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MPSG ANNUAL EXTENSION REPORT

PROJECT TITLE: Mitigating the Deleterious Effects of Above Normal Soil Moisture on the Productivity of Pulse Crops through Seed Treatment

PROJECT START DATE: April 1, 2014
PROJECT END DATE: March 31, 2017
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PART 1: PRINCIPAL RESEARCHER

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PART 2: EXECUTIVE SUMMARY

In Manitoba, excess soil moisture is one of the most important factors affecting the productivity of crops in the agricultural industry. Excess moisture in the soil creates a low oxygen environment that affects seed germination and seedling growth, and can force producers to plant seed at much later dates in the season. If the excess moisture builds up after seeding, it can negatively affect crop growth and development, and overall yield. The negative effects of excess soil moisture on crops is often associated with the production and accumulation of toxic substances. Plant growth regulators have been shown in mitigating the effects of different abiotic stress factors on crop performance and yield partly through increasing the production and activity of anti-stress proteins, which can limit the production of toxic compounds and thereby damage to the plants. Soybean and edible beans are among the most important crops of Manitoba that are vulnerable to excess moisture stress, especially during germination and at seedling stage. The objectives of this research are therefore 1) to evaluate the effect of treatment of soybean and edible bean seeds with growth regulators in enhancing their performance under excessive soil moisture; 2) to investigate if treatment of established plants with growth regulators improves their performance under excessive soil moisture. Using the 25-10RY and Windbreaker varieties of soybean and edible bean, respectively, this study investigates the effects of seed and plant treatments with selected growth regulators on the germination, seedling vigor, and accumulation and activity of anti-stress proteins under excess moisture conditions.

PART 3: PROJECT ACTIVITIES AND PRELIMINARY RESULTS

Project Activities

1) *Determining the effect of the two selected growth regulators on the germination of soybean and edible bean seeds*.
This experiment involved germination kinetics analysis of 25-10RY (soybean) and Windbreaker (edible bean) seeds treated with selected growth regulators and concentrations, and our results to date show that the growth regulators studied do not have effect on the percentage and rate of germination in both soybean and edible bean seeds (Fig. 1).

2) *Determining the effect of seed treatment with two growth regulators on seedling vigor/growth.*
In soybean, our preliminary result shows that treatment of the seeds with one of the growth regulators at a specific concentration resulted in increase in seedling vigor in terms of shoot growth. Validation of these results, and parallel experiments to examine the effects of such treatments on edible beans is underway.

3) *Examining the effects of the two growth regulators on the accumulation of precursors for known anti-stress proteins in seedlings and adult plants exposed to excess soil moisture conditions*.
This analysis is focused on two seedling developmental stages, and also on established young plants of soybean. To examine the effects of treatments on anti-stress protein production, we used the approach of measuring the level of precursors of the target anti-stress proteins. Our results show that excess moisture stress generally leads to decreases in the accumulation of the anti-stress protein precursors in the seedlings and leaf tissues of young plants. However, seed treatment or treatment of the established plants with the selected growth regulators leads to significant increases in the amount of the precursors used for the production of selected anti-stress proteins in different tissues of seedlings when grown under excess moisture stress (Fig. 2). However, the effect was found to vary with seedling stage. Similar experiments were also carried out on young plants to examine if the treatments can induce a similar effect as that observed on seedlings (Fig. 3), and our preliminary results show that the treatments are able to increase the accumulation of anti-stress protein precursors. Parallel studies are being conducted on the seedlings of edible beans.

4) *Determining the effect of the growth regulators studied on the activity of known anti-stress proteins in soybean seedlings exposed to excess soil moisture conditions.*
In order to validate the effects of the growth regulators on the actual activity of anti-stress proteins, we measured the activity of the targeted proteins in seedling tissue samples collected at different stages, and also in the tissues of young soybean plants. Analysis of the collected data is underway. A similar study will be performed with edible beans.

Communications

Sidhu G, Ayele BT (2016, March 19-20) Regulations of antioxidative genes by polyamines in soybean seedlings exposed to excess moisture condition. Annual Meeting of the Midwestern Section of American Society of Plant Biologists, Brookings, South Dakota, U.S.A.

Sidhu G, Ayele BT (2015, July 26-30) Polyamines-mediated regulation of antioxidative genes in soybean seedlings under excess moisture stress. Annual Meeting of the American Society of Plant Biologists, Minneapolis, Minnesota, U.S.A.

Sidhu G, Ayele BT (2015, March 13-14) Regulation of antioxidative genes by polyamines in soybean seeds and seedlings. 31st Annual Plant Science Graduate Student Symposium, Winnipeg, Manitoba, Canada

APPENDIX

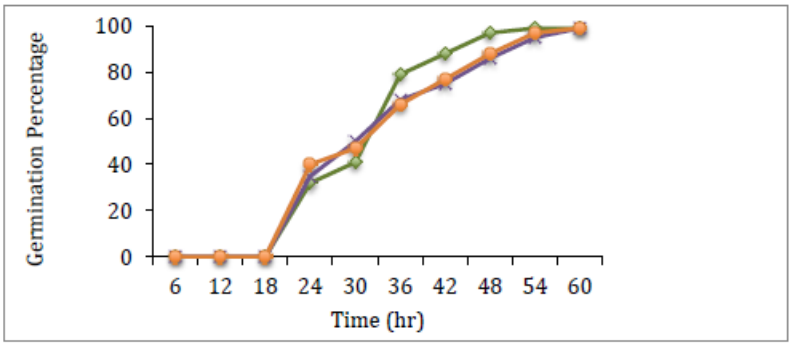

Fig. 1 Effect of growth regulators on soybean seed germination under normal conditions. Green, control; orange and purple lines represent treatments with two different types of growth regulators.

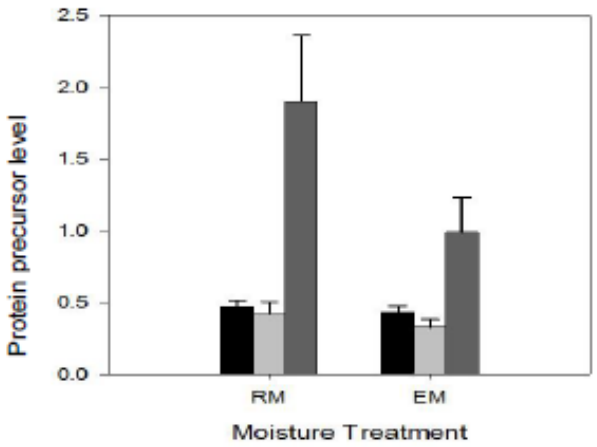

Fig. 2 Effect of growth regulators on the level of anti-stress protein transcripts under regular (RM) and excess moisture (EM). Black bar, control; light and dark grey bars represent treatments with two different types of growth regulators.

Fig 3. Experimental set up for treatment of young plants with excess moisture and growth regulators