ESTIMATING TIME OF WATERHEMP EMERGENCE USING A GROWING DEGREE DAY CALCULATOR

Thomas J. Peters

Extension Sugarbeet Agronomist and Weed Control Specialist
North Dakota State University and the University of Minnesota, Fargo, ND

Summary

1. Waterhemp germination and emergence occurs the end of May in sugarbeet growing regions in eastern North Dakota and Minnesota.
2. Positive verification and reporting of waterhemp germination and emergence in 2016 will enable adjustment of the 'Tbase' component of the model and improve accuracy of the forecast model

Introduction

Waterhemp is different from redroot pigweed in that it germinates and emerges later in the spring. It also emerges over a prolonged period of time (8 to 10 weeks) as compared to redroot pigweed. Thus, lay-by application of residual herbicides (herbicide application after sugarbeet have emerged but before waterhemp emergence) is a good weed management strategy for providing season-long control. Metolachlor, (Dual Magnum, Cinch and generics), Warrant and Outlook are labeled for waterhemp control lay-by when sugarbeet growth stage ranges from 2 to 8 leaves.

Sugarbeet rarely germinate and emerge uniformly. Thus, farmers must delay lay-by herbicide application to ensure sugarbeet stand is complete and sugarbeet across the field are at minimum in the 2-leaf stage before application. To achieve maximum control, lay-by herbicides must be rainfall activated prior to weed emergence since these herbicides do not control emerged weeds. This means farmers need to be concerned about germinating and emerging weeds, especially waterhemp. In many respects, lay-by application is a compromise between sugarbeet growth stage, activation of residual herbicide, and the germination and emergence of weeds. The idea for waterhemp control with lay-by herbicides is to position the application to maximize the longevity of the soil-applied herbicide in order to combat waterhemp throughout the duration of the growing season.

Growing degree days (GDD) have many applications in crop management. Accumulated GDD, calculated by summing GDDs for each day during a period, are useful in tracking the development of several important crops and insect pests. One of the original uses of GDD was characterization of corn development and classifying corn hybrid maturities. Corn has a base temperature of 50°F and each corn hybrid has a certain GDD requirement to reach maturity. Those grown in the central Corn Belt require anywhere from 2100 to 3200 GDD depending on the hybrid and critical time points such as tasseling, silk emergence and kernel blistering. Relative maturity can be measured by GGD.

GDDs have been used to classify weeds to simplify scouting (Iowa State University IPM-64). Annual weeds were clustered into five groups based on GDD accumulation ranging from less than150 (winter annuals) to grasses and broadleaves that germinated and emerged at greater than 350 accumulated GDD (base 48). By tracking GDDs, it may be possible to estimate waterhemp germination and emergence in order to time application of lay-by residual herbicides in sugarbeet. The objective of this probe experiment was to determine if waterhemp GDD accumulation could forecast waterhemp germination and emergence and be used as a tool to time residual herbicide application in sugarbeet.

Materials and Methods

Daily maximum and minimum temperatures were collected from NDAWN (North Dakota Agricultural Weather Network) or NOAA (National Oceanic and Atmospheric Administration) weather stations located near Prosper and Wahpeton, North Dakota and Moorhead, Sabin, Morris, Montevideo and Litchfield, Minnesota. GDDs were calculated by determining the mean daily temperature and subtracting this value from the base temperature needed for germination and emergence of waterhemp. Based upon the information developed by researchers at Iowa State University (1), the base temperature selected was '48°F' and accumulated GDDs was 350.

The GDD accumulation for one day for waterhemp was represented by the equation:

GDD = (Tmax +Tmin)/2 - Tbase

where:
Tmax is maximum daily air temperature
Tmin is the minimum daily air temperature
Tbase is the base temperature for waterhemp, '48' based on research conducted at Iowa State University.

Calendar date when accumulated GDDs, calculated by summing GDDs for each day from January 1, 2015, totaled 350 would be first date for waterhemp emergence. Farmers would need to anticipate precipitation events and apply lay-by herbicides at least five to seven days in advance of calendar date to ensure herbicide was activated before the calendar date for waterhemp emergence.

Results

Waterhemp growing degree day accumulation (calculated using NDAWN and NOAA stations maximum and minimum daily temperature data) and resultant calendar date to accumulate approximately 350 GDDs are presented in Table. Data indicated only a six day difference in calendar day to accumulate 350 GDDs from stations/cities 200 miles apart. Data also indicates 350 GDD accumulation generally occurred by late May.

"The second half of June" was the common reply during winter grower meetings when asked when waterhemp would germinate and emerge in sugarbeet in central and west central Minnesota in 2015. This calendar date was based on estimates of waterhemp emergence from studies conducted in Iowa fields and 2014 experiments near Herman and Moorhead, MN. **The predicted date of waterhemp germination and emergence was clearly inaccurate!**

The first telephone calls in 2015 about possible waterhemp emergence occurred in early May. However, the 'callers' often were not comfortable with positive waterhemp identification since waterhemp is very similar to redroot pigweed, powell pigweed or smooth pigweed during the early vegetative stage. The data in Table suggest there is a possibility those early observations in southern Minnesota were indeed waterhemp.

Table ~~1~~. Growing Degree Days (GDDs) accumulated to predict the calendar date of waterhemp emergence at 7 locations in 2015.

Location	Calendar Date	Accumulated GDDs
Prosper, ND	June 2	358
Moorhead, MN	May 28	353
Sabin, MN	May 28	354
Wahpeton, ND	May 31	349
Morris, MN	May 29	359
Litchfield, MN	June 3	348
Montevideo, MN	May 29	357

Discussion

2014 was a late spring for sugarbeet growers and researchers alike. The majority of our research locations were planted after May 15th and into freshly tilled fields. In retrospect, there may have been very small waterhemp germinating and emerging in experimental locations at planting at the Moorhead and Herman, MN locations. We typically till the experimental area prior to planting to ensure emerged or emerging weeds do not confound results. Thus, waterhemp would reinitiate the germination and emergence process at planting, partially explaining a predicted waterhemp emergence date of 'after June 15.'

Record keeping on waterhemp GDD accumulation in 2015 combined with greater knowledge of the biology of waterhemp supports the revised hypothesis, that waterhemp germinates and emerges end of May in sugarbeet growing regions in Minnesota and North Dakota. This working hypothesis will be tested for confirmation in 2016. Positive identification of waterhemp at the cotyledon to two leaf stage is critical to complete and verify the model. Second, the observation much occur in fields near climate collection instrumentation.

Future Research

Waterhemp germination and emergence will be tracked at several locations in 2016 to improve waterhemp forecast tracking and model development. Several agriculturalists and consultants shall assist in positive waterhemp identification and documentation of the first calendar date associated with the sighting. Observations shall occur at multiple locations in sugarbeet growing regions to verify the model.

Leadership at sugarbeet cooperatives have committed to utilizing resources to develop an electronic application to track GDD accumulation. The idea is for these estimates to be tracked and available for access on a smart phone application. We believe a forecast of waterhemp germination and emergence using a model is an obtainable goal and will assist farmers with management decisions for waterhemp control in sugarbeet.

Literature Cited

1. Iowa State University Extension and Outreach, "Weed Emergence Sequences: Knowledge to guide scouting and control" (2000). Agriculture and Environment Extension Publications. Book 214.