"UNDERSTANDING SOILS FOR BETTER CROPS"

27th Annual Zero Tillage and Winter Wheat Workshop

February 1st and 2nd, 2005
Victoria Inn, Brandon, MB, Canada

Sponsored by

ZERO T TILLAGE

CANADA

Canadian Cattlemen's Association

Canadian Pork Council / Conseil canadien du porc

Dairy Farmers of Canada / Les Producteurs laitiers du Canada

The Soil Conservation Council of Canada

DAKOTA PRAIRIES & DAKOTA WEST RC & D

RC & D — MAKING THINGS HAPPEN!

Greenhouse Gas Mitigation Program for Canadian Agriculture

Initiative sponsored by the Government of Canada, Action Plan 2000 on Climate Change

MANITOBA - NORTH DAKOTA ZERO-TILLAGE FARMERS ASSOCIATION

Website: www.mandakzerotill.org

WheatScout: Wild Oat and Foxtail Herbicide Decision Model

David Archer[1], Frank Forcella[2], Jochum Wiersma[3], Beverly Durgan[3]

[1]Corresponding author, North Central Soil Conservation Research Laboratory, Morris, MN. archer@morris.ars.usda.gov
[2]North Central Soil Conservation Research Laboratory, Morris, MN
[3]University of Minnesota

Introduction

Wild oat and foxtail problems continue to be a concern in the Northern Great Plains. In 2004 there were at least nine post-emergence grass herbicides labeled for use in North Dakota in spring wheat. Among these there was at least a three-fold range of costs at label rates. In making herbicide application decisions, there are many variables that are at best incompletely known. Application windows differ for differing herbicides and may vary from year to year and across soils depending on the growth rates of weeds and wheat in each particular year. In addition, weed control varies depending on application rates and timing, and resulting yield losses can be affected by weed densities and the amount of competition between weeds and wheat. There is a need to integrate weed biology with management and economics. However, real time and forecasted information on weed and crop status is not readily available. Understanding the variable nature of weed and crop conditions for each field and year may be useful in improving management decisions.

The WheatScout decision aid was designed to combine field observations with real-time observed and forecasted weather data to predict weed and crop emergence and growth. This is combined with herbicide information and economics to allow a user to evaluate application options. In this presentation, aspects of weed and crop biology will be discussed followed by a description of the WheatScout model.

Weed and Crop Biology

WheatScout builds upon the existing WeedCast model which uses weather information to estimate weed emergence and growth. Daily air temperature and precipitation information is used to estimate soil moisture and temperature conditions, which in turn determines weed emergence. Weed emergence is useful in identifying the potential for weed escapes due to late emergence. For example, in Figure 1, wild oat emergence for conditions at the Swan Lake Research Farm near Morris, Minnesota was estimated using 2004 observed daily weather. If herbicide was applied on June 3, emergence had stopped at about 40%. This means 60% of the weeds had yet to emerge, and could potentially cause yield loss. A rainfall event such as the one that occurred on June 7 spurs a new flush of emergence, so wild oat emergence is at 75% by June 17. Weed emergence

information might be used by a producer to weigh the potential for greater emergence to occur, reducing weed escapes, against the risk of running out of time to complete weed control activities.

WeedCast also uses daily weather information to estimate weed growth. This can be used to assess whether weeds are likely to be too large for adequate control. WeedCast can be used to estimate the emergence and growth of 17 weed species. WheatScout combines the weed emergence information of WeedCast with information on spring wheat growth. Spring wheat growth is calculated using the ShootGro model developed by McMaster et al. at the USDA-ARS Great Plains Systems Research Unit in Ft. Collins, CO.

Herbicide effectiveness can also be affected by application rates. Research findings from many locations were used in estimating percent control as a function of herbicide application rates. An example for wild oat control using the herbicide Assert is shown in Figure 2.

Existing research findings were also used in WheatScout in estimating the effect of weeds on spring wheat yields. Spring wheat yields in WheatScout are reduced based on the density of weeds remaining after herbicide application. However, adjustments are also made to account for differing effects that occur if weed growth is behind or ahead of wheat growth.

In addition to effects of weeds on wheat yields in the current year. WheatScout estimates wild oat and foxtail weed seed production to allow users to evaluate the potential for weeds to affect future crop yields. Weed seed production is estimated based on herbicide application rate and weed density.

WheatScout Model

WheatScout is a windows-based program that is currently available only as a test version. As the name of the model implies, WheatScout is designed to be used in conjunction with weed scouting. Observed and forecasted weather is used to estimate weed and wheat emergence and growth. Scouting observations are used to recalibrate the model on-the-fly, improving the accuracy of predictions and allowing relative weed densities to be converted to absolute numbers based on field observation at scouting. WheatScout provides a graphical display of current and future treatment options allowing the user to identify what options are available now, how long the options will be available, and what options are likely to become available in the future. In addition WheatScout provides estimates of the impacts of herbicide applications on crop yields, net returns and weed seed production, allowing comparisons among the available options.

The WheatScout main input screen is shown in Figure 5. The main input screen is divided into four sections. Preferences can be set to enter inputs in either metric or U.S. standard units. Scouting and basic site information are entered in the upper part of the screen. Herbicide information is entered in the second section, with detailed herbicide cost and application information entered in a separate window, as this information should

need to be updated infrequently. Information on crop yield goal (weed free yield) and price are entered in the third section. Weather information is entered via the bottom section. The model requires information on daily minimum and maximum air temperature and precipitation. Weather data is stored in a text file that can be edited outside of the program, entered directly through the built-in spreadsheet, or pasted from other spreadsheet programs. Forecasted weather may be entered to generate predictions into the future. Starting and ending dates for the model are also entered in the bottom section. Generally, the model is designed to be run with the starting date set equal to the scouting date, and the ending date as the end of the forecasted weather period.

An example of the WheatScout output screen is show in Figure 4. The output screen is divided into four main sections. The upper left hand section shows the spring wheat growth stage at the scouting date and the end of the forecast period. This is used in comparison to herbicide application windows in the lower left hand section to show availability of herbicides during the time between scouting and the end of the forecast period. The upper right hand section shows information on wild oat and foxtail emergence and density. The green bar shows the emergence on the scouting date, and the yellow bar shows the emergence at the end of the forecast period. This allows users to evaluate the potential for weed escapes. The lower right hand section shows estimated net returns for each herbicide on the scouting date and at the end of the forecast period. Net returns are calculated relative to a scenario of no herbicide application, so a positive value shows an economic benefit to application, while a negative value shows it is better not to apply the herbicide at that time. Details on net returns, yields and weed seed production as related to application rate are available by clicking on the bar representing the application window for that herbicide.

Field validation of WheatScout is currently being conducted. Plots were established at Crookston, Rosemount, and Morris, Minnesota to evaluate the accuracy of the model under differing conditions. Information from this study will be used in improving model predictions. The test version of the model is available to producers interested in providing feedback on the model design. Please contact the corresponding author to receive a copy of the model.

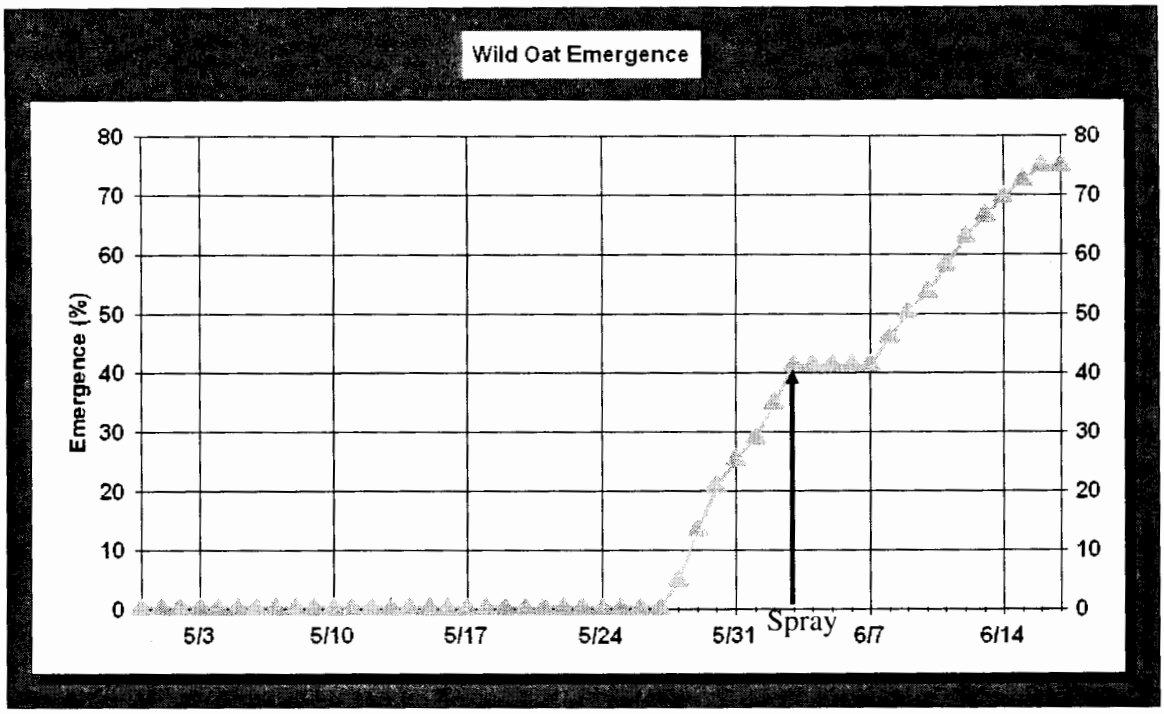

Figure 1. Estimated wild oat emergence for the Swan Lake Research Farm, Morris, MN 2004.

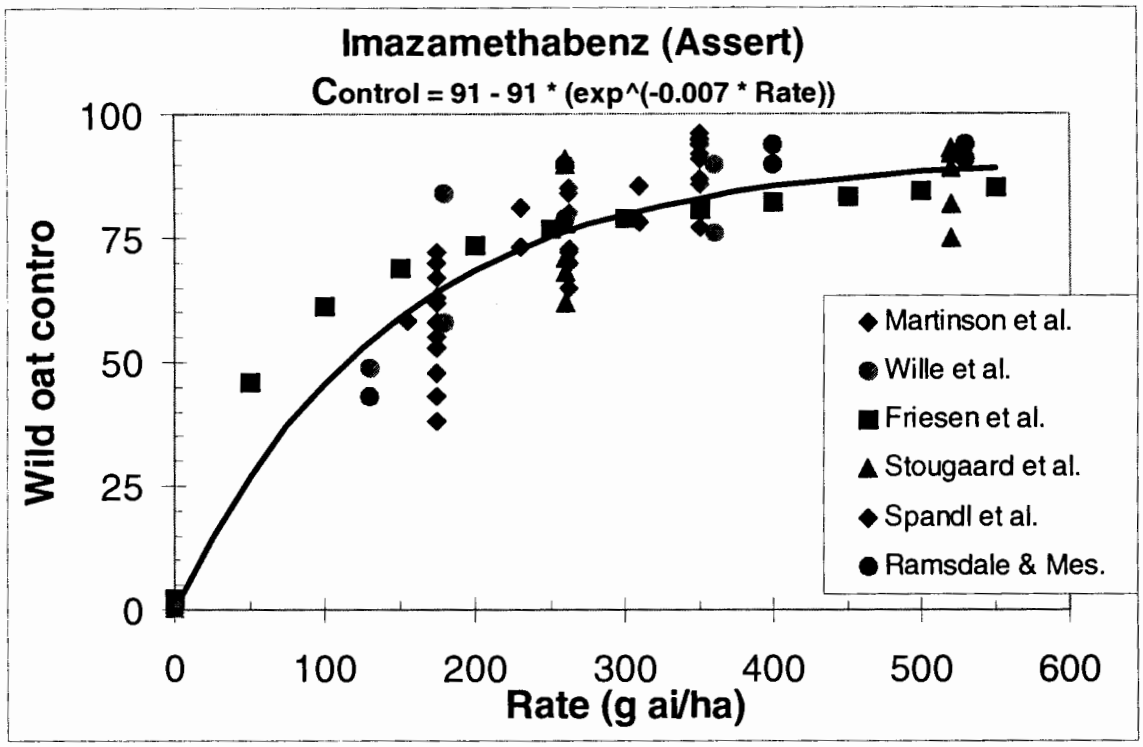

Figure 2. Estimated percent wild oat control as a function of application rate for Assert herbicide.

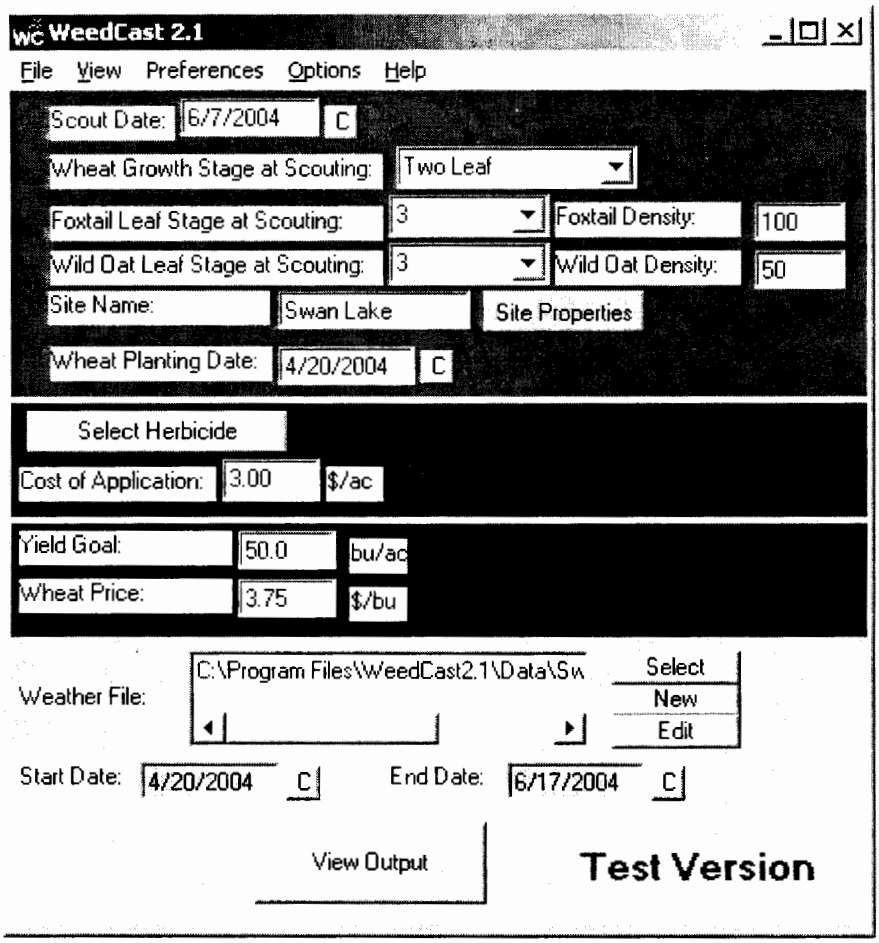

Figure 3. WheatScout main input screen.

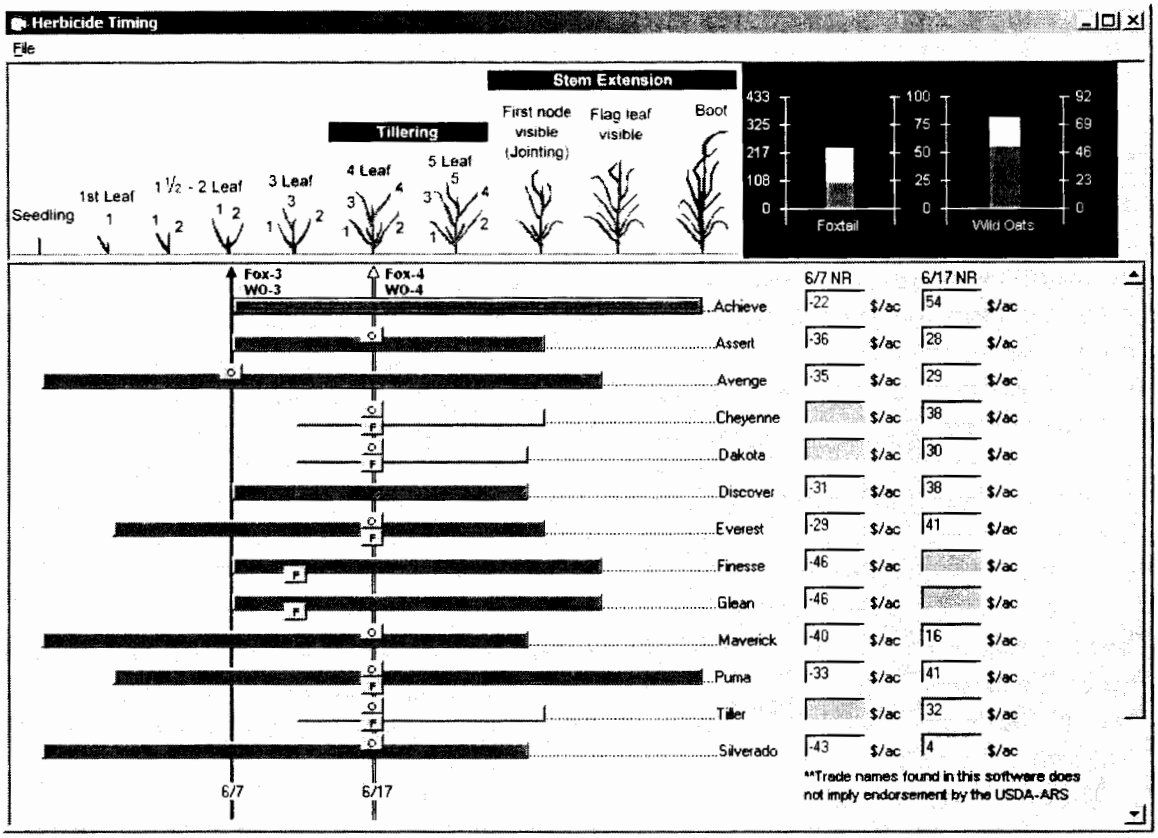

Figure 4. WheatScout sample output screen.