

Project 2012F007R

Field Proofing the Use of Plant Hormones to Increase Canola, Wheat and Pea Yields – Component 2

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Background:

Plant growth regulators have been used extensively to aid in efficient production of horticultural crops, but much less so in agronomic crops to date. The current lower cost of plant growth regulators and the need to develop new and revised agronomic management tools has led to a renewed interest in the use of plant growth regulators to aid in agronomic crop production. Among the classes of plant growth regulators, auxins show some promising characteristics in enhancing the vegetative growth and yielding ability of specific crops.

Objective:

The main objective of this project was to further develop the use of the plant growth regulator class, auxins, as a tool to increase grain yield of wheat grown under non-stress and abiotic stress conditions. Specifically, the studies assessed if foliar application of the auxins 4-chloroindole-3-acetic acid (4-Cl-IAA) and 4-methylindole-3-acetic acid (4-Me-IAA) at an early reproductive development stage of wheat will increase the seed yield under normal and heat stress environments, when the stress occurs during the reproductive stage.

What we did:

- 1) Determine auxin treatment/wheat cultivars combinations that interact to increase grain yield parameters under field conditions in wheat.
- 2) Understand the auxin response in wheat in various ecological areas of Western Canada.
- 3) Further explore the genetic component of auxin efficacy in increasing grain yield in wheat using small scale greenhouse experiments.

Key results:

We found that auxins can significantly increase wheat yield under both controlled environment and field conditions; however, a consistent yield increase response in the field was cultivar dependent. The wheat HRS cultivar CDC Go was the most responsive to auxin treatment in both controlled environment and western Canadian field conditions. Relative to control, foliar application of the auxin 4-chloroindole-3-acetic acid (4-Cl-IAA) at the late-boot stage increased grain yield per plant by 20% under controlled temperature conditions and 33% when plants were exposed to high temperature (35°C for 6 h per day for 6 days) during initial flowering in controlled environment experiments. The 4-Cl-IAA-induced increase in grain yield was associated with an increased number of grains per plant under the heat stress conditions. 4-Cl-IAA application also increased grain yield per plot of cv. CDC Go in the 2012 (8%) and 2013 (6%) field seasons at the site with higher mid-

season temperatures and lower moisture conditions (Saskatoon). In 2013, 4-Cl-IAA application resulted in an increase in grain yield at the Saskatoon site that was also associated with an increase in grain number per plant. Other wheat HRS cultivars including 5604 HR CL, AC Lillian, AC Unity, Harvest and WR859 CL were less or minimally responsive to 4-Cl-IAA-induced increase in grain yield as compared to that observed for CDC GO in the field.

Take home message for the industry:

Overall, these data suggest that one application of the auxins 4-Cl-IAA or 4-Me-IAA prior to or at flowering has the ability to increase seed yield and/or seed yield components of wheat. Further testing of the effects of 4-Cl-IAA and 4-Me-IAA is required to broaden our knowledge of the conditions and genotypes, necessary to obtain optimal auxin response for increased seed yield under a variety of environmental conditions. Ultimately, if producers know which cultivars are auxin responsive with respect to increasing seed yield, then they can target the use of this yield enhancing promoter to these cultivars and improve grain yield.

Value to the Industry:

If these results can be optimized and further confirmed under field conditions, the benefit to Alberta's agriculture industry would be significant. For example, if applying hormones to 25% of the wheat acres in Alberta would result in a 5% yield increase, this would equate to an increase of 76 million per year in farm gate sales in Alberta alone (note: calculations made using a price of \$183/T for wheat x 8.3 million tons produced in 2015).

Value to the team:

A number of highly qualified personnel were trained/involved in completing this project, they include:

- Research Associate (1): Development of skills in auxin formulations for the field.
- Project manager (1): Development of project manager skills.
- PDFs (2): Aided in field data collection.
- Trained and graduated 1 MSc student on project: Student developed skills in data collection, organization, analysis, and interpretation for writing MSc thesis on this project.
- Graduate student help (1): Student aided in data collection.
- Part-time technical staff for the lab and field trails (4): Developed skills in field trip organization and field data collection.
- Undergraduate students: (3) Developed skills in field trip organization and field data collection.