Project No. and Title: NC1191 Weeds as Phytometers in a Changing Environment

Period Covered: 10-2013 to 09-2014

Date of Report:

Annual Meet Dates: 29-Jul-2014 to 30-Jul-2014

Participants:

- Buhler, Doug (buhler@msu.edu) Michigan State University – via conference call
- Clay, Sharon (Sharon.clay@sdstate.edu) South Dakota State University
- Dille, Anita (dieleman@k-state.edu) Kansas State University
- Felix, Joel (joel.felix@oregonstate.edu) Oregon State University
- Gramig, Greta (greta.gramig@ndsu.edu) North Dakota State University
- Lindquist, John (jlindquist1@unl.edu) University of Nebraska-Lincoln
- Rew, Lisa (lrew@montana.edu) Montana State University
- Sprague, Christy (sprague1@msu.edu) Michigan State University

Summary of Minutes: see attachment

Meeting Minutes
NC1191 Summer Meeting
Kansas State University, Manhattan, KS
July 29, 2014

Chair/Minute Recorder: Christy Sprague (MSU - MI)
Local Host: Anita Dille (KSU)

Attending: Christy Sprague (MSU - MI), Anita Dille (KSU), Sharon Clay (SDSU), John Lindquist (UNL), Joel Felix (OSU - OR), Lisa Rew (MSU - MT), Greta Gramig (NDSU) and Andi Christensen (KSU).

Welcome: Anita Dille welcomed everyone to Kansas State University.

I. Discussion of possible projects for the next writing cycle.

Idea 1: Lisa Rew started the discussion by relating some of the research she has been conducting in conjunction with the Muran Group. Lisa brought up the idea of conducting low cost projects for measuring climate change impacts on crop and weed competition. She discussed the open top chamber experiments that they are currently working on.

Current experiment that Lisa is working on:

Open top chambers:

Shape:	cone
Size:	0.75 m top, 1.25 m base, ~18 inches tall
Other aspects:	some with rainfall shelters (reduce rainfall by ~60%)
Measurement devices:	gypsum & iButtons for measuring air temperature
Cost:	~$180 per chamber
Power:	4 to 5 chambers (replications)

Treatments:

1) *winter wheat only*
2) *cheatgrass only*
3) *winter wheat and cheatgrass*

The project could be an undergraduate project.

What direction is climate change going warming or cooling?

Potential funding sources:

Are there possible funding sources that we could tap into?
AFRI
New IPM program funding sources
Where may this projects like this and this group fit?

There was some discussion that funding rates are not very good and after institutional splits and overhead there is not much left to fund projects.

Idea 2: Since Frank Forcella (USDA-MN) was unable to attend the meeting Greta Gramig presented some of Frank's thoughts. She indicated that Frank values his collaborations with Argentina and Spain working on seedling emergence models, especially in the wake of herbicide-resistant weeds. Questions that could be addressed include
What effect does environment have on the seedbank (fall environment, maternal environment, etc)?
How do artificial seed banks reflect the actual seed bank?

Idea 3: John Lindquist (UNL) suggested that maybe we could combine the open top chamber experiment idea with weed emergence of different species. How does climate change influence and the rate of nutrient cycling, moisture conditions and microbial communities? The chambers would alter temperature above ground probably changing the soil temperature for seedling emergence and soil moisture could be measured with gypsum.

Joel Felix (OR) asked the question about epigenetics. How long will it take to change the DNA in these plants do to epigenetic changes?

What about selection from temperature gradients (sub-zero to 37 C)? Lisa indicated that she as a germination table. We could look at seed collections from different places and determine effects of temperature on germination.

Idea 4: Herbicide-resistant weeds were brought up, since this is a major topic in the weed science community.

1) *Predicting emergence of various herbicide-resistant weeds.*
2) *How do we get managers of weeds to use a more integrated approach?*
   Anita indicated that kochia is mostly an issue in fallow and it is difficult to get people to manage it. There is a kochia group CO, KS, ND, SD, WY, MT and Canada that is trying to work on this.

Idea 5: There was some discussion about cover crops and their effects on weeds, etc. There are a lot of recommendations out there that are not always science based. Cover crop

mixtures is another area of interest. How do we get producers to integrate some of these approaches, especially how it relates to herbicide-resistant weed management? Lisa indicated that she is setting up longer term plots that can be used as demo plots to scale how IPM works. This type of work takes a lot of time and money.

Idea 6: As a group we really should focus on a simple single question. That has been the strength of this research group has been the multiple locations and collaborations.

What types of questions can we answer and get value?
There were several participants that like the open top chamber ideas.

1) *How does an increase in temperature and decrease in moisture effect weed emergence?*
2) *Are there other things besides hydrothermal time that can explain differences in emergence?*
3) *Does the angle of radiance hitting the soil surface impact weed seedling emergence?*
4) *Does light affect seedling emergence?*
5) *Does the angle of the sun effect weed seedling emergence?*

Possible winter annual weed species to study: horseweed (marestail), pennycress, mustards, henbit, chickweed,

What about looking at the existing seed banks with the open top chambers? That way we could look at multiple species within each chamber. We could look at growth rate up to a certain point and could include looking at some different herbicide-resistant weed species.

Climate Variability vs. Climate Change?

II. Administrative update (Doug Buhler – via conference call).

The renewal time for this research project is in 2015. The group is currently in year 3 and we were approved through our three year review.

Timeline for 2015:
Sept. 15: Renewal indication deadline.
Oct. 15: Objective and list of participants.
Dec. 1: Research project proposal is due.

The general theme of this project has remained consistent and has been a driving force for a long-time. Range shifts of weeds and competitive changes due to climate change have been part of that theme. The group has been able to build on historical changes to include a more contemporary approach.

Doug also commented on Centers of Excellence. Currently, there is no money in the budgets for these Centers of Excellence. He is a little concerned that the funds for these Centers will be taken away from the foundational programs.

Doug encouraged the group to look at the best targets for the science and how to attract some new blood to the group. There should be opportunities in the future and it is important to

form the team. There may be opportunities to approach NSF in the future. The group should identify problems that have a real chance to be competitive at an external source. The current programs may be able to make some modest investments in building teams and possibly provide some support. How do we build programs to fit into the Climate Hub? (These were some thoughts from the meeting of the Experiment Station Directors). The broader representation the better, it doesn't necessarily need to be just in the North Central region. Think about different and more creative ways to bring others into the group. Currently, the North East and North Central weed groups are the two most active.

There are other types of committees. Doug is not encouraging us to go this way. However, there are ERA or CC committees, if the group doesn't want to go with the pure research group like it has in the past. We should try to meet with the North East group and see their interest.

III. Focusing the idea for the next writing cycle using Open Top Chambers.

Table 1. Winter annual weeds problems in wheat for each state.

	NE	MI	MT	KS	SD	ND	OR
Horseweed (marestail)	X	X		X	X	X	X
Pennycress	X	X	X	X	X	X	X
Henbit	X	X		X			
Chickweed		X	X?		X	X	
Mustards	X	X	X	X	X		X
Downy brome			X	X			X
Windgrass		X					

Other ideas:

C3 vs. C4 summer and winter annuals
Herbicide resistance

Species from previous projects (that may work):

Field pennycress
Giant ragweed
Sunflower

Resistant species:

Kochia
Palmer amaranth
Waterhemp
Giant ragweed
Common ragweed

Emergence and subsequent growth: field pennycress (C3) vs. kochia (C4)
What about henbit? SD and ND don't have it.

We could possibly bring in the WERA077 group *"Managing invasive weeds in wheat"* if we focus on kochia.

IV. Potential protocol for new project – Open top chambers: Climate change impacts on weed emergence and growth

Treatments:

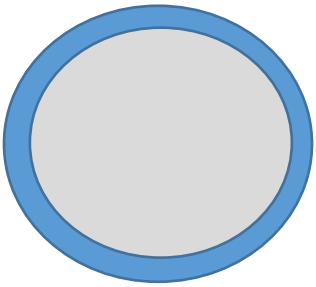
1) Natural conditions
2) Natural with rainout – Not sure if we need this treatment
3) Open top chamber
4) Open top chamber with rainout

Species questions:

C3 vs. C4 forbs?
Winter annuals vs. summer annuals?
Maternal effects on seed production?
Should local accessions be used?

Focus should be on emergence on growth up to a certain point.
Weed out other weeds as they emerge.
Looking at a slightly smaller version of the OTC.

1.3 m bottom; 0.8 m top



Action Item: Lisa Rew will try to put together a protocol.

Hypothesis: Changes in climate will make a shift to drier and warmer conditions.

What is the role of climate in the emergence and growth (fitness) of different weed species?
H1: Winter annuals will emerge later
H2: Summer annuals will emerge earlier and grow faster in the chambers with warmer temperatures
H3: Winter annuals will have higher mortality in chambers with rainouts
H4: OTC with reduced precipitation will reduce summer annual emergence and survival

Species: Henbit, downy brome, kochia, common lambsquarters, pennycress

Stage 1: Measure emergence, survival, and growth rate on a weekly basis 10 focal species per plot until a certain height or first flower.
Stage 2: Seed production for an expanded protocol.

Other questions: Nutrient cycling, maternal effects, microbial communities.

2nd Objective: preliminary data for a larger funding source

V. Potential new participants.
University of Illinois: Sam Wortman
New Mexico State University: Brian Schutte
Colorado State University: Sarah Ward, Todd Gaines and Cindy Brown
University of Missouri: Kevin Bradley
Ohio State University: John Cardina, Emilie Rengier and Kent Harrison
University of Wisconsin: Vince Davis and Mark Renz
Purdue University: Bryan Young
Oklahoma State University: Angela Post
University of Wyoming: Andrew Kniss
University of Kentucky: Erin Haromoto

College Station Texas: Muthu
Cornell University: Matt Ryan
Oregon State University: Ed Peachy and Andy Haulting
Utah State University: Earl Creech and Corey Ransom
Washington State University: Ian Burke

VI. Current project discussion.

We need to talk to Frank Forcella bought the current data analysis.
Also we want to make sure Frank has all the data by January 2015.

VII. 2015 Meeting and New Election

Time of meeting:	One face-to-face meeting and one conference call a year.
Communication:	Basecamp, google docs, or dropbox
2015 Chair:	Lisa Rew, Montana State University
2015 Vice-chair:	John Lindquist, University of Lincoln
2015 Meeting Location:	Lincoln, NE (John will be the chair), July 27-29.

Accomplishments:

Short-term outcomes: The information gained from this project will help improve our ability to predict weed seedling emergence and seed production of four difficult to manage weeds in the North Central region. Understanding weed seedling emergence and seed production of these important weed species will help growers to make informed decisions on the timing of cost-effective weed management strategies on their farm.

Outputs: A regional-scale data set on the phenology of summer annual and winter annual weeds of the north central region will be generated. These data will be used to update and improve weed seedling emergence models.

Activities: This year was the last year of four years of data collection on the phenology of common lambsquarters (*Chenopodium album* L.), field pennycress (*Thlaspi arvense* L.) horseweed (*Conyza canadensis* L.), and velvetleaf (*Abutilon theophrasti* L.). This common garden experiment was conducted in KS, MI, NE, ND, MN, OR, SD. For each weed species, seeds from common and local accessions were planted. Experimental units consisted of 1 m2 quadrats with two types of measurements taken within: seedling emergence, and monitoring of flowering and seed maturation within the quadrat as a whole. Each 1 m2 quadrat contained four evenly spaced rows (0.25 m between rows) of a given experimental species seeded at 30 seeds row-1.(populations will ultimately be thinned to 2-4 plants per row, for a total of 12 plants per quadrat; see below). Phenology measurements included seedling emergence over time, floral initiation (onset of anthesis), and species-specific measures of seed maturation. Weed seedling emergence was recorded non-destructively twice a week until there were at least 2-4 plants per row. Seedlings were thinned to leave 2-4 plants per row, to achieve a total quadrat population of 12 plants. Floral initiation and seed maturation for each marked individual in each plot was recorded. Currently, the group compiling data from this experiment and is in the process of analyzing the data set. The large comprehensive dataset will be used to test the current

parameterization of Hopkins Bioclimatic Law (HBL). By improving HBL, we will be able to develop more accurate predictions of weed phenology in support of weed management.

Milestones: We have collected three full cycles of weed phenology data that are required to improve modeling approaches for more accurate weed phenology predictions. Data were summarized by each participant and presented at the annual meeting. The data will be compiled for all locations and summarized prior to the 2015 annual meeting.

Impacts

1. Two publications resulting from this group's previous project were published in Weed Science and Microbial Ecology.

Publications

Clay, S., J. Cardina, A. Davis, A. Dille, F. Forcella, J. Lindquist, and C. Sprague. 2014. Common sunflower seedling emergence across the U.S. Midwest. Weed Sci. 62:63-70.

Lou, Yi, S. Clay, A. S. Davis, A. Dille, J. Felix, H. Ramirez, C. L. Sprague, and A. C. Yannarell. 2014. Plant-soil feedback involves a relationship between microbial affinity and microbial effect on plant growth. Microb. Ecol. DOI 10.1007/s00248-013-0349-2.