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Relative Emergence of Weeds and Corn and Soybean

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RELATIVE EMERGENCE OF WEEDS OF CORN AND SOYBEAN

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Introduction

The success of integrated weed management relies on matching control strategies to the specific weed problem in a field. This requires information not only on what weed species and how many of these weeds are present in a field, but also knowledge of the distribution of the weeds throughout the field and the stage of development of these weeds. Weed control recommendations typically provide information on appropriate tillage methods and herbicide selection. The information concerning weed infestations used to base these recommendations typically is not of sufficient detail to optimize the efficiency of these strategies.

Information on weed populations can be improved by increasing the time spent scouting fields. However, time restraints during the busy spring season restrict this opportunity. This problem could be alleviated with an improved understanding of the environmental influences on weed emergence and growth, therefore allowing us to predict when best to invest time in scouting. Armed with greater knowledge of weed development and populations, a person could determine the optimum time for tillage and crop planting to reduce weed populations, maximizing the effectiveness of mechanical weed control operations, and for timing of burndown and postemergence herbicide applications. Although there has been considerable research and modeling of weed emergence in recent years, little effort has been directed toward development of emergence information for persons involved in weed management.

This paper provides information on how weed emergence timing influences weed management
systems. Included are preliminary rankings of relative emergence for important weed species in the Midwest. The Leopold Center for Sustainable Agriculture is supporting efforts to develop more precise emergence indices that will be of greater benefit in aiding the development of more efficient weed management systems.

**Weed Life Cycles**

Weed life cycles are important to understanding emergence sequences. Weed species with different life cycles have different requirements for seedling establishment, growth, and reproduction. Weeds can be classified by life cycle as follows:

1. Annual species complete their life cycle from seed to seed in less than 12 months.
   
   a. Summer annual species emerge in the spring or early summer and produce seed during the same growing season (i.e., giant foxtail and velvetleaf). These species closely mimic the life cycle of corn and soybean and represent the most troublesome group of weeds in these crops.
   
   b. Winter annual species emerge in the late summer or fall, survive the winter, and produce seed during late spring or early summer of the following year (i.e., downy brome and field pennycress). Some of these species may also behave as summer annuals (i.e., wild oat and horseweed). Winter annuals require undisturbed soil from late summer or fall through early summer the following year. No-tillage systems provide the undisturbed soil conditions these species require.

2. Biennial species complete their life cycle in two years. In the first year they remain vegetative and store food in their roots. They flower, produce seed, and die during the second growing season (i.e., musk thistle). Because of the requirement for undisturbed soil for two consecutive growing seasons, biennial weeds are most frequently found in fields that have been under no-tillage for several years. Biennials sometimes behave as annuals or short-lived perennials depending on weather and soil fertility.

3. Perennial species live for more than two years. Usually, top growth dies each winter with below-ground structures persisting and initiating new growth in successive years.
   
   a. Simple perennials usually produce a taproot without root buds or rhizomes and spread only by seed (i.e., dandelion).
   
   b. Creeping and bulbous perennial species have roots that produce buds, rhizomes, or bulbs that produce new plants in addition to producing seed (i.e., field bindweed, quackgrass, and nutsedges). The occurrence and intensity of perennial species generally increase as tillage is reduced.
Weed Emergence Timing and Weed Management

The seed banks of most agricultural lands contain many weed species. Knowledge of when different weed species are likely to emerge is important in planning effective weed control programs. Each weed species has one or more periods of high emergence. The initial date of emergence for weed species varies widely from year to year, but the order of emergence for different species remains relatively constant. In a 1995 study evaluating the emergence profile of four summer annual species, velvetleaf was the first species to emerge, followed by woolly cupgrass, giant foxtail, and waterhemp (Table 1). There was more than a three-week difference between initial velvetleaf and waterhemp emergence. The rate of emergence varied among species, with woolly cupgrass reaching 75% emergence by May 18, compared with only 21% emergence for giant foxtail.

Table 1. Emergence profiles of four weed species in Iowa during 1995.

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>DATE OF FIRST EMERGENCE</th>
<th>% EMERGED ON MAY 18</th>
<th>% EMERGED ON MAY 31</th>
<th>% EMERGED ON JUNE 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giant foxtail</td>
<td>May 15</td>
<td>21</td>
<td>36</td>
<td>85</td>
</tr>
<tr>
<td>Woolly cupgrass</td>
<td>May 2</td>
<td>78</td>
<td>83</td>
<td>95</td>
</tr>
<tr>
<td>Velvetleaf</td>
<td>April 28</td>
<td>50</td>
<td>75</td>
<td>88</td>
</tr>
<tr>
<td>Waterhemp</td>
<td>May 22</td>
<td>0</td>
<td>23</td>
<td>53</td>
</tr>
</tbody>
</table>

The time of weed emergence influences which species will be the most serious weeds with a given crop production practice or most susceptible to certain control measures. For example, weed species that complete most of their emergence early are killed during soil preparation or burndown herbicide application before planting corn or soybean. Delaying soybean planting reduced weed populations and improved weed control with rotary hoeing and cultivation in a Minnesota study. Reductions in weed density due to delayed planting varied by species with a 25% reduction for pigweed species and nearly 80% for common lambsquarters (Table 2). These values directly reflect the timing of emergence of these two species, with common lambsquarters emerging much earlier than pigweed. Planting date influenced velvetleaf and foxtail control in a way that was intermediate of common lambsquarters and pigweed when relying on mechanical strategies (two rotary hoeings plus two cultivations) (data not shown). Not surprisingly, the timing of emergence of velvetleaf and giant foxtail are intermediate between common lambsquarters and pigweed.

The interaction of weed emergence, planting date, and weed control methods influence crop yields. Better weed control with late planting resulted in higher soybean yields than in the mid-May planting. In this study, weed control and soybean yields were not influenced by planting date with management systems relying on herbicides (data not presented).
Table 2. Reduction in weed populations due to delaying soybean planting from mid-May until early-June in east central Minnesota in 1989-1991.

<table>
<thead>
<tr>
<th>WEED SPECIES</th>
<th>WEED POPULATION REDUCTION DUE TO DELAYED PLANTING (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common lambsquarters</td>
<td>80</td>
</tr>
<tr>
<td>Giant foxtail</td>
<td>66</td>
</tr>
<tr>
<td>Pigweeds</td>
<td>25</td>
</tr>
<tr>
<td>Velvetleaf</td>
<td>69</td>
</tr>
</tbody>
</table>

We have used these examples to illustrate that knowledge of the time of emergence of weeds compared with the crop and each other and of the influence of tillage and other cultural practices on emergence can be useful in developing integrated weed management systems. Understanding the dynamics of weed emergence could be useful in determining the most effective timing for tillage and herbicide applications.

Relative Emergence Sequence of Common Weeds

The wide range of weed species present in corn and soybean complicates prediction of weed emergence patterns. Many factors, such as tillage system, crop rotation, weed control history, and weather patterns regulate the weed population of a given field. However, general trends in emergence among species are predictable. The rankings that follow estimates a general sequence of emergence developed from research data and other observations. These rankings are approximate and a species could easily shift one group in either direction depending on environmental and management factors. Rankings are based primarily on differences in initial emergence (first flush, about 5% of total emergence). Differences in the length of the emergence period are not considered in these rankings.

This paper is considered a first step in developing user-friendly information on weed emergence and growth. The weed management issue team of the Leopold Center for Sustainable Agriculture, in cooperation with other federal, state and regional groups, is working to develop more precise and sophisticated methods for predicting weed emergence and growth. These include methods based on heat unit accumulation and precipitation information, biological indicators, and real-time computer models.
### Relative emergence of common weeds of summer annual crops.

<table>
<thead>
<tr>
<th>Previous fall (Winter annuals &amp; biennials)</th>
<th>Early spring</th>
<th>Late spring</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GROUP 0</strong></td>
<td><strong>GROUP 1</strong></td>
<td><strong>GROUP 2</strong></td>
</tr>
<tr>
<td>Horseweed/marestail</td>
<td>Foxtail barley</td>
<td>Quackgrass</td>
</tr>
<tr>
<td>Downy brome</td>
<td>Kochia</td>
<td>Orchardgrass</td>
</tr>
<tr>
<td>Field pennycress</td>
<td>Prostrate knotweed</td>
<td>Giant ragweed</td>
</tr>
<tr>
<td>Shepherd's purse</td>
<td>Wild mustard</td>
<td>P. smartweed</td>
</tr>
<tr>
<td>Biennial thistles</td>
<td>Dandelion</td>
<td>C. lambsquarters</td>
</tr>
<tr>
<td>Wild carrot</td>
<td>Russian thistle</td>
<td>Wild oats</td>
</tr>
<tr>
<td>Dandelion (from seed)</td>
<td>White cockle</td>
<td>Hairy nightshade</td>
</tr>
<tr>
<td>Prior to crop planting</td>
<td>About the time of crop planting</td>
<td>After crop planting</td>
</tr>
</tbody>
</table>

- **GROUP 3**: Smooth brome, C. ragweed, Woolly cupgrass, Velvetleaf, Wild buckwheat
- **GROUP 4**: Canada thistle, Giant foxtail, C. cocklebur, Yellow nutsedge, Redroot pigweed
- **GROUP 5**: Green foxtail, C. milkweed, Hemp dogbane, Barnyardgrass, Yellow foxtail
- **GROUP 6**: Black Nightshade, Wirestem muhly, Shattercane, Common sunflower, Jimsonweed
- **GROUP 7**: Fall panicum, Crabgrass, Morningglories, Venice mallow, Waterhemp
References


