Southeast Iowa on-farm demonstration of sustainable tillage systems and weed profile developments on those systems

Arlyn Musselman  
*Southeastern Community College*

Richard M. Cruse  
*Iowa State University, rmc@iastate.edu*

Follow this and additional works at: [http://lib.dr.iastate.edu/leopold_grantreports](http://lib.dr.iastate.edu/leopold_grantreports)

Part of the [Agricultural Science Commons](http://lib.dr.iastate.edu/agr-science), [Agriculture Commons](http://lib.dr.iastate.edu/ag-agr), [Agronomy and Crop Sciences Commons](http://lib.dr.iastate.edu/agr-science), and the [Weed Science Commons](http://lib.dr.iastate.edu/wildlife-science)

**Recommended Citation**

[http://lib.dr.iastate.edu/leopold_grantreports/85](http://lib.dr.iastate.edu/leopold_grantreports/85)

This Article is brought to you for free and open access by the Leopold Center for Sustainable Agriculture at Iowa State University Digital Repository. It has been accepted for inclusion in Leopold Center Completed Grant Reports by an authorized administrator of Iowa State University Digital Repository. For more information, please contact digirep@iastate.edu.
Southeast Iowa on-farm demonstration of sustainable tillage systems and weed profile developments on those systems

Abstract
This study was designed to determine whether tillage systems left in place for significant periods of time develop different weed profiles. No-tillage, reduced tillage, and conventional tillage were placed in a corn/soybean rotation that had been maintained and documented for 15 years. No-tillage was the only corn tillage treatment that did not lead yields for at least one year of this three-year trial. No-tillage corn had significantly higher weed pressure from several species, and soybeans had significantly higher levels of giant foxtail with no-tillage. The study also compared ridge and reduced tillage yields and weed profile development; the third year of the study constituted the eighth year that those systems were in place. Ridge tillage soybeans had higher yields and significantly higher weed pressure for a number of species; no trends were detected for corn yields or weeds.

Keywords
Agronomy, Weed control alternatives (not GMOs)

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

This article is available at Iowa State University Digital Repository: http://lib.dr.iastate.edu/leopold_grantreports/85
Southeast Iowa on-farm demonstration of sustainable tillage systems and weed profile developments on those systems

Abstract: This study was designed to determine whether tillage systems left in place for significant periods of time develop different weed profiles. No-tillage, reduced tillage, and conventional tillage were placed in a corn/soybean rotation that had been maintained and documented for 15 years. No-tillage was the only corn tillage treatment that did not lead yields for at least one year of this three-year trial. No-tillage corn had significantly higher weed pressure from several species, and soybeans had significantly higher levels of giant foxtail with no-tillage. The study also compared ridge and reduced tillage yields and weed profile development; the third year of the study constituted the eighth year that those systems were in place. Ridge tillage soybeans had higher yields and significantly higher weed pressure for a number of species; no trends were detected for corn yields or weeds.

Background

Tillage systems have long been used for seedbed preparation as well as for insect, disease, and weed control. At the same time, reducing soil erosion is of great concern to growers and the government alike. Conservation tillage reduces soil erosion by allowing crop residue to remain on the soil surface, increasing filtration, and reducing runoff. Less tillage also means less destruction of weeds in the initial stages of crop growth. Growers must weigh the benefits of less tillage against the need for different weed management strategies.

The 1985 and 1990 farm bills encouraged several reduced tillage systems to be used as a way to protect soil from erosion by wind and water. The overall success of such approaches will depend greatly on growers’ ability to manage weeds. Farmers practicing conservation tillage can benefit from an ability to predict the type of weed pressure and weed species that are likely to develop with the different tillage systems.

In 1995, some 20,000 additional acres of no-tillage were implemented in Des Moines County on highly erodible land. Demonstrations cosponsored by Southeastern Iowa Community College in Burlington were intended to help farmers bridge the gap between new tillage technology and weed control. Des Moines County farmers were given the opportunity to observe a long-standing field demonstration of four systems: conventional tillage (fall plowing), reduced tillage (discing), no-tillage, and ridge tillage. These systems were in place for eight years on the Russ Reed farm and for 15 years at the Southeast Iowa Conservation Tillage Project on the Iowa Army Ammunition Plant farm. (The project was begun in 1980 to study the time, fuel, and economic requirements of different tillage systems.) The demonstrations addressed weed species and populations as they developed over the years. The information was intended to help farmers plan weed control strategies using sustainable tillage systems to comply with the farm bills.
Because these long-term tillage systems developed different weed populations over time, and because multi-year records of these plots provided historical data, these sites were well suited to an investigation of the interactions between tillage systems and weeds.

Both agricultural productivity and environmental quality can be maintained if growers can master weed management strategies in conservation tillage. This study helped to identify the changing weed problem and prepare growers for new weed management strategies to address weed concerns when moving from high levels of tillage to reduced or no-tillage. The objectives of this project were to:

1. evaluate weed populations and species for four tillage systems that have been in place for at least five years,
2. make yield comparisons to indicate the economic effects of tillage systems,
3. train growers in identification of weed species common to those tillage systems, and
4. make growers aware of long-term tillage system effects on weed species and populations.

Findings

In Experiment I, only no-tillage never led yields during the three-year project period. Corn yields in Experiment II were also variable, yielding higher than ridge tillage for two of the three years. Experiment I soybean yields revealed no clear advantage for any tillage system. Ridge tillage led the soybean yields in all three years for Experiment II.

Conventional tillage had the highest corn yield (and lowest weed pressure) for 1992 on Experiment I. No-tillage had the lowest corn yield with the higher weed population. In 1993 in Experiment I, no-tillage corn had the highest weed population and intermediate yield. In 1994, no-tillage corn had the highest overall weed population except for velvetleaf and the lowest yield. Giant foxtail (see Fig. 1), marestail, dandelion, and yellow nutsedge were significantly higher for no-tillage than for reduced or conventional tillage. Reduced tillage corn had the highest overall weed population except for velvetleaf.

In Experiment II (ridge and reduced tillage), 1992 corn yield was lower on reduced tillage, which had significantly higher weed populations than ridge tillage. Giant foxtail, prickly sida, and velvetleaf. The dandelion population was...
significantly higher for ridge tillage. In 1993, Experiment II had the highest corn yield in reduced tillage but no significant differences for weed population. In 1994, reduced tillage had the highest corn yield but had significantly higher giant foxtail, velvetleaf, and spiny sida populations. Ridge tillage corn had significantly higher dandelion populations.

In Experiment I, the same data gathered for soybeans indicated that reduced tillage had the lowest yield and the lowest giant foxtail weed pressure in 1992. Conventional tillage had the highest yields. In 1993, no-tillage and conventional tillage had nearly equal yields, and weed populations did not differ. In 1994, soybean yields were highest on reduced tillage and lowest on conventional. No-tillage had significantly higher giant foxtail, marestail, and lambsquarters populations. Velvetleaf pressure was highest in reduced tillage.

In Experiment II in 1992, ridge tillage had the highest yield and significantly more giant foxtail and lambsquarters. In 1993, ridge tillage had greater yields and significantly higher giant foxtail, prickly sida, and dandelion pressure. In 1994, ridge-tillage soybean yields were higher but also had significantly more weed population for giant foxtail. Reduced tillage had significantly higher lambsquarters pressure. Weed control results using herbicides changed significantly during the study. Use of post-emergence chemicals increased during the study time frame and changed the type and timing of chemical use.

Corn and soybeans were rotated each year of the study; thus years one and three were conducted on the same plots. Even so, weed populations were not the same for all of the study sites. Over the long term, the no-tillage corn in Experiment I seemed to increase weed pressure and coincide with reduced yield. In Experiment II, weed population and corn yields were more variable.

In Experiment I, soybean yields seemed to be more variable on all tillage types. No-tillage had the highest population of giant foxtail for years 1992 and 1994. Ridge tillage on Experiment II had the greatest weed pressure and also the highest yield.

Weed species were usually constant for a given location year after year. Drainage and other factors seemed to play a significant role in the location of certain weeds. Giant foxtail was probably the most prevalent weed in the study. No-tillage and ridge tillage seemed to have a higher incidence of weeds, which did not always reduce yields.

**Implications**

No-tillage and ridge tillage seemed to have a higher incidence of weeds, but this result was not consistently correlated with reduced yields. Sustainable agriculture practices like no-tillage or ridge tillage must be manageable in terms of weed pressure and capable of producing adequate crop yields if they are to be considered economically viable.

New low-rate, post-emergence herbicides and genetically engineered herbicide-resistant va-

![Fig. 1. Giant foxtail was the most prevalent weed in the study. Weed illustrations used in the identification sessions were reprinted from Weeds of the North Central States, NCRR Publication No. 281, 1981.](image)

1 = lower part of plant  
2 = stem with panicle  
3 = spikelets with bristles attached.
Varieties are now being tried to make no-tillage and ridge tillage management systems profitable and more environmentally benign. On-farm adaptation will probably answer these questions over time. Although policy has encouraged the shift to these tillage systems, the questionable sustainability of these systems in terms of chemical use, weed pressure, and profitability has prompted many producers to consider moving away from them. The adaptability of no-tillage to soils that are poorly drained also needs to be addressed.

**Education and outreach:** A series of in-field meetings, winter meetings, and fact sheets conveyed findings from the study. A four-session course for farmers who want better management of weed profiles on various tillage systems was delivered annually over the three years of the project. Information from the tillage demonstration was presented in these sessions as well as in a slide set.

**Evaluation:** Data were collected on participant enrollment, tillage systems used by participants, and participants' reactions to the various types of information and methods by which they were provided. An average of 35 persons attended each of the 12 sessions offered. Some 190 participants attended winter meetings, and 232 attended field days; 230 participants attended afternoon sessions, and 195 attended evening sessions. A high percentage of the participants use no-tillage. Course presentation was evaluated by questionnaire to gauge participants' reactions to the information they gained, whether their views changed as a result, the method of presentation, the quality of the presenters, and the scheduling of the presentations.

Although measuring attitudinal change is difficult, 82% of participants indicated that the project had done an adequate job in this regard. Weed identification information was given higher than a fair (3) rating (on a scale of 1 to 5 representing "poor" to "good") by 93% of participants; 87% indicated that the weed population information was higher than "fair"; 89% considered course presentation better than fair.

**Cooperation:** Field technicians, landowners and managers of the study sites, area extension crop specialists, and Soil Conservation Service (now NRCS) staff helped with program planning, implementation, education, and identification of farmers adopting new tillage systems for the 1985 and 1990 Farm Bill programs. Several agribusiness companies contributed pesticides and other supplies.