Project Title: Waterhemp Control in Sugarbeet

Project Number/Description: 2018-1, continuation from 2014 to 2017.

Project Leader: Thomas J. Peters, Extension Sugarbeet Agronomist, NDSU, Univ. of Minnesota

Other Personnel Involved: Nathan Haugrud, Graduate Student, NDSU, Alexa Lystad, Graduate Student, NDSU, Mike Metzger, Research Agronomist, Minn-Dak Farmers' Cooperative, Mark Bloomquist, Research Director, Southern Minnesota Beet Sugar Cooperative, and David Mettler, Research Agronomist, Southern Minnesota Beet Sugar Cooperative

Project Locations: Lake Lillian, MN, Moorhead, MN and three or four locations, to be determined

Justification for Research: (For new projects only)

Summary of Literature Review: (For new projects only)

We have made waterhemp control in sugarbeet our most important deliverable, having conducted 59 experiments in sugarbeet since 2013. Research has produced multiple waterhemp control strategies in environments representing the sugarbeet growing region in Minnesota and North Dakota. Program has been built around use of chloroacetamide herbicides (SOA15) applied preemergence (PRE), early postemergence (EPOST) and postemergence (POST) in sugarbeet. Results indicate PRE-followed by EPOST application of soil-residual herbicides (layering) is the most effective program for waterhemp control in sugarbeet. Results have been presented using a combination of media including field demonstration plots, grower meetings (large group), machine shop meetings (small group), and written reports. There has been tremendous adoption of waterhemp control recommendations by sugarbeet growers. Surveys conducted at 2017 winter meetings indicated 59% adoption by sugarbeet growers that rate waterhemp as their most important weed control challenge as compared to 13% in 2013.

There are additional challenges. There are soils where chloroacetamide herbicides cause sugarbeet injury and where ethofumesate may have a stronger technical fit. Additionally, research must be conducted to identify strategies to rescue unacceptable waterhemp control. Solutions include the best approach for utilizing remaining desmedipham plus phenmedipham or methodology for incorporating cultivation into the weed management plan. Finally, we need to continue to evaluate the durability of the chloroacetamide program, especially the PRE followed by POST/EPOST (split lay-by) program. 2018 Objective: A weed management system for continued and expanded control of waterhemp in sugarbeet.

Materials and Methods: Weed control experiments shall be grown in geographical areas where waterhemp is an indigenous weed and in fields with sufficiently uniform infestations to ensure collection of meaningful results. I shall continue to use the Moorhead location (ACH) and intend to continue to conduct trials in cooperation and collaboration with Minn-Dak Farmers' Cooperative and Southern Minnesota Beet Sugar Cooperative.

Experiments:

a. Waterhemp control from herbicides applied PRE, EPOST and/or POST in sugarbeet. Continue to evaluate waterhemp control system in additional environments. Consider transitioning from a sugarbeet growth stage based model to a calendar date based model, perhaps beginning with planting date. Data collection shall include sugarbeet stand counts, visual assessment of sugarbeet injury, weed counts per unit area, and visual assessment of weed control. Experiment shall be conducted at three

locations, Moorhead (ACS), a location in Minn-Dak Farmers Cooperative, and a location in the Lake Lillian area (SMBSC). Treatment list will be the starting point for 2018 protocols:

| Trt | Treatment | Rate* (pt or fl oz/A) | Application (Sugarbeet leaf stage) |
|---|---|---|---|
| 1 | Untreated | | |
| 2 | S-metolachlor | 1.25 | 2-4 lf |
| 3 | S-metolachlor | 1.67 | 2-4 lf |
| 4 | Warrant | 3.25 | 2-4 lf |
| 5 | Warrant | 4 | 2-4 lf |
| 6 | Outlook | 18 | 2-4 lf |
| 7 | Outlook | 21 | 2-4 lf |
| 8 | S-metolachlor / S-metolachlor | 1 / 1 | 2-4 lf / 6-8 lf |
| 9 | S-metolachlor / S-metolachlor | 1.25 / 1.25 | 2-4 lf / 6-8 lf |
| 10 | Warrant / Warrant | 2.25 / 2.25 | 2-4 lf / 6-8 lf |
| 11 | Warrant / Warrant | 3 / 3 | 2-4 lf / 6-8 lf |
| 12 | Outlook / Outlook | 12 / 12 | 2-4 lf / 6-8 lf |
| 13 | Outlook / Outlook | 15 / 9 | 2-4 lf / 6-8 lf |
| 14 | S-metolachlor / S-metolachlor | 0.5 / 1.25 | Pre / 2-4 lf |
| 15 | S-metolachlor / Warrant | 0.5 / 3.25 | Pre / 2-4 lf |
| 16 | S-metolachlor / Outlook | 0.5 / 18 | Pre / 2-4 lf |
| 17 | S-metolachlor / S-metolachlor / S-metolachlor | 0.5 / 1 / 1 | Pre / 2-4 lf / 6-8 lf |
| 18 | S-metolachlor / Warrant / Warrant | 0.5 / 2.25 / 2.25 | Pre / 2-4 lf / 6-8 lf |
| 19 | S-metolachlor / Outlook / Outlook | 0.5 / 10 / 10 | Pre / 2-4 lf / 6-8 lf |
| 20 | Glyphosate/Glyphosate | 28 /28 | 2-4 / 6-8 |

b. How to best rescue waterhemp control; how to best utilize Betamix. Our inventory of Betamix is running out. We need to ensure there are recommendations for when our planned waterhemp control program fails to deliver acceptable results. We believe size of waterhemp escapes are critical. We also believe recognition of ALS resistant waterhemp (SOA2) is critical. Data collection shall include visual assessment of sugarbeet injury, weed counts per unit area, and visual assessment of weed control. Experiment shall be conducted at Moorhead (ACS) and at our Lake Lillian location (SMBSC).

c. Waterhemp control in an integrated weed management approach that includes herbicides and row-crop cultivation. The purpose of the experiment is to quantify the effect of cultivation on waterhemp control. Cultivation: a) may control of waterhemp escapes; b) may disrupt the herbicide layer, creating additional waterhemp germination; c) may activate herbicides when precipitation is not timely; and d) may contribute to the development of unintended root diseases. Experiment shall be conducted at four locations, one in ACS, two in Minn-Dak, and one in SMBSC geographies. Details about experimental design and data collection will be addressed by Mr. Nathan Haugrud, graduate student.

d. Integrating ethofumesate and chloroacetamide herbicides into a weed management program for waterhemp control. There were no statistical differences in waterhemp counts per square meter from ethofumesate applied PRE at 2 or 3 pt/A on June 6, 2017 at Lake Lillian, MN. However, numerically, there were fewer waterhemp plants per unit area from ethofumesate at 3 pt/A. We believe there are areas where ethofumesate may be a better PRE herbicice than S-metolachlor. Ethofumesate presumably provides greater length of control compared to S-metolachlor, which may decrease the

urgency in applying EPOST chloroacetamides. Ethofumesate PRE followed by ethofumesate POST might be a viable alternative for some growers, especially growers with high organic matter or fine texture soils. Consider the following treatments:

| Trt # | Product | Rate (pt, or fl oz/A) | Sugarbeet stage (lvs) |
|---|---|---|---|
| 1 | PowerMax + etho / PowerMax + etho | 28 + 4 / 28 + 4 | 2 / 6 |
| 2 | Etho / PM + etho / PM + etho | 3p / 28 + 4 / 28 + 4 | Pre / 2 / 6 |
| 3 | Ethofumesate / Ethofumesate | 3p / 3p | Pre/ 2 |
| 4 | Ethofumesate / Ethofumesate | 3p / 3p | Pre/ 6 |
| 5 | Ethofumesate / Warrant | 3p / 3p | Pre/ 2 |
| 6 | Ethofumesate / Warrant | 3p / 3p | Pre/ 6 |
| 7 | Ethofumesate / Etho / Etho | 3p / 2p / 2 p | Pre/ 2 / 6 |
| 8 | Ethofumesate / Warrant /Warrant | 3p / 2.25p / 2.25 p | Pre/ 2 / 6 |
| 9 | Dual Magnum / PM + etho / PM + etho | 0.75p / 28 + 4 / 28 + 4 | Pre / 2 / 6 |
| 10 | Dual Magnum / Ethofumesate | 0.75p / 3p | Pre/ 2 |
| 11 | Dual Magnum / Ethofumesate | 0.75p / 3p | Pre/ 6 |
| 12 | Dual Magnum / Warrant | 0.75p / 3p | Pre/ 2 |
| 13 | Dual Magnum / Warrant | 0.75p / 3p | Pre/ 6 |
| 14 | Dual Magnum / Etho / Etho | 0.75p / 2p / 2 p | Pre/ 2 / 6 |
| 15 | Dual Magnum / Warrant /Warrant | 0.75p / 2.25p / 2.25 p | Pre/ 2 / 6 |

e. Integrating application method, chemical, and mechanical measures for waterhemp control. I'm interested learning if band application over the row coupled with herbicide and the use of cultivation might be a viable weed control option for the future. This is a probe experiment we may conduct at the Moorhead and Lake Lillian locations.

Time Line of Anticipated Accomplishments: Results or preliminary results shall be summarized in the Sugarbeet Research and Extension Report, presented at grower seminars and discussed at grower field tours. Results from experiments conducted in 2014 to 2017 shall be summarized in manuscript and submitted to a journal for publication, ASAP.

Progress Toward Objectives of On-going Projects: Waterhemp research has been a priority in my field research program. Number of experiments conducted across locations and years follows:

| | Experiments | Locations | Total Trials/ Environments |
|---|---|---|---|
| 2014 | 3 | 3 | 6 |
| 2015 | 6 | 8 | 18 |
| 2016 | 7 | 8 | 16 |
| 2017 | 7 | 10 | 19 |

We continue to improve our understanding of waterhemp control in sugarbeet. Our most consistent and efficacious recommendation is chloroacetamide herbicides applied PRE, POST and EPOST. We seek even greater weed efficacy and to create a program that is durable across a range of environments including soils, planting dates precipitation patterns, and waterhemp densities.

There is progress every year. We saw the promise and potential of ethofumesate applied PRE and EPOST in a system approach for waterhemp control in 2017. Research will be expanded in 2017 with the goal of

creating additional options for waterhemp control since we know that there are certain environments where chloroacetamides do not peform properly.

Our watherhemp control recommendations are:

- Plant in April
  - Metolachlor or ethofumesate PRE followed by split lay-by application
  - Split application of chloroacetamide herbicides applied lay-by; sugarbeet growth stages, 2-lf fb 4-6 lf
  - Lay-by when sugarbeet is at the 2-lf stage or greater
- Plant in May
  - Metolachlor or ethofumesate PRE followed by split lay-by at 2-lf stage
- July
  - Scout fields
  - Be prepared to control waterhemp escapes with Betamix + ethofumesate, UpBeet + ethofumesate or Betamix + UpBeet (be mindful of PHI)
  - Cultivation

Information has been communicated using multiple media approaches including magazines, local agricultural outlets such as Red River Farm Network, Ag-Week, and Interstate Farm Network, the sugarbeet research and extension report, grower summer tours, grower meetings, and 'machine shop' meetings.

Waterhemp program information has been presented to stakeholders outside of our region in professional society meetings. Waterhemp systems approach shall be published in a referee journal. We shall continue to host grower field days at our primary field locations in 2018 to discuss and demonstrate progress of experiments.

Budget Requested: $43,937 (see the attached Budget Summary for details). Note that grant includes graduate student salary cost, NDSU.