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Investigation of the influence of tillage for management of woolly cupgrass

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Investigation of the influence of tillage for management of woolly cupgrass

Abstract
Woolly cupgrass is a difficult weed for farmers to manage. Different methods of controlling woolly cupgrass are tested for efficiency and sustainability.

Keywords
Agronomy, Weed control alternatives (not GMOs)

Disciplines
Agricultural Science | Agriculture | Agronomy and Crop Sciences | Weed Science

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Investigation of the influence of tillage for management of woolly cupgrass

Abstract: Woolly cupgrass is a difficult weed for farmers to manage. Different methods of controlling woolly cupgrass are tested for efficiency and sustainability.

Question & Answer

Q: 1) Why is woolly cupgrass so difficult to manage effectively? 2) How can this research help a farmer manage woolly cupgrass? 3) How does a grower implement this research?

A: 1) Woolly cupgrass has adapted to current production systems and flourishes in current tillage systems, including no-tillage production systems. More importantly, woolly cupgrass has considerably greater tolerance (shown in previous research) to most herbicides or has adapted to current herbicide systems (i.e. glyphosate-based programs). 2) The basic principle that was researched was the impact of various production techniques and how they can collectively provide a better opportunity to manage woolly cupgrass. This reflects not only on woolly cupgrass populations that affect crop yield during the current cropping year, but more importantly, how manipulating the system can negatively impact woolly cupgrass seed banks, thus lessening future infestations. 3) The concept demonstrated reinforces a basic premise of pest management – that one specific tactic may not consistently or efficiently manage a pest, but when combined with other tactics, better and more effective management is achieved. Farmers typically focus on either tillage or (more likely) herbicides for weed control. Neither tactic, when used without consideration of the other, will consistently provide woolly cupgrass manage-

ment. Together, the two tactics can be optimized and provide a better and more consistent management of this weed. The key to implementing the research is for farmers to understand that by using these tactics, they are impacting the growth habit of the woolly cupgrass and using the herbicide when it/they have the greatest chance of effectively and efficiently causing the demise of the weed.

Background

More information is required to understand woolly cupgrass responses to chemical and cultural management strategies; this research will help producers reduce the negative economic impact of woolly cupgrass on their operations. Recommendations can then be developed to apply environmentally sound, sustainable, and effective weed management systems.

The project goal was to determine which tillage methods, chemical control practices, and tillage timing techniques can be utilized to help producers more efficiently reduce woolly cupgrass populations.

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Budget:
$8,175 for year one
$10,375 for year two
$10,800 for year three
$10,800 for year four
Approach and methods

Two experiments were conducted to integrate several management strategies for woolly cupgrass control. These experiments investigated which tillage practices are more efficient at exploiting the biological characteristics of woolly cupgrass and thus helping producers decrease woolly cupgrass incidence. Both experiments were established on a grower-cooperator farm in Boone County near Ogden. The farm was heavily infested with woolly cupgrass.

Experiment 1 evaluated the potential for tillage and herbicide combinations to deplete woolly cupgrass seeds from the soil. Tillage regimes are performed at different times of the year, and may have differing results with the equipment used and its effect on the vertical seed placement in the weed seed bank. Most woolly cupgrass seeds germinate the year following seed maturation and deposition on the soil surface (seed rain). Tillage methods that place woolly cupgrass seeds in a favorable germination environment may deplete the seed bank more effectively when germinating plants are then controlled. Herbicide treatments include weed-free control versus a single post-emergence application. Tillage systems include no-tillage, reduced tillage, and deep tillage (fall chisel plowing).

Experiment 2 chronicled woolly cupgrass emergence with time and determined the effect that tillage timing had on subsequent emergence. Weed species differ in their emergence time, and an improved understanding of woolly cupgrass emergence characteristics could help pinpoint the optimal time for growers to implement spring tillage and other field operations. Conducting tillage during the time of maximum woolly cupgrass emergence would enhance mechanical control strategies while improving overall control. The split-plot field experiment included tillage timing as the whole-plot treatment and field cultivation (tillage) and non-tillage as the split-plot treatments. The split-plot treatment of tillage and no-tillage was included to determine if tillage stimulated greater or later woolly cupgrass emergence. Tillage treatment timing, dependent on favorable field conditions, was scheduled weekly for a five- to six-week period beginning in mid-April. Each weekly timed tillage treatment was applied once.

Results and discussion

Experiment 1. Data from 1999, 2000, and 2001 demonstrated that the tillage methods varied in their manipulation of the vertical distribution of the seed. Fall chisel plowing buried a high percentage of woolly cupgrass seeds at a soil depth that did not allow germination. Consequently, the deep tillage regime maintained higher seed numbers in the seed bank after the first year of tillage. This translated into higher plant populations than the other regimes for 2000 and 2001. Reduced tillage kept the majority of the woolly cupgrass seeds in the zone of germination, which resulted in a greater reduction in seed numbers due to germination. Seed decay and predation also likely contributed to lower seed numbers in the reduced tillage regime.

No-tillage seed numbers were greatly affected by weed management tactic. Under weed-free management, seed numbers were greatly diminished in spite of low germination. It was assumed that seed decay and predation were significant factors in reducing seed numbers in the no-tillage regime. However, with the single herbicide application, no-tillage seed numbers remained higher than under the other management systems because of continued germination following herbicide application. Unlike the no-tillage regime, the reduced tillage and deep tillage regimes’ seed and plant numbers were not significantly impacted by weed management.

Experiments 2. Results of the tillage timing study conducted in year 1999, 2000, and 2001 showed initial woolly cupgrass seedlings consistently occurred around mid-April. The highest number of seedlings generally appeared within two to three weeks following initial emergence. Timing of the first tillage during or shortly after this period proved to be too early. The earlier tillage timing did not result in fewer woolly cupgrass seeds emerging in tillage and no-tillage plots at five or six weeks when compared to what was present at the initiation of the tillage timing. To be most effective, this operation should occur in late April or early May when emergence is at or near its highest point.

The comparison of tillage to no-tillage was included to determine if tillage stimulates greater or later woolly cupgrass emergence. Each year, the entire experiment area received a fall disking before tillage initiation in the spring. Consequently, tillage and no-tillage plots had similar seed positioning in terms of favorable germination conditions.
Conclusions

Experiment 1. It appears that the reduced tillage regime was the most efficient in cutting woolly cupgrass seed numbers. Weed-free management in the no-tillage regime was most effective at reducing plant numbers. However, there was an added cost to maintaining weed-free management for the no-tillage regime in comparison to the single application management tactic in reduced tillage plots. This likely made no-tillage a less efficient program for decreasing the woolly cupgrass population.

Trends observed in woolly cupgrass germination as affected by tillage in this project were confirmed with an additional year of experimentation (2004). Results from 2004 also indicated that corn yield was not adversely affected regardless of the tillage regimes or weed management strategies that were pursued.

Experiment 2. When woolly cupgrass emergence numbers in tillage and no-tillage at five and six weeks were averaged across the tillage timings, no significant differences were observed. Although the differences were not significant between tillage and no-tillage, a trend was noted for lower populations of emerged woolly cupgrass associated with no-tillage, suggesting tillage might stimulate germination.

Impact of results
Tillage had a significant effect on woolly cupgrass management because it affected the vertical distribution of woolly cupgrass seeds in the soil. The depth of tillage, as well as the time of year it was performed, had a major impact on woolly cupgrass populations through seed losses caused by germination or predation. Additionally, timing of tillage or herbicide application reduced woolly cupgrass plant numbers for that season when delayed until a significant flush of woolly cupgrass emergence had occurred. This was usually after the first week of May for central Iowa.

Based on yield data from 2004, the tillage regime and weed management tactics used in this research (a single, early post-emergence application versus complete weed control) did not affect corn yield. Therefore, the reduced tillage regime described in this research provided the best return because it was the least costly yet environmentally sustainable method, it offered adequate woolly cupgrass management using fewer inputs, and it left significant plant residues on the soil surface. Reduced tillage proved to be a more economical choice than even the no-tillage regime because it avoided the multiple herbicide applications needed to achieve adequate woolly cupgrass control.

Education and outreach
Information from this project was presented at various meetings, including the Integrated Crop Management Conference, Crop Advantage Series, Weed Biology short course, and Ag Chem Dealer meetings. Presentations were made at the North Central Weed Science Society meeting in 2001. More than a dozen scholarly journal articles and several student dissertations were generated from this research.

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