. The most common forms of weed control include mechanical and chemical methods. Mechanical weed control uses implements to till the soil, disrupting weed growth and establishment. Mechanical tillage has been employed in agriculture for centuries. While well-established, mechanical weed control has limitations. The disturbance of the soil can impair soil quality by breaking down the soil structure. Tillage also contributes to soil and nutrient loss from wind and water erosion. More importantly, tillage can actually exacerbate weed control by redistributing weed seeds.

With the improvements in chemistry, weed control methods have shifted to chemical control. Recent advances have provided farmers with many herbicides that have specific actions for weed control. The use of pre-emergent residual herbicides has benefitted the producer by maximizing their efficiency and reduced the need for post-planting applications. However, chemical weed control does come with some limitations. We continue to see the development of weed populations that are resistant to several herbicides. As the number of resistant weeds increases, the need for more herbicide sites of action (groups) in a tank mix is needed to optimize weed control, increasing the cost of application. Environmental factors are also a concern with the use of herbicides, especially with some residuals such as atrazine, which can persist in the soil and contaminate water.

A third option that is emerging as a viable form of weed control is the use of cover crops. Cover crops are primarily planted for use other than harvesting. Utilizing cover crops can provide many benefits including weed control, retaining soil moisture, adding soil organic matter, reducing erosion, and improving soil aeration and nitrogen fixation, depending on the species. Cover crops can be planted at any time of the year but fall and spring are most common. For many of the rotations we see in Kansas, fall planted cover crops fit well without affecting the planting time of the subsequent cash crop. Fall planted cover crops are also ideal in the sense that they provide a much longer time for weed suppression. Cover crops are typically terminated within a few weeks prior to planting a spring crop, but there are also other options to utilize cover crops. They can be grazed throughout the winter, providing additional profits for the grower.

Southeast Kansas has several unique challenges that limit good, consistent crop production. The rich silt loam topsoil is shallow in depth and overlies an unproductive claypan layer. Conventional tillage can further reduce this productive layer by increasing soil loss through erosion. Moreover, several weed species have become resistant to traditional chemical control methods, requiring use of more expensive chemical herbicides. One of the major goals for weed scientists, agronomists, and crop producers is to diversify and integrate our weed management practices in order to limit the evolution of herbicide-resistant weeds. Using cover crops as a weed control method offers farmers several advantages. In addition to reducing weed species, cover crops keep the soil covered, thereby reducing erosion. Cover crops may also improve the soil health, increasing crop productivity. Cover crops can also reduce the expense of weed control while providing additional benefits that are not easily accounted for, but can have long-term improvements to the crop system.

This experiment was located three miles south of Girard, KS, in an eight-acre field. The field was known to have high populations of winter annuals, such as marestail (horseweed), and summer annuals such as common waterhemp. These were the two weeds targeted for control. Tillage is the preferred form of weed control in southeast Kansas and is used at a much higher rate comparatively than in the rest of the state. In this study we tested the weed control benefits that could be provided by using cover crops.

Experimental Procedures

This study contained nine treatments with three replications. Six different cover crop mixes were planted within a week after corn harvest in September 2017 (Table 1). The cover crops chosen included two grasses: cereal rye, which produces high biomass amounts, and spring oats. The spring variety of oats was chosen to reduce the need for chemical burndown in the spring. One legume, clover, and a brassica, tillage radish, were also planted as cover crops. Clover will add to the soil health by fixing nitrogen. Tillage radish improves soil structure because of the large tap root that creates macrochannels in the soil. One advantage of tillage radish over other brassicas, such as purple top turnip, is that the tillage radish will winter-kill, which reduces the need for spring burndown chemicals prior to planting the cash crop. The chemical burndown and vertical tillage treatments were both performed after cover crops were planted. The chemical burndown was a tank mix of 32 oz/a glyphosate (Buckaneer Plus, 4 lb/gallon, Tenkoz, Inc.), 12 oz/a dicamba (Banvel, 4 lb/gallon, Arysta Lifescience, LLC), and 0.3 oz/a chlorsulfuron + metsulfuron (Finesse, 62.5% + 12.5%, DuPont, Inc.). The ninth treatment was fallow, where no weed control was done, which served as the check.

On May 17, 2018, weed species were identified and counted, and weed and cover crop biomass were harvested. Biomass was collected and recorded for a total of 10 ft^2 per plot, using quadrats placed in four separate locations throughout each individual plot (Figure 1). The weeds and cover crops within these quadrats were clipped at the ground using garden shears and put into paper bags. After the biomass was collected, it was dried and weighed on campus in Manhattan to determine the final dry weight in pounds per acre.

Results and Discussion

After the biomass of the weeds was dried and weighed, they were compared to the non-treated check (Figures 2 and 3A). A percentage was then calculated to represent the weed control effectiveness (Figure 2). The first treatment contained cereal rye, the second treatment contained a cereal rye and clover mix, and the third contained cereal rye and radish. All three treatments containing cereal rye resulted in a reduction in weed biomass of 98% compared to the check (Figures 2 and 3D). Within those rye cover crop plots, most of the biomass was cereal rye (Figure 2). The fourth treatment of oats provided a reduction of weed biomass by 46%. The fifth treatment contained a mix of oats and clover which reduced weed biomass 55%. The sixth treatment was a mix of oats and radish, reducing weed biomass by 47%. While the three cover crop treatments containing oats had little to no cover crop biomass in the spring due to winter-kill of the cover crops, there was still an average of 50% reduction in weed biomass.

The chemical treatment, with fall applied glyphosate, Banvel, and Finesse, resulted in a 96% reduction in weed biomass (Figures 2 and 3C). While all other treatments contained a diverse population of weeds composed of winter annuals in May, the chemically-treated plots were primarily dominated by waterhemp. Surprisingly, the mechanical treatment of fall tillage increased the amount of weed biomass by 6% compared to the non-treated check (Figures 2 and 3B).

This experiment demonstrates the potential for using cover crops to control winter annuals, and the problems with tillage. Tillage increased weed production more than the untreated plots. While the chemical treatment was approximately the same in weed control, the chemical treatment resulted in a higher population of waterhemp. While we did not specifically test the waterhemp, it was potentially herbicide-resistant. Moreover, use of a rye cover crop would provide additional benefits by increasing the organic matter in the soil because of the high biomass produced. Increased productivity has been observed as soil organic matter increases. Use of rye as a cover crop may not be ideal in wheat-producing areas, but alternative grain crops are available for use as cover crops that are inexpensive and have good biomass production in our area. Research is continuing to examine other potential cover crops and their weed-suppressing potential. We are also comparing costs of production for chemical, mechanical, and cover crop weed control approaches. The goal is an integrated approach to weed control that improves the productivity and profitability of the agronomic system. Note, however, that many of the benefits of cover crops are found in soil health improvements–such as increased organic matter content–for which determination of explicit economic value is difficult.

Acknowledgments

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Table 1. Cover crop mixes, chemical, and mechanical treatments

Treatments	
1	Rye
2	Rye + clover
3	Rye + radish
4	Oats
5	Oats + clover
6	Oats + radish
7	Chemical (32 oz glyphosate, 12 oz Banvel, 0.3 oz Finesse)
8	Tillage
9	Fallow (check)

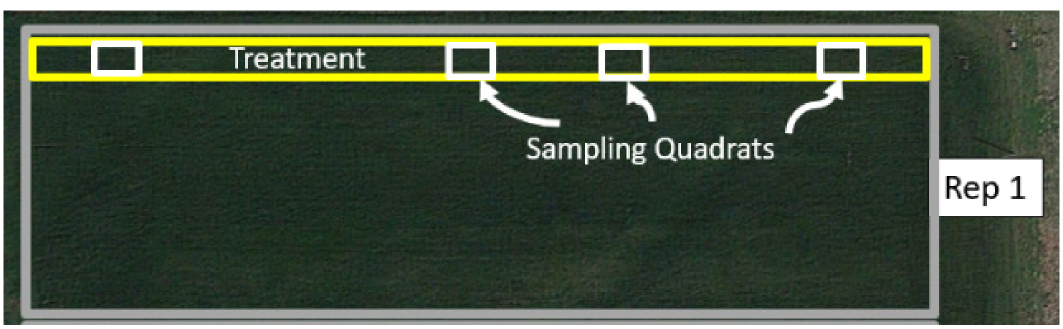


Figure 1. Aerial image of a portion of the crop field, demonstrating four sampling quadrats from a single treatment within a replication. All of the cover crop and weed biomass was collected from within each quadrat. The cover crop and weed biomass were separated, dried, and weighed to determine total production within each quadrat and each replicated plot.

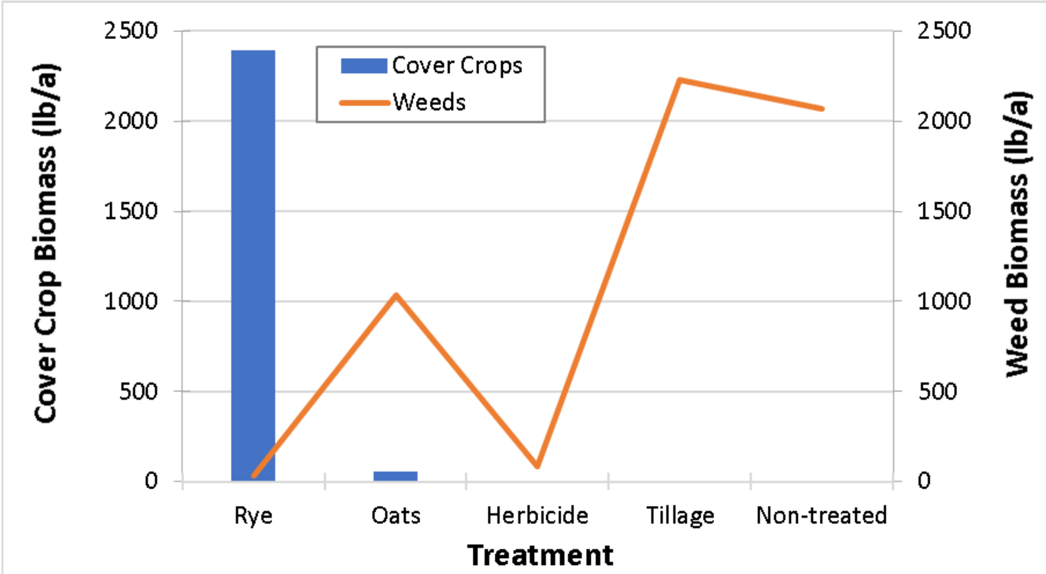
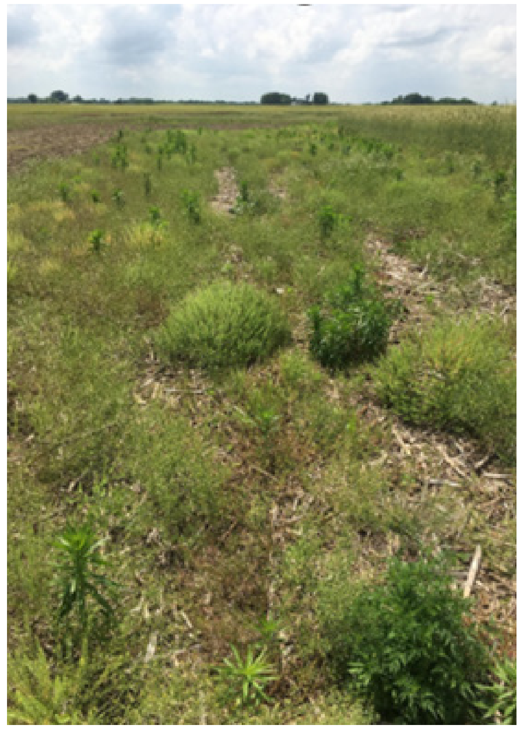


Figure 2. Weed biomass response to treatments (orange line, right axis) and total cover crop biomass production (blue bars, left axis).

A.

B.



C.

D.

Figure 3. Pictures of plots in spring of 2018. A. Non-treated check. B. Mechanical control – vertical tillage in fall. C. Chemical control – fall-applied herbicide. D. Cereal rye cover crop.