Reducing height and lodging in canola (*Brassica napus* L.) using plant growth regulators

by

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Summary and General Conclusions

Anti-lodging plant growth regulators (PGRs) are synthetic compounds, primarily used to reduce unwanted longitudinal shoot growth and lodging in agricultural crops, while either preserving or enhancing productivity. Previously PGRs have experimentally, successfully been used to reduce canola plant height and lodging in Australia. In spite of this, the commercial use of anti-lodging PGRs on canola cultivars is limited due to lack of scientific data. The objective of this study was to determine the effect of anti-lodging PGRs on the agronomic and quality characteristics of commercial canola cultivars (*Brassica napus* L.), under South African conditions.

The present study consists of two glasshouse trials presented in Chapter 3: "Influence of anti-lodging plant growth regulators on growth and yield of glasshouse grown canola (*Brassica napus* L.) in sandy soil" and Chapter 4: "Efficacy of anti-lodging plant growth regulators on growth and yield of glasshouse grown canola (*Brassica napus* L.) under optimum growth conditions" as well as a field trial presented in Chapter 5: "Effect of anti-lodging plant growth regulators on growth and yield of canola (*Brassica napus* L.) grown at different localities in the Western Cape Province of South Africa".

The glasshouse trials were conducted using 3.0 L pots under temperature-controlled conditions (15/10˚C day/night) at the Department of Agronomy at Stellenbosch University. Glasshouse trials comprised of a randomized complete block design with a factorial combination of two cultivars of spring canola (Hyola 555TT and 43C80) and four PGR treatments, applied at growth stage 3.1 (budding stage) using an automated cabinet sprayer. In the first trial, Kelpak® (in combination with wetting agent Foliwett® 900); CeCeCe® 750; Moddus® 250 EC and a control (untreated) treatment were used. During the second trial three changes were made: firstly PGR Moddus® 250 EC was replaced with Primo MAXX®; secondly all PGRs were applied in combination with Foliwett® 900; and thirdly the growing medium (coarse sand) was replaced with a 1:1 combination of coarse sand and compost for optimum growth conditions.

The field trial was conducted at Langgewens, Altona and Roodebloem Research Farms using one cultivar of spring canola (Hyola 555TT) and comprised of a randomized complete block design with a factorial combination of five PGR treatments, replicated four times: Kelpak® (in combination with Foliwett® 900), CeCeCe® 750, Moddus® 250 EC, Primo MAXX® and control (untreated). Treatments were applied at growth stage 3.1 (budding stage) using a 20 L knapsack sprayer.

Kelpak®

The application of Kelpak® significantly increased the above ground dry mass of Hyola 555TT in the glasshouse trial done in sandy soil as well as during the field trial at respectively full flower (93 days after planting) and lower pod filling stage (110 days after planting), when compared to the control. However, in contrast the root dry mass remained unaffected under field conditions; possibly due to the stony soil which made the measurement of roots challenging. Moreover, contradictory results were shown at lower pod filling stage in the glasshouse trial, as above ground dry mass of Kelpak®-treated Hyola 555TT plants decreased significantly in the sandy soil. With the exception of lower node diameter during lower pod filling stage (110 days after planting) and number of pods plant^{-1} during full pod filling stage (125 days after planting) that were significantly increased under field conditions and a tendency to improve vegetative growth, Kelpak® treatments did not have any significant effect on growth and yield of canola. Since Kelpak® did not reduce plant height in this study it can be concluded that it will most probably not reduce lodging in canola.

CeCeCe® 750

Though showing significant contrasting effects between cultivar Hyola 555TT and 43C80 at full flower (93 days after planting) in sandy soil in the glasshouse, CeCeCe® 750, generally did not reduce plant height. Whilst the leaf area and above ground dry mass plant^{-1} of Hyola 555TT was significantly increased in the sandy soil at flowering (93 days after planting), CeCeCe® 750 significantly decreased the overall above ground dry mass during pod filling (114 days after planting), compared to the control. Under field conditions the effect of CeCeCe®

750 treatments showed only during pod filling (125 days after planting) when the number of pods plant^{-1} were significantly increased, compared to the control. Although grain yields tend to increase in the field trial, CeCeCe® 750 applications generally did not have a large effect on growth, yield or plant height of canola and for this reason do not show much potential to decrease lodging in canola.

Moddus® 250 EC

Although Moddus® 250 EC tend to reduce plant height and increase the lower node diameter during the glasshouse trial in sandy soil and the field trial, Moddus® 250 EC in general, failed to have a significant effect on plant height and therefore resistance to lodging. During the glasshouse trial in sandy soil Moddus® 250 EC resulted in a significant reduction in above ground dry mass of cultivar 43C80 at 114 days after planting (pod filling stage). Under field conditions an increase in number of pods plant^{-1} was however recorded which resulted in a tendency to increase grain yield. Presumably, this might be the accumulated result of various insignificant morphological changes in the plants architecture induced by Moddus® 250 EC.

Primo MAXX®

Primo MAXX® showed the most promising results with regard to the decrease in plant height in both the glasshouse trial under optimum conditions and the trial conducted under field conditions in the canola production area of the Western Cape. The decrease in plant height is most probably due to the reduced rate of cell elongation and division initiated by Primo MAXX®. In addition to that Primo MAXX® also increased the lower node diameter of 43C80 and number of flower stalks plant^{-1} in the glasshouse trial under optimum conditions. This increase in lower node diameter may reduce lodging, while the increase in number of flowers may suggest a higher yield potential. Unfortunately, Primo MAXX® reduced the pod dry mass plant^{-1} and mass pod^{-1} of 43C80 in the same trial. However, it should be taken in consideration that no final grain yield was measured in this glasshouse trial. Reduced pod dry mass and mass pod^{-1} measured at 114 days after planting when only seeds in the lower pods became

green-brown mottled (growth stage 5.3) may therefore be the result of a delay in the rate of pod filling and retarded ripening due to the Primo MAXX® application and not a true indication of grain yield potential.

Although the reduction of plant height of Primo MAXX® treated plants also showed a reduced above ground dry mass in the glasshouse trial under optimum conditions, this was not true for the trial under field conditions. The field trials conducted at three localities in the canola production area of the Western Cape showed a significant increase in above ground dry mass, root dry mass and number of pods plant^{-1} at 125 days after planting and a tendency to increase the grain yield at 195 days after planting.

The improved response achieved by Primo MAXX® (trinexapac-ethyl 120 g L^{-1}) application compared to Moddus® (trinexapac-ethyl 250 g L^{-1}) may be ascribed to the higher application rate used (Primo MAXX® applied at 10 × the application rate of Moddus®).

Conclusions and future research

This study showed that Primo MAXX® without any doubt has the potential to reduce plant height in canola which may suggest better resistance to lodging. Because Primo MAXX® treated plants also produce more flowers and pods, grain yields may also increase. However, since only PGR Kelpak® is at present registered for use on canola in South Africa, it is quite possible that dosage rates and application protocols used for CeCeCe® 750, Moddus® 250 EC and Primo MAXX® might not have been optimal for use in canola. For this reason it is recommended that further research be done to establish the optimum timing and rates of PGRs for canola. Additionally, research is required to determine whether the response is cultivar specific and whether different PGRs can be combined. Finally, an economic analysis needs to be done to determine the cost benefit ratio of PGR usage.