Effects of AgTonik's MLG-50™ Organic Acid Trace Mineral Complex on Hydroponically Grown Cannabis

Results of a Study Conducted for AgTonik, LLC

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Disclaimer: This study was conducted in the State of Michigan in accordance with all Michigan Medical Marijuana statutes. The grower is licensed by the State of Michigan to supply medical cannabis to State Registered patients. The courier transport of laboratory samples to PSI Labs was also conducted with strict adherence to the applicable State Medical Marijuana statutes.

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Introduction:

AgTonik's MLG-50™ Organic Acid Trace Mineral Complex (MLG-50™) is a pure, water extracted organic acid/trace mineral complex. Manufactured by AgTonik, LLC of Portage, Michigan, USA, the product is derived from a rare mineral deposit with a unique organic acid and micro-mineral profile. MLG-50™ has been found to promote the health and growth of soybeans, increasing yields by 30%. The primary purpose of this study is to evaluate if the same effects can be duplicated in regards to yield production when MLG-50™ is fed to hydroponically grown plants in this case; cannabis. The secondary purpose is to investigate whether the accelerated growth rates produced by MLG-50™ have any effects on cannabinoid or terpene profiles.

Materials and Methods:

The cannabis plant was chosen for this study because of its short growing period and versatility in regards to growing mediums and environments.

Six seeds in all were readied for germination. Three seeds germinated (50% germination) and were promptly planted in Pro-Mix HP Mycorrhizae™. The resulting mother plants were fed nutrients from Technaflora Plant Products Ltd. These mother plants were grown under a 24-hour light cycle for a period of nine weeks using standard, full-spectrum grow lights.

Clones for this study were harvested from the most vibrant of the three mother plants and placed in cloning trays under a 24-hour light cycle. The cloning solution used was General Hydroponics® RapidStart Rooting Enhancer, which was administered via the EZ-Clone® Original 30 Slot Cutting System Plant Cloning Equipment.

After 10 days, the twelve most vibrant clones of uniform size were chosen for planting. Six clones for the control group and six clones for the MLG-50™ group were planted in Oxygen Pot System's 6 Site Digital XL Super-Flow Hydroponic Grow System, an ebb and flow hydroponic bucket system. The growing medium was Growstone's GS-1 Hydro Stone Substrate, an inert glass particle stone. Each group was fed via their own distinct six bucket Super-Flow system.

Reverse osmosis water was used throughout the course of this study. Technaflora nutrient products were given in equal amounts to the control group and to the MLG-50™ group. The MLG-50™ group was fed one milliliter of MLG-50™ per gallon of feed water throughout the vegetative and flowering growth cycles. Feed water was maintained at a 6.0 pH using General Hydroponics® pH Up when necessary, which was infrequently.

The control group and the MLG-50™ group were grown in the same room, which was maintained at a temperature of seventy to seventy-five degrees Fahrenheit throughout the growth cycles of the plants. Lighting for the vegetative growth cycle was two 1,000-watt Triple XO metal halide lamps with six-inch venting. At three weeks, the plants were moved into the flowering stage. The light cycle length was reduced to twelve hours and Technaflora nutrient products were changed to the flowering nutrient protocol. Lighting for the flowering cycle was two 1,000-watt high pressure sodium lamps with six-inch venting.

The feed water cycle was set to five hour intervals with a 20-minute feed cycle. Water temperature was kept between sixty-five and seventy degrees Fahrenheit. The MLG-50™ used in this study contained more than 30 organic acids and a diverse variety of naturally occurring trace minerals and elements.

Test samples were collected at the four-week, eight-week and twelve-week points in the life cycles of both cannabis test groups. Sterilized 100 mL laboratory test sample vials were used with a tamper resistant seal. Samples were delivered via a private courier to Precision Safety Innovation (PSI) Labs at 259 Jackson Plaza, Ann Arbor Michigan 48103. A chain of custody document was obtained from PSI Labs prior to transport

Tests performed by research chemist, Dr. Spivak-Birndorf, at PSI Labs, included tests for cannabinoid content, terpene content, THC content and microbial profiles.

Data was collected on a weekly basis, including: amounts of feed water consumed, plant heights, room temperature, room humidity, light cycle hours, photo records, lab sample records and chain of custody documents. Strict study protocols were maintained throughout the research process.

Raw Data, Weeks One to Four:

At three weeks of vegetative growth, plants showed distinct differences in growth rate, height and size, number of leaves, leaf size and water consumption between the control group and the MLG-50™ group. The MLG-50™ plants had an average height of 15.5 inches after three weeks of growth, compared to an average height of 10.5 inches for the control group. A 35.2% difference in overall height between the two groups is significant.

After three weeks of vegetative growth, the plants were moved into the flowering stage, at which point, the MLG-50™ group plants were consuming almost twice the amount of feed water as were the control group plants.

By the fourth week, the girth and height of the MLG-50™ plants appeared significantly superior to the control group. Leaf development was thicker and lusher in the MLG-50™ group during the fourth week. Below, compare the following fourth week photos: Figure 1a, the largest leaf from control group (12 inches long); and, Figure 1b, the largest leaf from MLG-50™ group (14.5 inches long). (Please look at the number where the end of the leaf stem touches the measuring tape).

Laboratory Results after Four Weeks of Growth:

At the end of the fourth week, the first set of laboratory samples was clipped and transported to PSI Labs. The chain of custody, numbered 31116, completed the transfer of the samples to scientists at PSI Labs.

The control group showed a 2.6% THC content, with a margin of error of ± 0.3%, while the MLG-50™ showed a 2.4 % THC content with a margin of error of ± 0.2%. The minor cannabinoids CBG, CBC and THCV were slightly lower in the control group than in the MLG-50™ group. Given the negligibility of the difference in values between the groups, and also the margin of error, it was concluded that the results for the MLG-50™ group and the control group concerning minor or major cannabinoids after four weeks of growth were virtually identical.

Total terpenoid content for the control group was 0.037 % (370 ppm), while the MLG-50™ group quantified at 0.048 % (480 ppm). Although there is a more than 100 ppm difference between these values, Dr.Spivak-Birndorf of PSI Labs pointed out that the RSD (relative standard deviation) at this early stage can be as great as 50%, making it difficult to obtain results that show the actual variability between the two groups. Leafy material in general is a difficult medium with which to measure terpenes.

Raw Data, Weeks Five to Eight:

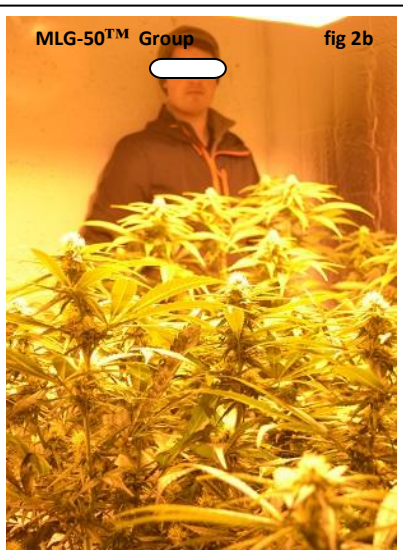
In the MLG-50™ group, the onset of flowers was observed during the fifth week of growth. The control group showed no onset of flowering during the fifth week. At this point, the uptake of feed water in the MLG-50™ group was twice that of the control group. Simultaneously, the tallest fifth week plant in the MLG-50™ group was 9.5 inches taller than the tallest fifth week plant in the control group. During the sixth week, the MLG-50™ group plants had noticeably more flowering sites than did the control group plants. Also during the sixth week, calyx development in the MLG-50™ group plants appeared thicker and more abundant than in the control group plants.

During the eighth week of growth, the feed water consumption by the control group plants leveled off, while the MLG-50™ group plants continued to increase their feed water consumption. See Chart C-1 below.

Feed Water Consumption: Gallons Consumed per Week *[Chart C-1]*

	week 4	**week 8**	**week 12**
Control Group	4.5 gal	14.3 gal	7.0 gal
MLG-50™ Group	8.5 gal	21.3 gal	9.0 gal

The differences in overall plant size and in flower production between the plants of the MLG-50™ group after eight weeks of growth as compared to plant size and flower production in the control group are noticeably superior. Compare the following eighth week photos: Figure 2a, a control group plant; and, Figure 2b, an MLG-50™ group plant.



Laboratory Results after Eight Weeks of Growth:

At the end of the eighth week, the second set of laboratory samples was clipped and transported to PSI Labs. The chain of custody, numbered 41116, completed the transfer of the samples to scientists at PSI Labs.

The control group showed a 11.0% THC content, with a margin of error of ±1.1%, while the MLG-50™ showed a 13.4% THC content, with a margin of error of ±1.3%. The MLG-50™ group had a higher THC content in the eighth week of growth (or, in the fifth week of the flowering cycle). The minor cannabinoids CBG, CBC and THCV in the control group were also lower than in the MLG-50™ group. Terpene levels were virtually identical in both groups. Factoring in the margin of error, it was concluded that there is no difference between the constituent contents of either group, however, the higher THC content in the MLG-50™ group indicates a potential area of further investigation into plant maturation rates, given that the MLG-50™ plants may have been maturing more quickly than the control group plants.

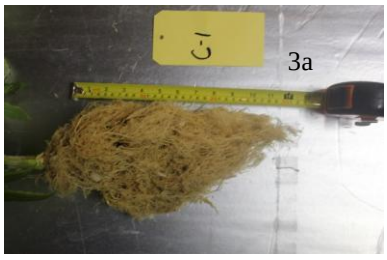
Raw Data, Weeks Nine to Twelve:

The greatest change at nine weeks into the growth cycle (which was also six weeks into the flowering cycle) was the drastic drop in feed water consumption, which dropped in both groups by 36%. The number of flowering sites continued to be greater in the MLG-50™ group plants and the thickness and abundance of flowers in the MLG-50™ group plants was noticeably greater than in the control group plants. The plants also stopped growing in height during the ninth week; the control group leveled off at 25.0 inches for the shortest plant, and 34.0 inches for the tallest plant, while the MLG-50™ group leveled off at 32.0 inches for the shortest plant, and 42.0 inches for the tallest plant. The MLG-50™ group plants averaged 20% taller than the control group plants at this stage.

During the tenth week, the feed water consumption of the control group dropped another 17.5%, while the MLG-50™ group showed a 5% increase in feed water consumption from the previous week. The flower development on the lower stems of the MLG-50™ group plants was far more profuse than it was on the control group lower plant stems.

Water consumption during the final (or, twelfth) week of growth leveled off at seven gallons per week for the control group and nine gallons per week for the MLG-50™ group. At this stage, the MLG-50™ group continued to show superior flower development.

At the end of the twelfth week, the plants from both groups were harvested. Photos were taken of the root ball of the largest plant from the control group and of the root ball of the largest plant from the MLG-50™ group. The root development of the MLG-50™ group plant was significantly more pronounced. Below, compare the following twelfth week photos: Figure 3a, the root ball from the largest control group plant was 12 inches in length; and, Figure 3b, the root ball from the largest MLG-50™ group plant was 24 inches in length.



3a

3b

Laboratory Results after Twelve Weeks of Growth:

After the harvest at the end of the twelfth week, the final set of laboratory samples was clipped and transported to PSI Labs. The chain of custody, numbered 51616, completed the transfer of the samples to scientists at PSI Labs. The samples consisted of a flower each from the largest plant in the control group and the largest plant in the MLG-50™ group. The plants had been dried and cured for ten days before these final samples were clipped.

Lab results showed that the MLG-50™ group concentrations of a couple different terpenes, e.g., terpinolene and beta-ocimene, were 500 ppm greater than in the control group.

THC levels were equal in both groups, at 14.7%. This demonstrates that adding MLG-50™ to hydroponic feed water does not reduce THC concentration, in spite of the accelerated growth rate.

Total terpene content was 8800 ppm (0.88%) in the MLG-50™ group, 11.3% higher than the control group with 7800 ppm (0.78%). Although total terpene values for the two different groups may seem significantly different, the margin of error allows for the range of deviation.

The total cannabinoid content of both test groups remained virtually the same, especially when the margin of error is factored in. The MLG-50™ group had a total of 16.3% total cannabinoid content, while the control group had a 16.4% total cannabinoid content.

Moisture content of the dried flowers was also equal in both groups, at 13%, which indicates that overall moisture content was not increased in the MLG-50™ group despite the much greater feed water consumption and growth rate in that group.

Raw Data Throughout Plant Growth Cycles:

Control Group Data:

Total amount of feed water consumed: 91 gallons.
Average height of plants: 29.5 inches.
Average amount of feed water consumed per week: 7.58 gallons.
Average temperature of the grow room: 71.21 degrees.
Average humidity of the grow room: 42.91.
YIELD: 23.2 ounces (657.17 g).

MLG-50 Group Data:

Total amount of feed water consumed: 134.5 gallons.
Average height of plants: 37 inches.
Average amount of feed water consumed per week: 11.20 gallons.
Average temperature of the grow room: 71.21 degrees.
Average humidity of the grow room: 42.91%.
Amount of MLG-50™ used during growth cycle: 134.5 mL.
Cost of MLG-50™ per mL: 0.165 cents.
Total cost for MLG-50™ for this study: < $23.00
YIELD: 29.3 ounces (830.64 g).

DISCUSSION OF RESULTS

Results of this study show conclusively that MLG-50™ can increase the height and size of cannabis plants by 20% and the yield by 20.9%. Previous test plot results were further validated by this study, in which soy bean fields showed an impressive yield increase of 30%. Field winter wheat grown with MLG-50™ produced an extra eleven bushels per acre and showed a 13% increase in yield.

In addition to the impressive yield increases, the significantly greater feed water consumption by the MLG-50™ group represented a dramatic difference between the two groups. It is interesting to note that the water consumption of the MLG-50™ group was almost twice that of the control group at the midway point in the life cycle of the plants. The feed water consumption for plants in the MLG-50 group totaled 134.5 gallons for the entire growth cycle; while the control group feed water totaled 91 gallons for the entire growth cycle. A question as to whether the greater water consumption in the MLG-50™ group would affect potency, especially in regards to cannabinoid content, was initially posited; however, no corresponding decrease in potency was reflected in the laboratory analyses.

The MLG-50™ group plants had a healthier overall look in the leaves, flowers and stems. Yellowing during the early part of the growing cycle was observed in the control group plant leaves, while no such yellowing occurred in MLG-50™ group plant leaves.

All laboratory samples were tested at the independent laboratory for mold, bacteria and pests and were found to be negative for these values throughout the course of this study.

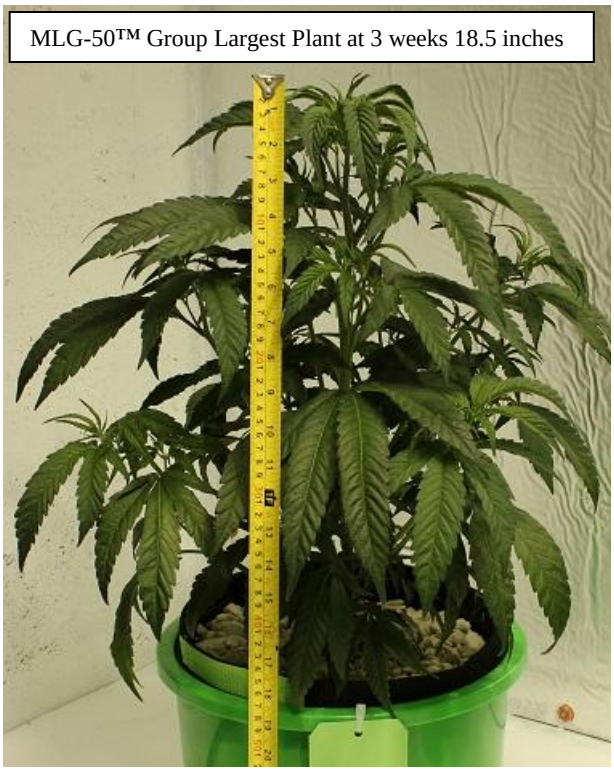
We hypothesize that the primary mode of action of MLG-50™ within the plant is as a nutrient vehicle, transporting nutrients into the cells at accelerated and more efficient rates. MLG-50™ supplies plants with organic acids and rare trace elements that the plant would otherwise go without, therefore making a considerable difference in the overall health and size of the plant. (Hydroponic crops are typically grown in nutrient mediums that are especially void of organic acids.)

The findings in this study will be highly valuable to growers of cannabis and other hydroponic crops. Growers are facing considerable increases in expenses and competition while the cost of producing continues to increase. The ability to consistently increase yields with MLG-50™, without sacrificing product potency or quality, translates into a far greater profitability for the grower.

The cardinal finding of this study is that MLG-50™ will substantially increase yields without sacrificing potency levels of desirable plant (or, medical cannabis) constituents and this finding is reported here for the first time. This further validates that MLG-50™ is a material that impressively increases plant yield and the overall health of plants.

Control Group Largest Plant at 3 weeks 12 inches tall

MLG-50™ Group Largest Plant at 3 weeks 18.5 inches



Additional photos and laboratory report data available upon request.