

## Development of improved crop management practices using plant growth regulators to manage secondary crop growth and accelerate the maturity of rain-fed and irrigated kabuli chickpeas

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SPG Contributions	Project Status	Duration/Timeline of Project (Year to Year)	Co-funders	Total Project Cost
\$10,350.00	Completed	April 2010 – June 2013	Canadian Agricultural Adaptation Program (CAAP); Alberta Pulse Growers Commission	\$175,300.00

### Project Description

To examine the impact of plant growth regulators (PGR) on the phenology of Kabuli chickpeas; to perform cost/benefit analyses of the use of PGR on Kabuli chickpeas; to investigate relationships among yield components and phenological traits of chickpeas.

Production of high quality chickpea seeds on the Canadian Prairies is challenged by the occurrence of excessive soil moisture, and cooler and shorter growing conditions, which favour continuous flowering resulting in increased green seed percentage. Plant growth regulators (PGRs) are frequently used to control such vegetative growth of cereal crops. Limited research information is available in literature on the use of PGRs on pulse crops to control vegetative growth.

The study 1 was conducted to test the following hypotheses:

1. Apogee®, Cycocel extra® and Palisade® will control excessive vegetative growth (plant height and above ground biomass production) of chickpea when applied at the reproductive stage.
2. Controlled secondary vegetative growth at the reproductive stage will be beneficial for the seed development due to enhanced of assimilates partition for reproductive organs.
3. Possible growth regulatory property of PGRs used in this study would not diminish as a result of tank mixing with fungicides.
4. PGRs used in this study will synchronize seed maturity and reduce the proportion of green and immature seeds at harvest.

In the first study, three commercially available PGRs, including Prohexadione Calcium (PC), Cycocel (CCC), and Trinexapac Ethyl (TE) were evaluated. These PGRs, which have been categorized as Gibberellins Biosynthesis Inhibitors based on their mode-of-action, are currently used in Europe, the United States, and Canada to control lodging in cereal grain crops and other applications such as for orchards and turf.

#### Study 1

A field study was conducted at two test sites (Brooks and Bow Island) in southern Alberta, under rain-fed or supplementary irrigated conditions in 2010, 2011, and 2012 cropping seasons to examine the effects of Prohexadione Calcium (PC), Chlormequat Chloride (CCC), and Trinexapac Ethyl (TE) applied at pre- and post-flowering stages on vegetative growth, seed quality, and yield, and crop maturity of Kabuli chickpea cultivars CDC Frontier and CDC Orion. In 2010 and 2011 four concentrations of each PGR (PC= 750, 1500, 3000, and 4500 mg L<sup>-1</sup>; CCC= 1000, 2000, 3000, and 6000 mg L<sup>-1</sup>; TE= 2083, 4167, 8333, and 12498 mg L<sup>-1</sup> in 2010; and 1000, 2000, 4000, and 6000 mg L<sup>-1</sup> in 2011) were applied to Kabuli chickpea cultivar CDC Frontier at 10, 20, and 30 days after flowering (DAF). In 2012, only two concentrations of each PGR (PC= 750 and 1500 mg L<sup>-1</sup>; CCC= 4000 and 6000 mg L<sup>-1</sup>; TE= 1000 and 2000 mg L<sup>-1</sup>) were applied to two Kabuli chickpea cultivars, CDC Frontier and CDC Orion at 21 days after seedling emergence (DASE), 20 DAF, and 30 DAF.

#### Study 2

In 2011, a separate study was conducted at the Brooks irrigated site to evaluate the impact of Pyraclostrobin+Boscalid (Headline Duo®) fungicide on the crop growth and development of CDC Frontier chickpeas, as compared with that of Prothioconazole (Proline®), and also to examine if this impact would be altered by PGRs (PC at 1500 mg L<sup>-1</sup>, CCC at 6000 mg L<sup>-1</sup>, and TE at 2000 mg L<sup>-1</sup>) when applied as a tank mixture at 20 DAF.

#### Study 3

In 2012, an additional field study was conducted at the Brooks irrigated site to evaluate the effect of two auxin type PGRs [2,4-dichlorophenoxyacetic acid (2,4-D) at 10 mg L<sup>-1</sup> and naphthalene acetic acid (NAA) at 50 mg L<sup>-1</sup>] and gibberellic acid (GA3) at 10 mg L<sup>-1</sup>, applied either alone or as a tank mixture at 21 or 35 DASE, on crop growth, seed yield, and crop maturity of CDC Frontier chickpeas.

In general, during the study, the 2010 growing season had above average soil moisture and cooler temperature conditions. In contrast, the 2011 growing season, particularly during the latter part of growing period, had above average dry and warm weather, and the 2012 growing season was relatively warmer and had satisfactory soil moisture conditions, during the entire growing period.

### Outcome

The results of Study 1 indicated that the use of PGRs such as CCC, PC, and TE may not be a reliable cultural practice for controlling of secondary crop growth in Kabuli chickpeas to improve seed yield and yield quality. The growth retarding effect of PC and TE on chickpeas gradually diminished after PGR treatment. The diminishing rate of PGRs is dependent upon PGR type, PGR concentration, growth condition, and growth stage of the crop has been applied.

Only PC and TE produced growth inhibitory effect on both chickpea cultivars and TE was the most effective one among the PGRs tested in this study. The growth inhibitory effect, however gradually diminished over time, and as a result, none of the PGRs used in this study had a significant effect on plant height when determined at 30 days after each treatment or on above ground biomass plant at harvest. In general, PGR applications reduced the total and marketable seed yields. The 2012 results

also revealed that regardless of growth stage of application or concentration, PGRs had no significant effect either on the number of nodes of main stem or the number of pod bearing branches/plant of both chickpea cultivars.

Results of study 2 revealed that Headline Duo® appears to have no significant impact on phenology of the chickpea, and also the fungicide appears to have no significant impact on the growth inhibitory effect of PC and TE, when applied as a tank mix, as compared to tank mix with Proline®. The effect of Pyraclostrobin+Boscalid (Headline Duo®) and Prothioconazole (Proline®) fungicides on crop growth, development, maturity, and seed yields of CDC Frontier were statistically comparable, and also revealed that effect of each PGR on growth and yield parameters was statistically comparable when applied as a tank mixture with Headline® and Proline®.

In study 3, the growth inhibitory effect of PGRs did not change as a result of tank mixing with fungicides such as Headline®, Headline Duo®, and Proline®, as compared to the effect of PGRs applied alone. The results revealed that the application of 2,4-D and NAA at low concentrations (non-toxic levels) as a tank mixture with GA3 or separately had no significant impact on crop growth, seed yield, or crop maturity of CDC Frontier.

In summary, the study results suggest that PGR applied at pre- or post-flowering had no significant impact on controlling the vegetative growth of the two chickpea cultivars at later stages. Also none of the treatments had improved seed yield or consistently accelerated crop maturity. Thus, it can be concluded that the application of PGR is not a reliable agronomic option to alleviate the production issues associated with continuous vegetative growth (indeterminate growth habit) during the latter part of reproductive stage of Kabuli chickpeas.

The study results indicate that PGRs applied at pre- or post-flowering had no significant impact on controlling the vegetative growth of the two chickpea cultivars at later growth stages. Thus, pulse growers can save some money by not applying PGRs on chickpeas as this practice is not cost-effective.

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## Research Objective

### OBJECTIVE 1

To examine the impact of plant growth regulators (PGR) on the phenology of Kabuli chickpeas.

### OBJECTIVE 2

To perform cost/benefit analyses of the use of PGR on Kabuli chickpeas.

### OBJECTIVE 3

To investigate relationships among yield components and phenological traits of chickpeas.