Testing Candeo's NaturaTerra™ BioRoc™/PoweRoc™ Soil Blend In One-acre Pilot Field Trial in the 2019 Growing Season

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In addition to the greenhouse studies aimed at evaluation of the Candeo Growth Solution Inc. ("Candeo") NaturaTerra™ Soil Blends ("BioRoc™ and PoweRoc™) on performance of Industrial Hemp ("Hemp") (**Slaski 2019**) in the 2019 growing season, InnoTech Alberta conducted a one-acre pilot field trial focused on testing the effectiveness of Candeo's NaturaTerra™ PoweRoc™ and BioRoc™ Hemp Blend (the "NaturaTerra™ Hemp Blend") as a sole source of nutrients in production of a fibre usage type hemp variety known as Joey.

Methodology

A one-acre test plot was established at the InnoTech Alberta research farm in Vegreville, Alberta, Canada. Shortly prior to seeding of Hemp on May 31, 2019, the NaturaTerra™ Hemp Blend was spread on the soil surface at the rate of4000 lb./acre. The NaturaTerra™ Hemp Blend was partially incorporated into the soil during the seeding operation done with the use of an air drill. The NaturaTerra™ Hemp Blend-treated field did not receive any additional fertilizers, while the control, commercial size field was amended with a full suite of fertilizers at the rate of 120 lb./acre N, 60 lb./acre P and 20 lb./acre S.

On August 25 multiple biomass samples (4 x 1m2) from the different sections of field amended with the NaturaTerra™ Hemp Blend and from the control field fertilized with standard NPK rates were collected for quantification aboveground biomass yield and levels of cannabinoids in the seed heads (**Slaski 2019**). Due to extremely wet fall preventing using mechanical farming equipment the grain harvest was delayed till December 6, 2019, when frozen ground allowed for access of a Wintersteiger small plot combine. Miniscule snowfall received by the Vegreville, Alberta site in late November 2019 did not obstruct combining operation (see ***Photo 1***).

Results and discussion

Visual observations conducted during the course of the trial revealed that Hemp plants grown in the Candeo-test field did not display obvious nutrient deficiencies (i.e. stunted growth, yellowing of bottom leaves, leaf necrosis, etc.) for the most of vegetations season, approximately until seed setting, despite the minute nutrient loads in the NaturaTerra™ Hemp Blend product (i.e. 6 kg/ha N) (see ***Photo 2***). Therefore, this soil amendment NaturaTerra™ Hemp Blend apparently offers other means of improving performance of plants grown in the field. These may include activation of residual soil fertility, increased microbial diversity and activity, supply of otherwise undersupplied micronutrients or fine tuning of soil pH. Due to limited soil and plant data collected in this InnoTech Alberta pilot study, elucidation or clarity of the specific mode of action of the NaturaTerra™ Hemp Blend product was not achievable. Therefore, a fully controlled, replicated plot study involving different rates of application of the product and thorough examination of chemical and microbiological parameters of soil should be warranted. In this regard, Candeo has indicated they would agree to work with InnoTech Alberta in the 2020 growing season.

Among all tested performance parameters of industrial hemp grown in the field Candeo's NaturaTerra™ Hemp Blend product appeared to have the biggest impact on grain yield. The NaturaTerra™ Hemp Blend amended field produced 72 % more seeds that the control field receiving standard fertility program (see ***Figure 1***). Interestingly, increase of grain yield was not reported in greenhouse study most likely due to relatively small number of pots (entries) that obscured the potential of grain improving properties of tested amendments (**Slaski 2019**). However, significant increase in grain production captured in samples collected from the test field provides strong indication of the crop boosting potential of Candeo's NaturaTerra™ Hemp Blend product.

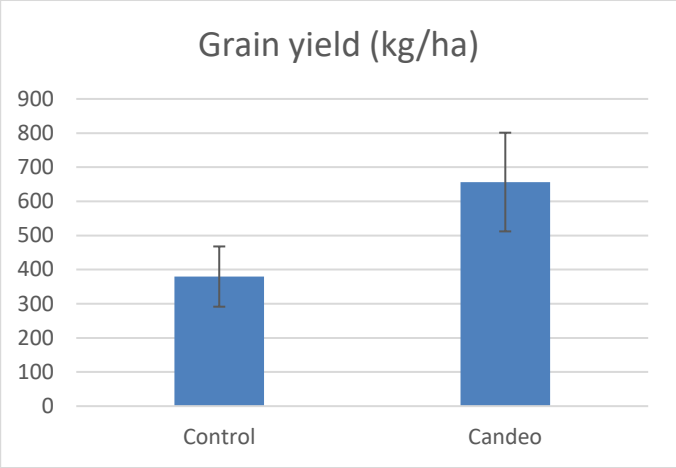

Figure 1: Effect of application of NaturaTerra™ Hemp Blend at the rate of 4000 lb./ac at grain yield of industrial hemp cv. Joey. Vertical bars represent Standard Deviation (n=4).

The Field study was also able to reveal beneficial effects of the NaturaTerra™ Hemp Blend application on total aboveground biomass, which was not observed in the greenhouse studies (**Slaski 2019**). Although not statistically significant, Candeo's NaturaTerra™ Hemp Blend-driven 23% increase in combined stems, leaves and flowers/seeds yield is a good indicator of an overall health and the yielding potential of Hemp (see ***Figure 2***). Again, detailed, application rate-response field trials should be conducted to verify this encouraging observation.

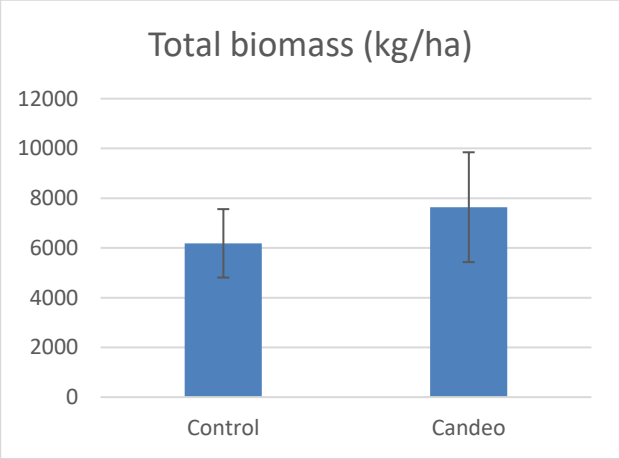

Figure 2: Effect of application of NaturaTerra™ Hemp Blend at the rate of 4000 lb./ac at total aboveground biomass of industrial hemp cv. Joey. Vertical bars represent Standard Deviation (n=4).

Contrary to the grain and biomass-promoting effects of the NaturaTerra™ Hemp Blend, canopy height of the Candeo-amended field was about 15 % shorter than the control field (see ***Figure 3***). This observation does not correspond to our previous greenhouse studies showing that all tested Candeo amendments stimulated elongation of hemp stems, hence at maturity height of the all treated plants were 6-10% higher than the

controls (**Slaski 2019**). The discrepancy between greenhouse and field studies was most likely attributed to different rates of the NaturaTerra™ Hemp Blend product's application, vastly different growing conditions and different varieties considered for the greenhouse (short, grain-type Katani) and the test field (tall, fibre-type Joey) experiments. Furthermore, our previous hemp agronomy studies discovered that short, grain type varieties are much more responsive to the provided production inputs (fertilizer, irrigation, etc.) with respect to plant height than tall, fibre-type varieties (**Slaski et. al 2018**)

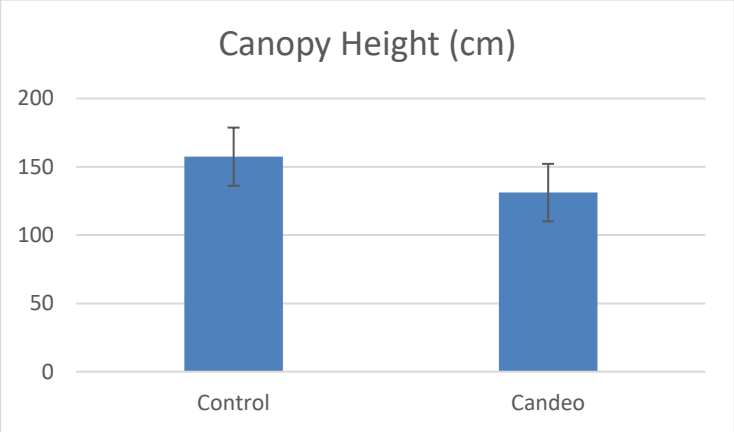

Figure 3: Effect of application of the NaturaTerra™ Hemp Blend at the rate of 4000 lb./ac at height of canopy of industrial hemp cv. Joey. Vertical bars represent Standard Deviation (n=10).

In the greenhouse studies (Slaski 2019), all tested Candeo products profoundly stimulated biosynthesis of total cannabinoids in Katani sampled 60 days after seeding, when the crop was at the early seed setting stage. NaturaTerra™ Hemp Blend applied to fibre-type variety grown in the field exhibited the same properties, since CBD, CBG and THC contents in the seed heads harvested 76 days after seeding were 41%, 24% and 47 % higher than in the controls, respectively (see ***Figures 4 and 5***). It is worth emphasizing that despite the substantial increase of THC the levels in the Candeo-treated hemp concentration of this cannabinoid did not exceed the legal Health Canada limit of 0.3%. One can expect that the NaturaTerra™ Hemp Blend may have even more profound effect on stimulation of CBD content in field-grown Hemp since this pilot field study involved only one, late summer sampling date. As cannabinoids content in Hemp changes during the growing season, the future fully controlled field study should include collection of tissue for CBD analysis at several growth stages. Such approach would permit to identify a time-point when NaturaTerra™ Hemp Blend amended plants reach the peak of cannabinoid synthesis.

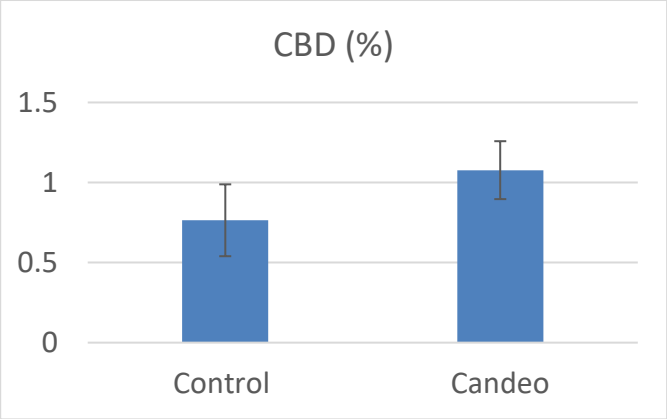

Figure 4: Effect of application of the NaturaTerra™ Hemp Blend at the rate of 4000 lb./ac at content of cannabidiol (CBD) in seedheads of industrial hemp cv. Joey. Vertical bars represent Standard Deviation (n=4).

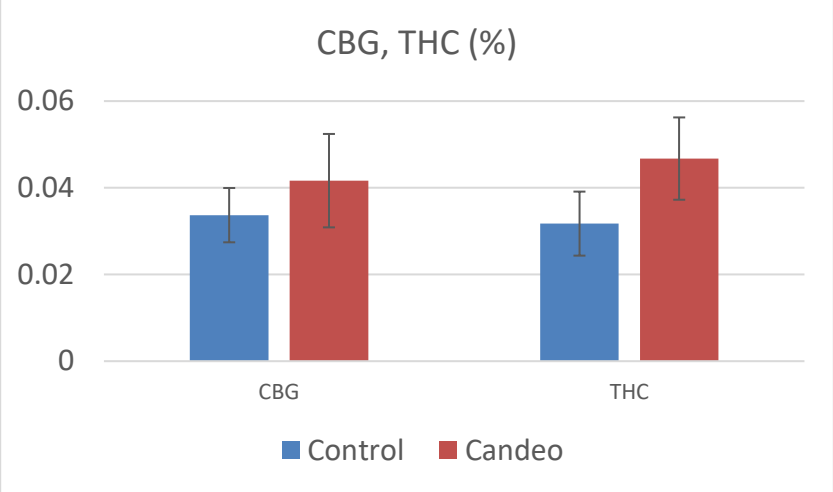

Figure 5: Effect of application of the NaturaTerra™ Hemp Blend at the rate of 4000 lb./ac at content of canabidgerol (CBG) and tetrahydocannabinol (THC) in seedheads of industrial hemp cv. Joey. Vertical bars represent Standard Deviation (n=4).

Conclusion

Since the preliminary InnoTech Alberta pilot field study clearly indicated that Candeo's NaturaTerra™ Hemp Blend product exbibits potential to increase performance of field grown Hemp, in particular grain yield and content of CBD in the seed heads, we recommend execution of a fully controlled, replicated plot study testing rates of application of the product. This field trial should also include a thorough examination of chemical and microbiological parameters that would allow for elucidation of the mode of action of Candeo products and thus improve marketability of the NaturaTerra™ Hemp Blend as a soil amendment.

References

Slaski, J. (**2019**): Testing efficacy of Candeo's NaturaTerra™ Soil Blends on Industrial Hemp. InnoTech Alberta report to Candeo Growth Solutions Inc., pp. 41.

Slaski J.J., K. Coles, K. Gill (**2018**): Development of best management practices for industrial Hemp cultivated in Alberta. Report to Agriculture Funding Consortium. pp. 56.

Appendix 1: Photographic documentation

Photo 1: Grain harvest with a small plot Wintersteiger combine (December 6, 2019).

Photo 2: NaturaTerra™ Hemp Blend amended field did not exhibit visual symptoms of nutrient deficiency until late summer. Control, fully fertilized field is seen on the left size (next to the tree line) (August 12, 2019)