

COMPARISON OF THE EFFECTS OF AgTonik's MLG-50™ AND BioAg's FUL-POWER™  
ON CANNABIS PRODUCTION

Results of a Study Conducted by AgTonik, LLC  
Portage, Michigan, USA

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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

## INTRODUCTION:

MLG-50™ Organic Acid Trace Mineral Complex (MLG-50™) is a pure, water extracted product 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 as much as 30%. The primary purpose of this study is to compare the yield-boosting effects of BioAg's Ful-Power™ humic/fulvic acid product to AgTonik's MLG-50™ when used in hydroponic medical cannabis production. The economic variables will also be investigated.

## MATERIALS AND METHODS:

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. The strain chosen for this study was Critical Mass, a Sativa-Indica blend.

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 Ful-Power™ 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 Ful-Power™ and MLG-50™ groups. The MLG-50™ group was fed one milliliter of MLG-50™ per gallon of feed water--the maximum recommended dosage--throughout the vegetative and flowering growth cycles. The Ful-Power™ group was fed 30 milliliters of Ful-Power™ per gallon of feed water--the maximum recommended dosage--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 Ful-Power™ and the MLG-50™ groups were grown in the same room, which was maintained at a temperature of seventy to seventy-nine degrees Fahrenheit throughout the growth cycle of the plants. Lighting for the vegetative growth cycle was two 1,000-watt Triple XO metal halide lamps with six-inch venting. At two weeks, the plants were moved into the flowering stage. At this point, nutrients were changed over to the flower protocols. The light cycle length was reduced from 18 hours 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 five degrees Fahrenheit.

The fulvic acid/humic acid (fulvic acid is a type of humic acid) concentration of MLG-50™ is 12.5%, (125,000 part per million), with a recommended feeding of 1 mL per gallon of hydroponic feed water. MLG-50™ also contains 12 additional organic acids, 18 amino acids and various trace minerals.

The Ful-Power™ product contains one ingredient - fulvic acid, listed on the label as humic acid. The total organic acid (humic acid) concentration listed on the product label is 0.06% (600 part per million). See Chart C-1 below for ingredient lists of the two products tested.



Fig-1a Ful-Power™ Product



Fig-1b MLG-50™ Product

CONTENT LIST		
Ingredient	Ful-Power™	MLG-50™
Fulvic Acid	0.6 mg/mL (0.06%)	125 mg/mL 12.5%
Organic Acids	None	≥ 2 mg/mL (0.2%)
Amino Acids	None	≥ 2 mg/mL (0.2%)
Minerals	None	≥ 11 mg /mL (1.1%)
Water Content	99.94%	86%

Test samples were collected at 10 weeks. Samples were collected into sterilized 100 mL laboratory test sample vials with tamper resistant seals. Samples were delivered via 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 at PSI Labs by research chemist, Dr. Spivak-Birndorf, 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 and photo records. Laboratory sample data was recorded at the end of the study. Strict study protocols were maintained throughout the research process.

## RESULTS:

### Raw Data, Weeks One to Four:

Noticeable differences in growth rate, height and feed water consumption between the Ful-Power™ and the MLG-50™ group were observed. The MLG-50™ plants ranged from 18-25 inches in height after three weeks of growth, compared to a range of 16-22 inches in height within the Ful-Power™ group.

By the end of the fourth week, the MLG-50™ group was consuming 11.5 gallons of feed water per week, while the Ful-Power™ group consumed 9.5 gallons per week, a difference of 17.4%. Total feed water consumption throughout the first four weeks of growth for the MLG-50™ group was 24.5 gallons, while the Ful-Power™ group consumed 19.5 gallons throughout the first four weeks.

The MLG-50™ group consumed 20.4% more water during the first four weeks than did the Ful-Power™ group.



Fig-2a -Ful-Power™ 22"  
Largest Plant-3 weeks

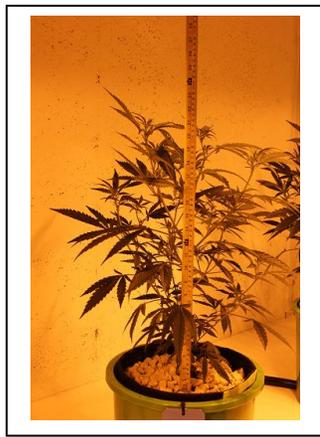


Fig-2b MLG-50™ 25"  
Largest Plant-3 weeks

**Raw Data, Weeks Five to Eight:**

Feed water consumption during weeks five through eight was equal, with both groups consuming 55 gallons of feed water. The heights of the MLG-50™ group plants were now 27" to 32". The MLG-50™ group plants would stay within this height range for the remainder of the growth cycle. The Ful-Power™ group plants were 25" - 30" in height and would also remain within this height range throughout the growth cycle. The height difference between the groups is not a significant difference.

Flower presentation was first observed in the MLG-50™ group at three weeks into the growth cycle, while the Ful-Power™ group started to show flower development 3 days later than the MLG-50™ group. It was becoming apparent that, other than a two-inch difference in plant height, no other significant differences could be visually observed between the two groups of plants.

**Raw Data, Weeks Nine to Ten:**

During the ninth week, the feed water consumption for both groups dropped from 12.5 gallons of feed water per week to 9.5 gallons per week. The tenth week showed another 0.5 gallon drop in feed water consumption for both groups. The MLG-50™ group consumed 5 more gallons of feed water overall than did the Ful-Power™ group. See Chart C-2 below.

Week #	Ful- Power™	Acc-Totals	MLG-50™	Acc-Totals
1	2.0	2.0	2.5	2.5
2	3.0	5.0	4.0	6.5
3	5.0	10.0	6.5	13.0
4	9.5	19.5	11.5	24.5
5	13.5	33.0	13.5	38.0
6	14.5	47.5	14.5	52.5
7	14.5	62.0	14.5	67.0
8	12.5	74.5	12.5	79.5
9	9.5	84.0	9.5	89.0
10	9.0	93.0	9.0	98.0
	Total = 93.0		Total = 98.0	

Plants were harvested on August 26, 2016 and were prepared for the drying and curing process. Only a slight difference between the MLG-50™ group and the Ful-Power™ group root balls

could be observed on comparison. On the other hand, the flowers of the MLG-50™ group plants seemed somewhat harder and tighter than the flowers of the Ful-Power™ group plants. Once the yields were calculated, the results were not drastically different between the two groups. However, the MLG-50™ group had a 38-gram greater total yield (from 6 plants, with an average of 6.33 grams more per plant) than did the Ful-Power™ group.

**Laboratory Findings:**

At the end of the tenth week, a set of laboratory samples was clipped and transported to PSI Labs via private courier. The chain of custody, numbered 90816, completed the transfer of the samples to scientists at PSI Labs. The test sample package consisted of one flower from the largest plant in the Ful-Power™ group and one flower from the largest plant in the MLG-50™ group. Before this test sample collection, the plants had been dried and cured for ten days.

THC levels were somewhat higher in the MLG-50™ group, at 15.8%, compared to THC levels in the Ful-Power™ group, which measured at 14.7%. Total terpene content was 0.33% (3,300 ppm) in the MLG-50™ group, and was a bit higher in the Ful-Power™ group, at 0.40% or 4,000 ppm. These differences may seem significant; however, the results are considered virtually identical when the margin of error is factored in.

The total non-THC cannabinoid content of both test groups was also virtually the same when the margin of error was factored in. The MLG-50™ group had 1.6% total non-THC cannabinoid content. The Ful-Power™ group had 1.4% total non-THC cannabinoid content.

Moisture content of the dried flowers was also equal in both groups, at 14%. This may indicate that overall moisture content was not increased in the MLG-50™ group despite the greater feed water consumption and growth rate in that group. See Data Chart C-3 below.

DATA	Ful-Power™	MLG-50™
Total Feed Water Consumed:	93 G / 352 L	98 G / 371 L
Average FW per week:	7.58 G / 28.6 L	9.3 G / 35.2 L
Average FW per plant:	15.5 G / 58.7 L	16.3 G / 61.8 L
Average GR temperature	76.2 F	76.2 F
Average GR-humidity	64.0%	64.0%
Average Height of Plants:	27.5 inches	29.5 inches
Total THC Content:	15.7 %	16.8%
Total Terpene Content:	0.40%	0.33%
Total Cannabinoids non THC	1.6%	1.4%
Total Moisture Content:	14.0%	14.0%
Product Volume Used:	2,790 mL	98 mL
Amount used /Gallon of FW	30 mL	1.0 mL
Cost / Gallon of Feed Water	\$0.396	\$0.165
Total Product Cost - 6 plants	\$36.82	\$16.17
FA supplied / G of FW	18 mg/G	125 mg/G
Total YIELD in grams:	930	968
Ave. YIELD per plant-grams	155	161.9
Total YIELD in ounces:	32.8	34.2
Ave. YIELD per plant in oz.	5.46	5.70

mL = milliliters L = Liters mg = milligrams G = Gallons

## DISCUSSION:

The intent and premise of this study was to reveal not only which product created superior results in regards to yield, growth rate and plant size, but to also compare the economic differences between the two products.

MLG-50™ and Ful-Power™ are two products that have a track record of increasing yields when applied to various crops, including cannabis. Product ingredients and ingredient potency within each of the two products are vastly different, while product effectiveness claims are very much the same. (See Chart C-1 for product contents.)

Initial observations and data showed a remarkable difference in feed water consumption in the first 4 weeks between the two groups. The MLG-50™ group consumed 5 gallons more feed water during that time and presented a considerably faster growth rate than did the Ful-Power™ group.

It is interesting to note that, starting in the 5<sup>th</sup> week of growth, the water consumption was the same for both groups and remained that way throughout the remainder of the study. (See Chart C-2 for weekly feed water consumption data.)

Plant size after 8 weeks was not significantly different between the two groups, although the MLG-50™ group maintained an overall height that was 2 inches greater than that of the Ful-Power™ group.

MLG-50™ seemed to have the greatest impact on the plants early on in the study, creating a virulent growth rate throughout the entire vegetative cycle. The 20.4% difference in feed water consumption between the two test groups during the first 4 weeks of growth may be significant with respect to potential for an increase in crop yield. When the vegetative growth cycle is lengthened, yields resulting from the use of MLG-50™ could be increased beyond what would normally occur without the use of MLG-50™.

Laboratory findings somewhat favored the MLG-50™ product in the data values when it came to THC and other cannabinoid levels. When one factors in the margin of error, however, the results are not different enough between the two groups to say conclusively that the MLG-50™ is more potent. Terpene content favored the Ful-Power™ group in the data values; however, when the margin of error is factored in, the results are considered equal.

Also notable is the fact that both groups of plants showed no signs of nutrient deficiency or other botanical health issues.

Yield production was somewhat better in the MLG-50™ group, which produced 6.33 grams more flower weight per plant, totaling (in dried flower weight from six plants) 34.2 more ounces (968 grams) the total yield produced by the Ful-Power™ group. (See Chart C-1.) We theorize that this is due to the additional organic acids that are contained in the MLG-50™. Healthy soils contain a variety of these acids while hydroponic feed water generally lacks any such content unless it is amended.

## The Economics:

The recommended MLG-50™ feed water ratio required the use of 1 mL per gallon of RO water, which resulted in feed water that contained 125 mg of fulvic/humic acid per gallon. The cost of MLG-50™ was \$0.165 per gallon of feed water. The six MLG-50™ plants required a total of 98 mL of MLG-50™, so, the total cost of MLG-50™ for six plants was \$16.17.

Adding Ful-Power™ required us to use 30 mL per gallon of RO water, creating feed water that contained 18 mg of fulvic acid per gallon of feed water. Cost was \$0.396 per gallon of feed water, with a total cost of \$36.82.

Once we analyzed all costs involved, including shipping costs, the economic advantages of using the MLG-50™ became evident.

Using Ful-Power™ costs more than twice as much per plant for 7 times less fulvic acid and comes with no additional organic acid content. More convincing is the fact that MLG-50™ showed superior yield-producing results than did Ful-Power™. In this study, the MLG-50™ group had a 3.92% greater yield.

For the average small grower, a 6.33 gram increase in yield, as evidenced by the MLG-50™ group in this study, will make an impact on the final economics.

In a previous study (publication number M502316), MLG-50™ produced a more than 20% increase in yield when compared to plants grown without the use of MLG-50™.

## Conclusion:

Both of the products tested in this study produced impressive results, as compared to the conventional fare of hydroponic nutrients for cannabis plants. Although the difference in yield between the two groups is less than 4%, the impact for the grower can nonetheless be significant.

We grew 6 plants per group and had a 1.35 ounce greater yield in the MLG-50™ group. At the average market price of \$220.00 per ounce, the grower will enjoy an extra \$280.00 profit as compared to the Ful-Power™ product. Once you multiply that by 60 plants or 600 plants the economic differences become clear.

The primary finding of this study is that MLG-50™ and Ful-Power™ will substantially increase yields without sacrificing potency levels of desirable plant (or medical cannabis) constituents.

The economics however, substantially favor the MLG-50™ product. For every gallon of MLG-50™, a grower would need 30 gallons of the Ful-Power™ product to achieve congruent results. This makes a significant difference, especially to the commercial grower, who would be using 55 gallon barrels or 275 gallon totes. The difference in shipping costs between delivering 30 totes (weighing 2,750 pounds each) of the Ful-Power™ product as compared to shipping one tote of the MLG-50™ product would be enormous.