

Cannabis Research

Three phases of cannabis research and development testing with BC Bud Depot (“BCBD”), a producer of high quality marijuana seeds.

Phase 1

Wollastonite testing commenced January 20th, 2018 at BCBD’s Testing Facility, which features 5,500 square feet of indoor growing space with Phase one testing 198 cannabis plants.

Testing took ongoing measurements from four categories plus a control group. The four test categories of wollastonite consisted of testing the different grades:

- Crushed powder
- Crushed small granular
- Pelletized
- Large ore

Each was subdivided into two groups according to increments of enrichment to the base potting mixture.

Research distributed plant sets at 15% for each category, wollastonite enrichment was subdivided at 5% and 10% per plant using the different ratios of grade. The control group (40%) contained a base potting mixture which consisted of 90% growing medium, 9% worm castings and less than 1% of glacial rock dust and kelp.

The Phase 1 trials were successful, and allowed the company to move on to Phase 2 trials in the summer of 2018.

Phase 2

The successful completion of Phase Two trials in October 2018, involving cannabis growth with wollastonite (CaSiO_3) as a growth medium additive at BC Bud Depot's ACMPR-licensed Research and Development facilities in Vancouver, BC. Samples of marijuana grown with 15% wollastonite from Vertical's St. Onge project were entered in an international growers' competition, winning first place overall for Best Flower at the August 2018 Kootenay Cannabis Cup in Cranbrook, BC.

Phase 2 of the BCBD wollastonite study began Apr. 4th, 2018 with 270 plants being tested after Phase 1 showed crushed powder, at either 5% or 10% per plant/base potting mix ratio, had a dramatic effect that reduced the test group resistance to stresses such as nutrient imbalances, water, pests and diseases. BCBD decided to use crushed powder and crushed small granular in Phase 2 studies after Phase 1 results.

First part of Phase 2-A was broken into 6 groups, using only crushed powder, 30 plants in each group with increasing amounts of wollastonite used in each group. Ratios of 2%, 5%, 10% 15% and 20% were used in the base potting mix and a control group.

BCBD base potting mix and control groups had an average PH level of 6.0, at 2% no PH changes were noticed, at 5% PH level raised to 6.1, at 10 % PH level raised to 6.3, at 15% PH level raised to 6.5, at 20% PH level raised to 6.8.

There was a noticeable difference in root mass, root health, and resistance to stresses in the 5%, 10%, and 15% groups. There was also a noticeable difference in foliage density when compared to the control group.

Phase 2-B was started July 20th, 2018 using crushed small granular, using the same base formula that was established in Phase 2-A, results for this Phase are still undetermined.

270 plants were involved in the trials, split into 30-plant groups with wollastonite added at 0%, 2%, 5%, 10%, 15% and 20% of the total growth medium.

We documented soil PH and insect pest levels on a weekly basis through the course of our study. We observed a steadily declining pest density as levels of wollastonite increased. In terms of crop protection, wollastonite addition had the greatest net benefit of any environmental measure we took, sharply reducing or even eliminating the need to use other means to manage pest activity. Reduced insect stress allowed higher plant health and vigour, leading to greater yields of end marijuana product, especially in the 10%, 15% and 20% wollastonite groups. Our in-house experts deemed that peak marijuana quality occurred in plants grown with 15% wollastonite. The judges at the Kootenays Cannabis Cup event did not disagree.

The growth trials also documented improved root and foliage density with the addition of wollastonite. Result tables from the time of harvest indicate a sharp contrast between sparser, tinted roots of control groups (consisting of peat moss, worm castings, kelp meal and glacial rock dust) and the dense, white root matrix of plants grown with 10%, 15% and 20% wollastonite. Wollastonite used in the study was -40 mesh fine-grade powder, sourced from the Company's St. Onge Wollastonite project located in Quebec, Canada.

From an accounting perspective, the costs of growing with wollastonite were offset by the cost savings associated with reduced pest management requirements. From an industry perspective, wollastonite is a very appealing **additive** because it couples crop protection with product improvement. For consumers, it leads to a more natural and

organic product. For Micro Producers it means enhanced quality and a simplified growing process. For the large-scale producers, risk mitigation and crop protection will be the greatest driver for wollastonite adoption in the cannabis industry.

The Cannabis strains used in the wollastonite trials were BC Sweet God and Cali Cure, a high-CBD strain. The First Place Overall award for BC Sweet God was the 45th major award earned by BC Bud Depot over fifteen years of international competition, but the first one credited largely to a soil additive.

Competition at these events is extremely tight,” stated BCBD’s lead researcher. “It takes more than excellent genetic varieties win awards at this kind of competition. It takes advanced growing techniques and high-quality soils. Our soil recipe featuring high levels of wollastonite allowed plants to maximize their genetic potential to produce cannabinoids and terpenes. We’re extremely pleased by the competition results and what it does for us as a company, showing our top genetics, high-end skills and techniques. Growers tend to be secretive about their soil recipes, but we’re happy to share that wollastonite is a key ingredient leading to the success of our grows.”

Phase 3

The successful completion of Phase Three trials involving cannabis grown with wollastonite (CaSiO_3) as a soil additive at BC Bud Depot’s (BCBD) ACMPR-licenced Research and Development facilities in Vancouver, BC. The positive Phase Three trials build on the success of Phase Two Trials, which included samples of marijuana grown with 15% wollastonite from the Company’s St. Onge project being entered in an international growers’ competition, winning first place overall for Best Flower at the August 2018 Kootenay Cannabis Cup in Cranbrook, BC.

In the Phase Three trials BCBD measured and recorded significant improvements in root mass, powdery mildew control and pest elimination. In every case the most optimal results occurred with an admixture rate of 10% to 15% wollastonite to the growth medium. Most notably, powdery mildew, the most common fungal blight to affect *Cannabis sativa*, was virtually undetectable with wollastonite admixture above 10%. An admixture above 10% wollastonite also correlated with sharp reductions in the presence of thrips and fungus gnats, insect pests with a sub-soil life phase in which the wollastonite crystals lacerate and impale their soft bodies. At a microscopic level, wollastonite's needle-like structure penetrates soft-bodied insect larvae and pupae, interrupting the life cycle without the use of pesticides. Wollastonite's unique properties also allow it to break down into calcium, magnesium and silicon in a highly bio-available form that balances soil PH throughout the growth cycle – this allows the cannabis plants to uptake silicic acid and promotes strong cell walls that better resist insect feeding and spore penetration, supporting increased growth and elevated product yields.

We recorded a dramatic elevation of overall health among plants grown with wollastonite. The wollastonite group produced consistently low levels of powdery mildew – little to none – appearing later in the growth cycle. Roots, meanwhile, showed extreme vigour, growing dense and white with no sign of yellowing. Root health indicates a plant's ability to resist disease and to support high yields of high-quality of finished marijuana.

The findings of the Phase Three BCBD wollastonite study indicate a major financial implication for the cannabis industry, where a trend towards cultivation of expansive plant canopies creates a powerful incentive for effective and efficient methods of crop protection and production.

Large-scale cultivators need every tool at their disposal to improve plant health and avoid crop losses – a 10% to 20% loss in crop production due to a preventable outbreak of a destructive fungal pathogen can equate to millions of dollars of lost product. Companies that take crop protection seriously are looking for cost-effective soil additives that not only nourish plants but build resilience against the pests and pathogens that threaten profits. Our findings show wollastonite to be a critical tool for both cannabis crop protection and top-end production in a market where quality is of vital importance. It is no longer acceptable to spray fungicides on marijuana: natural prevention is the key and Wollastonite is the answer.

We are very excited by these excellent Phase Three results which prove that wollastonite is a very appealing natural growing additive for the cannabis industry because it couples crop protection with product improvement, resulting in a more natural and healthier product for consumers.