2022 Multistate Weed Emergence Annual Meeting

March 15, 2022, Zoom

Attending: Jacob Barney, Caroline Marschner, Toni DiTommaso, Mark van Gessel, Arthur DeGaetano, Thierry Besancon, Vijay Singh, Scott Morris, Lynn Sosnoskie

Notes

Potential new members: what about hilary sandler or Katie ___ in MA?

Art showed a general format for the potential tool. It can include uncertainty areas and a three day moisture/temperature forecast.

His current thought is to house it somewhere at Cornell and have NEWA link to it, as it doesn't use the NEWA weather stations. Another option is to link it to the NEWA weather station's observed data rather than the gridded forecast.

Are the models ready to go? Well, we can use the existing Myers models, or we can use Mohsen's re-tuned models. The form of the models wouldn't change, but the parameters do. The Myers use soil degree days, and Mohsen is adding moisture.

Our soil temperatures in the grid are modeled, based on air temperature. Jacob recently saw some measured soil temperatures; NEWA has soil temperatures at about half of their sites, and NJ has ~13 stations have moisture measured at 5cm as well as air temperatures. Those data are in NEWA. The gridded data uses radar for rainfall, ground truthed with actual rain gauges.

Art thinks it's possible to make it a choice, to do gridded data or real data – he'll think about it.

The output will be emergence to date, in graphic and tabular format, and projected emergence for the rest of the season.

Can we make it so they can click on the species that they have? Yes, Art thinks that's doable.

How accurate is good enough? Jacob's thought is we report the accuracy and let the user decide how good it is. Prediction of the beginning of emergence is important for pre-emergence; more complete emergence more important for post-emergence treatment.

Lynn's site got washed out last year.

Regarding validation: we're using the same very artificial validation with seeding and etc. Should we be validating in a more environmental setup?

Vijay concurs that emergence from farm fields would be best.

Could we ask CCE folks to tell us when they see x,y,z species? We could, but it wouldn't be locationally tied or necessarily catch actual emergence.

An alternative approach is to run the model on each 4km grid, and produce a map of emergence %, then ask if that's what people are seeing.

The value of this model is the curve, and where you are on the curve. A single snapshot doesn't give you that location on the curve.

Lynn can certainly do this at the Geneva station for at least a few species. She will also do that on muck soil. Ethan Gunberg and she have been talking on the Orange County muck, now that Palmer is almost there. She seeded again this year, and it may wash out again.

We'll see everybody at the joint meeting next year.

Lynn has done quite a bit of germination work with Palmer and waterhemp populations, looking at germination under various stresses (temp, salinity, etc).

United States Department of Agriculture

Progress Report

Title:	**Development of a Weed Emergence Model for the Northeastern United States**

Sponsoring Agency	NIFA	**Project Status**	ACTIVE
Funding Source	Hatch/Multi State	**Reporting Frequency**	Annual
Accession No.	1018540	**Project No.**	NYC-125838
		Multistate No.	NE1838
Project Start Date	12/12/2018	**Project End Date**	09/30/2022
Reporting Period Start Date	10/01/2020	**Reporting Period End Date**	09/30/2021
Submitted By	Crystal Clark	**Date Submitted to NIFA**	01/19/2022

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Performing Department

Crop & Soil Sciences

Non-Technical Summary

Unlike crops, which have been selected for uniform emergence, weed species have evolved variability in timing of their emergence; even seeds maturing on the same plant may germinate at different times. This "bet-hedging" strategy, with which a weed avoids putting all its "seed in one basket" of emergence timing, enables weeds to escape control measures that are applied at the "wrong" time. Post-emergence management carried out too early, i.e. before most problem weeds have emerged, will yield low returns for the effort, investment, and ecological cost of the management (herbicide off-target effects, soil compaction, etc.), as weed seeds that have yet to germinate are often unaffected. Providing seedling emergence information so that farmers can effectively time their weed management operations can increase efficacy of control, reduce labor costs, and minimize any negative environmental impacts (e.g. reduce the likelihood that repeat applications of an herbicide or cultivation may be required for late germinating/emerging weeds). There is, therefore, an urgent need for the development of time-specific weed management tools to help address the frequently asked, yet to be answered, question of when is the "right" time to control weeds?

Weed seedling emergence is a complex process regulated by a multitude of internal (e.g. species-specific parameters such as base temperature, base water potential) and environmental (e.g. soil temperature and moisture) factors. A range of modeling approaches, varying from simple empirical to advanced mechanistic models, have therefore been adopted to quantify the extent and time of emergence for a significant number of weeds. These can be used to produce weed management decision support tools, which enable farmers to determine the percent emergence of a specific weed species by a given date, taking into account the weather, management actions, and field conditions to that point. Populations of weeds respond differently in different regions to climate and habitat, requiring that emergence models be modified for a particular region. No weed management decision support tool exists for the Northeastern region of the United States, despite recent advances in our understanding of regional weed emergence patterns and developments in fine-scale weather prediction and soil moisture modeling. Data exist to create a weed forecasting product similar to those available for insect and disease threats to Northeastern agriculture, which would enable farmers to approach weed management with more precision and planning. In the past decade, decision support tools have been developed to help farmers manage weeds effectively in the Midwestern United States and Europe; these would serve as a road map for the Northeastern decision support tool. Recent advancements in climate and weather models and computational power have generated detailed weather data that are available to the general public free of charge. In the Northeast, daily weather data are now available on a 4 × 4 km grid across the region using the Applied Climate Information System (ACIS) Web Services (DeGaetano et al. 2014). These databases provide an unprecedented opportunity to estimate parameters directly relevant to seedling emergence such as growing degree day and hydrothermal time, from soil temperature and moisture data at very fine spatial resolution.

The **overarching goal of this project** is to work collaboratively across the northeast region to optimize farmers' ability to manage weeds in agricultural systems, in the face of challenges posed from a changing climate and increased prevalence of herbicide resistant weeds.

Accession No. 1018540 **Project No. NYC-125838** **Multistate No. NE1838**

In this proposal, our goal is to develop and validate a user-friendly, online decision support tool for the real time prediction of weed emergence in the northeastern US. The decision support tool takes GPS location, soil type, tillage, crop data, and accesses weather history to provide percent emergence of the farmer's problem weeds at that location.

Accomplishments

Major goals of the project

(1)
Link Northeastern weed emergence timing data to existing weed emergence models and modern weather prediction models to create an online tool for farmers that will help them plan their weed management for optimal weed control. This tool will include three weeds that are problematic across the region: common lambsquarters (Chenopodium album), redroot pigweed (Amaranthus retroflexus) and large crabgrass (Digitaria sanguinalis). Common ragweed (Ambrosia artemisiifolia) will also be included in the northern portion of the Northeast and morningglory species (Ipomoea spp.) in the southern portion of the region. Individual participating states may also include one additional species of particular interest to their state.

(2)
Collect weed emergence data across the region to validate and refine the existing weed emergence models to fit Northeastern data, and refine the decision support tool through testing by select farmers and extension staff.

What was accomplished under these goals?

We collected our second year of field data, and re-started our scoping review of weed emergence modeling literature. Our contributors deployed the field sensors purchased before the COVID lockdown in 2020. Our partnership collected data in New York (3 locations), New Jersey, Pennsylvania, Delaware, and Virginia (2 locations).

What opportunities for training and professional development has the project provided?

Students at all of the participating institutions participated in data collection, developing weed seedling identification skills, a useful and difficult skill set.

How have the results been disseminated to communities of interest?

{Nothing to report}

What do you plan to do during the next reporting period to accomplish the goals?

In the next year of the grant, we intend to use this year's data to refine our weed emergence model and develop a decision tool using the results of that work. The model will be posted on the Northeast Environment and Weather Applications website (newa.cornell.edu/crop-and-pest-management). We will also collect a third year of weed emergence data for further refinement of our models, and complete the scoping review of weed emergence literature.

Participants

Actual FTE's for this Reporting Period

Role	Non-Students or faculty	Students with Staffing Roles			Computed Total by Role
		Undergraduate	Graduate	Post-Doctorate	
Scientist	0.4	0	0	0	0.4
Professional	0.2	0.5	0.1	0	0.7999999999999999
Technical	0	0	0	0	0
Administrative	0	0	0	0	0
Other	0	0	0	0	0
Computed Total	0.6	0.5	0.1	0	1.1999999999999999

Accession No. 1018540	Project No. NYC-125838	Multistate No. NE1838

Student Count by Classification of Instructional Programs (CIP) Code

Undergraduate	Graduate	Post-Doctorate	CIP Code
7	1	0	01.00 Agriculture, General.

Target Audience

In this reporting season, we did not conduct any extension around our research. We restarted our work after a one-year hiatus due to COVID-19. Once we have products to share, our target audience will be extension agents and growers.

Products

{Nothing to report}

Other Products

{Nothing to report}

Changes/Problems

{Nothing to report}