TITLE: Improving Oklahoma Wheat Yield and Quality through Weed Management V

PRINCIPAL INVESTIGATOR:
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COOPERATORS:
Dr. Brett Carver – OSU Wheat Breeder
Dr. Amanda de Oliveira Silva – OSU Small Grains Extension Specialist

FUNDING HISTORY:
Fiscal year 2019 – $25,000 requested and funded
Fiscal year 2018 – $25,000 requested and funded
Fiscal year 2017 – $25,000 requested and funded

ABSTRACT:
Recent commercialization of CoAXium Wheat Production Systems allows producers to apply quizalofop (Aggressor) over-the-top of winter wheat to control many annual grass weeds postemergence. The Oklahoma State University Small Grains Weed Science Program is in its 4th year of studying the system. Over the years excellent weed control has been observed; however, in three of four years, winter wheat injury also has been documented and in two of those years it was significant. Last season, in a regional study (Oklahoma, Colorado, and Nebraska), visual crop response of 7-9% and 20-32%, was documented following Aggressor applications in the early spring (jointing/first detectable node) and late spring (second detectable node), respectively. These same applications resulted in 11 and 20 bushel per acre yield reductions compared to the nontreated plots. The early spring application timing was on-label while the late spring timing was a few weeks off-label, but not outside of the realm of when a producer might spray, especially when environmental conditions delay a timely application. Similar injury also was documented in the 2019-20 growing season (Figure 1). As CoAXium Production Systems become more widely adapted in Oklahoma, it is critical that we are aware of not only its strengths but also its limitations and how those limitations can be mitigated. A new MS student in the Weed Science Program, Caitlyn Carnahan, will lead an eight-site year experiment over two years beginning in the fall of 2020 to evaluate the effects of Aggressor herbicide application timing and rate, and adjuvant use on various winter wheat varieties that contain the AXigen trait (AX varieties). Results will aid growers in best management practices for this new system and will support the Oklahoma State University Breeding Program in its efforts to breed AX OSU varieties with robust tolerance.
Figure 1. Crescent AX wheat following Aggressor in the fall (A), early spring (B), and late spring (C). Significant crop response was observed following both spring applications at Perkins, OK during the 2019-20 growing season.
OBJECTIVES:
The primary objective of this research will be to evaluate the tolerance of several AX winter wheat varieties (commercially available and not) to Aggressor herbicide at various application timings, rates, and adjuvants use. Ongoing efforts include the herbicide resistance screening program and dissemination of weed control information in winter wheat.

1. **New:** Evaluate AX winter wheat variety tolerance to Aggressor herbicide following multiple application timings, herbicide rates, and adjuvants across four locations in Oklahoma during the 2020-21 season.

2. Provide herbicide resistance screening services for farmers, Extension educators, and industry professionals, with a continuing emphasis on *Bromus* species.

3. Provide current and updated weed management information to Oklahoma farmers through Extension publications, presentations, and social media outreach. The brand-new OSU Plant Identification Website also will be launched this year, more details are below in ‘Report of Accomplishments’.

PROCEDURES:
Field experiments will be conducted at multiple locations (OSU Research Stations and Grower Fields). Greenhouse experiments will be conducted at the Weed Science Laboratory and OSU Controlled Environmental Research Lab.

1. **New:** Evaluation of AX Winter Wheat Varieties to Aggressor

Studies will be conducted at four locations during the 2020-21 season to determine the effects of Aggressor application timing, herbicide rate, and adjuvant selection on multiple varieties of winter wheat that contain the AXigen trait (commercially released and not). Percent visual injury for weed control and crop response will be collected as well as plant biomass and yield. Varieties selected will have multiple double-mutant combinations as tolerance may be related to what two genomes confer the Aggressor tolerance. If multiple double-mutant combinations are not available, Caitlyn will assist Dr. Carver in obtaining these lines in OSU candidate material.

2. **Herbicide Resistance Screening**

Anyone in the state of Oklahoma can send suspected herbicide resistant weeds to the weeds lab to be evaluated. Screening of weeds will follow the criteria used by the International Survey of Herbicide Resistant Weeds. Confirmed cases will be listed on the website (weed.science.org) for anyone to access. Internally, a seed collection of *Bromus* species in critical winter wheat producing areas has begun and will continue into the summer of 2020. Bromus species will be screened for common ALS herbicides including but not limited to, chlorsulfuron (Glean), flucarbazone (Pre-pare), imazamox (Beyond), mesosulfuron (Ally XP), propoxycarbazone (Olympus), pyroxsulam (PowerFlex HL), and sulfosulfuron (Outrider). As mentioned
previously, it has been nearly a decade since a detailed screen of *Bromus* species was carried out in the state.

3. **Dissemination of Information**

Data to be collected will include percent visual weed control, wheat tolerance ratings, biomass (wheat and weeds), wheat grain yield, and dockage/foreign material estimates. Upon completion of the experiments, data will be distributed through Extension publications, presentations (state, regional, and national), web-based communication (Twitter, Facebook, and SUNUP), and refereed journal articles. Additionally, the new OSU Plant identification website, which will include agronomic weeds, will be launched.

**TIMELINES:**

Plots will be planted in October of 2020 and data will be collected throughout the 2020-2021 growing season. Results will be published in the summer and fall of 2021 and will continue to be updated as projects are continued, improved upon, and new data is generated.

**JUSTIFICATION:**

The data collected from this research will help answer weed management questions from the state’s farmers, Extension educators, commodity groups, industry professionals, or any other agricultural stakeholder who seeks weed management information in wheat. This research also will help the OSU Weed Science Extension Program develop a foundation for future weed management studies.

**REPORT OF ACCOMPLISHMENTS (previously funded that relate to this proposal):**

1. **Objective 1 (2019-20): Integrated Weed Management Strategies for Control of *Bromus* Species**

To evaluate integrated management of rescuegrass and other *Bromus* species outside of herbicide tolerant systems, a study was conducted at Lahoma, Marshall, and Tipton, Oklahoma and Burk Burnett, Texas to assess planting date, wheat variety, and herbicide selection on rescuegrass control. Wheat was planted at an optimal, delayed, and late timing where the early date represented the optimal time to sow wheat harvested for grain. Recently released varieties, Green Hammer and Showdown, were used. Two commonly used herbicides, pyroxsulam (Powerflex HL) at 2 oz/A and sulfsulfuron (Outrider) at 0.67 oz/A, were applied when rescuegrass was at the 2- to 3-leaf stage. Rescuegrass counts at Marshall decreased by 13 plants/ft\(^2\) from the optimal to delayed planting date (Figure 2A) and Powerflex HL controlled rescuegrass 23% more than sulfsulfuron (Figure 2B). This work will continue into the 2020-21 season.

Studies using both herbicide tolerant technologies have been conducted during the last four growing seasons and will continue to be evaluated. In a Clearfield system, rescuegrass control was the highest following fall or fall + spring applications of Beyond + NIS or MSO. Exceptional control of rescuegrass was achieved following all Aggressor treatments, regardless of application timing or surfactant used. Feral rye control with Aggressor was above 89% control during the 2016-17, 2017-18, and 2018-19 seasons regardless of application timing, rate, or surfactant used. In a study this season, over 90% control of feral rye was achieved following various treatments in both Clearfield and CoAXium Systems (Figure 3).

![Figure 2. Rescuegrass counts at the optimal and delayed planting date (A) and percent visual control following Outrider and PowerFlex HL (B) 8-9 weeks after application at the on-farm location in Marshall, Oklahoma.](image)

![Figure 3. Percent visual feral rye control at Perkins, OK during the 2019-20 winter wheat growing season following application in Clearfield and CoAXium Systems.](image)

To date, the OSU Weed Science Herbicide Resistance Screening Program has screened over 2,000 suspected herbicide resistant weeds. From these screenings, three new cases have been documented and posted to weedscience.org, the website for the International Survey of Herbicide Resistant Weeds. Cases include glyphosate resistant Palmer amaranth (*Amaranthus palmeri* S. Wats.), mesosulfuron and chlorsulfuron (Ally XP, Finesse Cereal & Fallow, and Glean XP) resistant horseweed/marestail (*Conyza canadensis* L.), and recently, pinoxaden (Axial XL) resistant Italian ryegrass (*Lolium perenne* L. ssp. *multiflorum*) (Figure 4). Palmer and horseweed are two competitive weeds in both winter and summer cropping systems while Italian ryegrass is a critical winter annual grass weed in Oklahoma, commonly reducing both yield and grain quality.

![Figure 4: Pinoxaden resistant Italian ryegrass (left) and a susceptible biotype (right).](image)

4. **Objective Four: Dissemination of Information**

Results supported by the OWRF/Oklahoma Wheat Commission have been distributed via 10 fact sheets (links below), over 54 Extension presentations, 17 Extension educator trainings, 10 national academic presentations, numerous SUNUP videos, and weekly Twitter updates. Lastly, many meetings have taken place with different lab groups within our college to create a Plant ID Website that will include weed identification. Templates are being created now and an official launch will occur in 2020. Below is an example of one plant/page that will be in the ‘Rangeland’ category (Figure 5). Dr. Beatrix Haggard and I will manage the ‘Cropping Systems’ category, which will include crops and weeds.
Figure 5. Species/page template from new OSU Plant Identification website. Example is from ‘Range Systems’. Dr. Beatrix Haggard and Dr. Misha Manuchehri will manage the ‘Cropping Systems’ section that will include crops and weeds. Site will launch this year.

Fact Sheet Links:

Horseweed Management in Oklahoma Winter Wheat

Cotton Harvest Aid Considerations for Small Grains

Harvest Aid Weed Management in Wheat

Herbicide Programs for Italian Ryegrass Control in Winter Wheat

Herbicide Mixing Order

Rainfastness for Fallow and In-Season Winter Wheat Herbicides with Postemergence Activity

How Does Soil pH Impact Herbicides?

Weedy Mustards of Oklahoma
SCREENING OF HERBICIDE-RESISTANT WEEDS IN OKLAHOMA

SINGLE HERBICIDES AND HERBICIDE PREMIXES FOR USE IN WINTER WHEAT

BUDGET & BUDGET JUSTIFICATION:
One 0.5 FTE Graduate Student…………………………………………………………..$19,500.00
Fringe for Graduate Student…………………………………………………………..$829.00
One Undergraduate Student ($10/hour)…………………………………………………..$4,631.00
Fringe for Undergraduate Student……………………………………………………..$40.00

Caitlyn Carnahan, incoming recruited graduate student will lead the establishment, maintenance, data collection, and harvest of the trials at four locations during the 2020-2021 growing season. An undergraduate student will assist with all tasks necessary.

Total………………………………………………………………………………………….$25,000.00

RELATION TO OTHER RESEARCH:
This research supports the overall Extension efforts of the Wheat Extension Program and Wheat Improvement Team at OSU. Weed management is a critical component of a successful wheat production system and it is the responsibility of the OSU Weed Science Extension Program to share effective and economical weed management tools with the state’s farmers, Extension educators, and industry professionals. Additionally, the support of students in these projects provides learning opportunities for the future of our agricultural industry.
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