NM WRRI Student Water Research Final Report

1. **Student Researcher:** Jackson Powers
   Faculty Advisor: Dr. Ryan Goss

2. **Project title:** Herbicide Phytotoxicity Under Drought Conditions in Warm and Cool Season Turfgrass

3. **Description of research problem and research objectives**.

Water management is one of the most pressing issues turfgrass managers face in the arid regions of the world and periodically in temperate regions. In response to reduced water supplies, governments enacted policies that restrict potable water use for non-essential uses. Regional and local climate change impacts will result in increased evaporation and decreased soil moisture available for turfgrass growth. Ornamental crops like turfgrass provide many environmental benefits like soil erosion reduction, increased oxygen production, ambient temperature reduction, and provide low cost playing surfaces. Herbicides are the primary management practice to reduce difficult to control weeds in turfgrass stands. However, under drought conditions, herbicide efficacy can be reduced since plants are not able to perform normal physiological functions.

3a. **Research Objectives**

The objectives of this research are to determine 1) the severity of herbicide turfgrass phytotoxicity at differing water statuses and 2) if these differing turfgrass water statuses effect herbicide efficacy.

4. **Description of methodology employed.**

Two experiments will be conducted to test the objectives.

4a. **Field Experiment**

The field experiment will be conducted at the Fabian Garcia Research Science Center in Las Cruces, NM. A Linear Gradient Irrigation System will be used to determine the interaction of precise water statuses use and herbicide application responses. A LGIS is a single row of sprinkler heads arranged to provide an irrigation continuum from none to excessive applied-water. After establishment, experiment will be initiated and LGIS will used to differentially irrigate. Plots will run along irrigation gradient so that one herbicide treatment is exposed to the entire continuum of irrigation amounts. Irrigation will be measured along the irrigation gradient at every irrigation event and precipitation event to determine total applied water amounts. Irrigation will be scheduled to irrigate twice weekly to replace 100% ET at 1.5 m (5 ft) from LGIS as measured with nearby NMSU weather station. A total of five experimental areas have been established, each with their own independent LGIS.

Two warm season experimental areas have been established with bermudagrass (*Cynodon dactylon* L.). Three unique cool-season experimental areas were established with perennial ryegrass (*Lolium perenne* L.), Kentucky bluegrass (*Poa pratensis* L.), and a mixture of perennial

ryegrass, Kentucky bluegrass and tall fescue (*Schedonorus arundinaceus* (Schreb.) Dumort., nom. cons.). Four weed species were introduced into each experimental area after establishment. Green foxtail (*Setaria viridis* L. P. Beauv.), annual bluegrass (*Poa annua* L.), dandelion (*Taraxacum officinale* F.H. Wigg*),* and white clover (*Trifolium repens* L.) were inter-seeded in each experimental area (0.5 lbs/1000 ft^2). These weeds were selected based on the high economic impact each of these weeds have in turfgrass systems in the Las Cruces area. All experimental areas will be maintained as golf course rough and mowed at 5 cm (2 in). Other cultural practices and pest management strategies will occur as needed to prevent stress. The field experiment is established and will receive water and herbicide treatments in May 2019.

Each plot will be irrigated on a gradient of applied water through LGIS for two weeks and will receive a combination of herbicide applications arranged in a 2 (application rates) x 14 (herbicides) factorial treatment structure. Two rates of each herbicide will be applied: maximum label rate and 2x maximum label rate to mimic overlapping of herbicides. Plots will be visually rated for turfgrass and weed phytotoxicity, turfgrass and weed quality, and percent turfgrass green cover on 0.3m (1-foot) intervals along irrigation gradient 0, 1, 3, 7, 14, 21, 28 and 60 days after treatment. NDVI ratings and volumetric soil moisture will be taken weekly along these same gradients.

Figure 1- Calibration of cool season LGIS research plots

Figure 2- Calibration of Bermudagrass LGIS research plots

4b. **Greenhouse Experiment**

The greenhouse experiment will be conducted at the research greenhouses in Fabian Garcia Research Science Center in Las Cruces, NM. Bermudagrass (*Cynodon dactylon* L.) and Kentucky bluegrass (*Poa pratensis* L.) will be grown to 5 cm (2 in) in 3.785 L (1 gal) pots with uniform irrigation. After maturity, plants will be exposed to 4 decreasing water contents (80, 60, 40, 20% ET) for two weeks and then sprayed with a combination of herbicide applications arranged in a 2 label rates x 8 herbicides factorial treatment structure. Pots will be visually rated for turfgrass phytotoxicity, quality, and density for 0, 1, 3, 7, 14, 21, 28 and 60 days after treatment. The first trial of the greenhouse experiment was completed in summer 2018 and the second trial has been initiated as of April 2019.

Figure 3- Pots two weeks after differential irrigation initiated and before herbicides

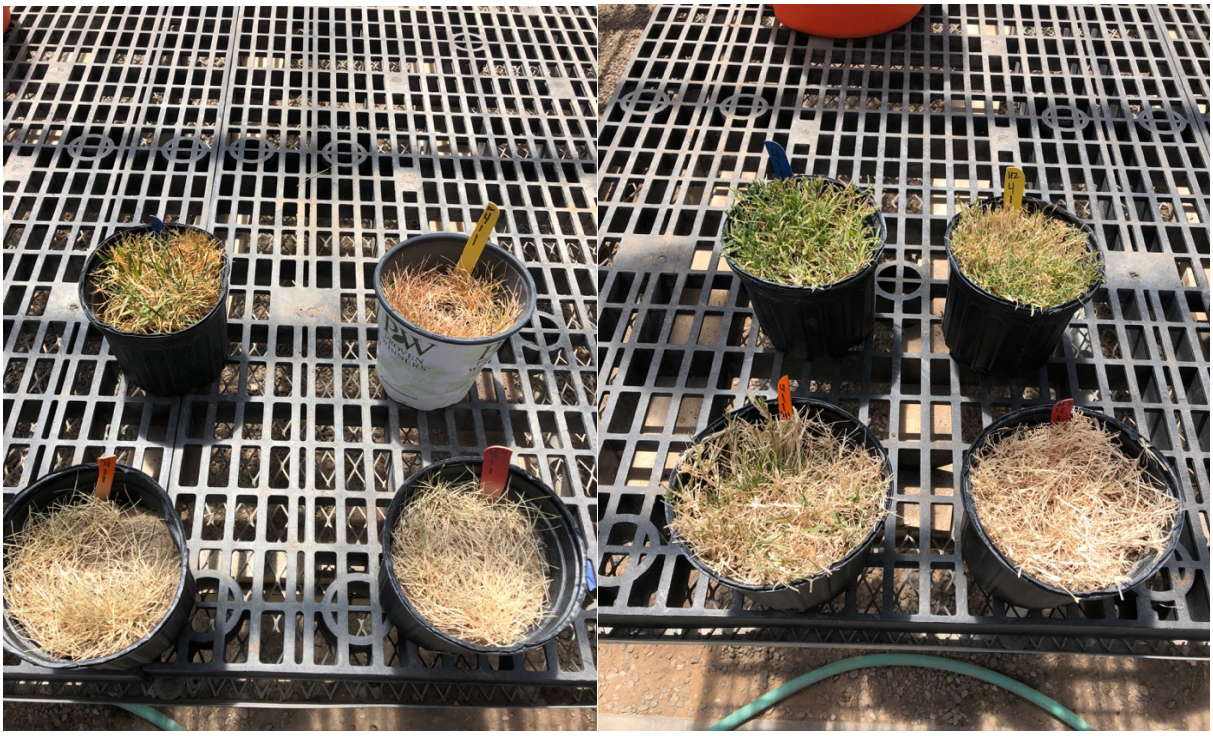

Figure 4- Side by side comparison of Kentucky bluegrass and Bermudagrass after glyphosate application 14 days after treatment

5. **Description of results and recommendations for further research.**

Summer 2018 was spent establishing all 5 research plots in preparation for the experiment. The first trial of the greenhouse experiment was conducted over summer 2018. The data and results were presented at the NMWRRI conference on October 17-18, 2018. After completion of trail, we concluded that two herbicide label rates (maximum label rate and 2X maximum label rate) were needed both in the field and greenhouse experiments to precisely determine the interaction between turfgrass water status and herbicide phytotoxicity and efficacy. The second trial of the greenhouse experiment is underway, and data will be available in July 2019. The field experiment will be run in May-June 2019 and August-September 2019. The methodology used in this experiment can be used to evaluate certified organic herbicides performance under differing water statuses, which can be important for the city of Las Cruces given recent outcry from citizens over the use of conventional herbicides

6. **Who will benefit from your research results**

Determining the minimum water status needed for each mode of action herbicide will benefit turfgrass managers in New Mexico and regions that experience periodic drought conditions. These results can be used a management tool by athletic field managers, golf course superintendents, and other landscape managers in determining if herbicide applications will be effective in preserving turfgrass quality by controlling difficult to control weeds during periods of drought. Local governments can use this decision-making tool to manage their public turfgrass sites like parks and athletic fields effectively under reduced water conditions. Wasteful or damaging herbicide applications can be avoided. In addition, water use for turfgrass reestablishment or turfgrass recover can be avoided if the turfgrass stand does not receive damage due to a poor herbicide application decision. Ultimately this research will ensure that the environmental benefits turfgrass provides will not diminish under the drought conditions seen in New Mexico.

7. **Describe how you have spent your grant funds.**

$5,655- Used for summer salary for Jackson Powers to establish research plots and collect data
$57- Fringe benefits
All funds were used up by May 15, 2019

The funds provided by NMWRRI helped additional outside grants support this project and allowed for substantial progress for this project

8. **Presentations have made related to the project.**

- NMWRRI Annual Conference- October 17-18, 2018
- RGGCSA Annual Conference- October 23, 2018
- RGGCSA Regular Meeting- January 21, 2019

10. **Special recognition awards or notable achievements as a result of the research**

- The Rio Grande Golf Course Superintendents Association (RGGCSA) donated $4,000 to the project for 2019-2020 ($2,000 per year). This was in conjunction with a proposal sent to the Golf Course Superintendents Association (GCSAA), the professional organization for the golf course superintendents in the United States.
- Upon reading the joint proposal with the RGGCSA, the GCSAA awarded a grant totaling $13,200 ($7,583 in 2019 and $5,617 in 2020) with the stipulation that weed seed be introduced in the field plots.
- Publication in trade newsletters:
    - https://www.gcsaa.org/media/news/2019/03/26/gcsaa-funds-$127-500-for-new-turfgrass-research-in-2019
    - https://www.gcmonline.com/headlines/gcsaa-news/news/gcsaa-research-2019?utm_source=informz&utm_medium=email&utm_campaign=TW%203.26.19

12. **Provide information on degree completion and future career plans**

The tentative Masters of Science in the Department of Plant and Environmental Science graduation date for Mr. Jackson Powers is Spring 2020. Upon graduation, he will pursue a career in the turfgrass industry either pursing research or aiding in golf course managers with any problems that arise in their daily maintenance. If a position in water management in New Mexico is available upon my graduation, he would be happy to consider it to ensure ornamental crops, like turfgrass, will still be able to provide their environmental benefits under drought conditions in his native state.