# EVALUATION OF METALOSATE® FOLIAR NUTRIENTS ON PROCESSING TOMATOES AND UPLAND COTTON

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## INTRODUCTION

A trial was conducted in 1998, with Albion Laboratories to test the effectiveness of their Metalosate® amino acid chelated nutrients by making foliar applications for processing tomatoes and cotton. Treatments compared different formulations and amounts of Albion® Laboratories products to an untreated control and an application of liquid potassium sulfate (ESP). Except for the untreated control, all plots received an equivalent 150 lbs $K_2O$ per acre (168 kg per hectare), sidedressed in early June, as per Albion recommendations. Potassium sulfate was the source of potash. Treatments are listed in Table 1.

**Table1.**
**Metalosate Treatments on Processing Tomatoes and Upland Cotton**

| | First Application | | | Second Application | | |
|---|---|---|---|---|---|---|
| | Treatment | Rate Fl oz / A | Rate L / ha | Treatment | Rate Fl oz / A | Rate L / ha |
| 1. | Untreated Control | 0 | 0 | Untreated Control | 0 | 0 |
| 2. | K Metalosate<br>Mn Metalosate<br>Zn Metalosate | 32<br>32<br>24 | 2.4<br>2.4<br>1.8 | K Metalosate<br>Mn Metalosate<br>Ca Metalosate<br>Foliar $P_2O_5$* | 64<br>24<br>16<br>2.0 lb | 4.8<br>1.8<br>1.2<br>2.2 kg |
| 3. | Crop Up Metalosate | 96 | 7.2 | Crop Up Metalosate | 96 | 1.8 |
| 4. | Crop Up Metalosate<br>K Metalosate | 96<br>32 | 7.2<br>2.4 | Crop Up Metalosate<br>K Metalosate | 96<br>32 | 7.2<br>2.4 |
| 5. | K Metalosate | 96 | 7.2 | K Metalosate | 96 | 7.2 |
| 6. | Multimineral | 64 | 4.8 | Multimineral | 64 | 4.8 |
| 7. | Foliar $K_2O$** | 4.4 lb | 4.9 kg | Foliar $K_2O$** | 4.4 lb | 4.9 kg |

*Foliar $P_2O_5$ was derived from monopotassium phosphate.
**Foliar $K_2O$ was derived from ESP, a liquid potash product made from potassium sulfate.

Treatment 2 was based on tissue samples taken before first bloom and again 3 weeks later, for tomato, and at first square and again three weeks later, for cotton, in an attempt to tailor the treatment to best meet the nutritional needs of the crop. In total, three tissue samples and one soil sample were taken for this test. The results of the early season (before planting) soil test was the basis for the potash sidedress application of 150 lbs/A (168 kg/ha) noted above.

Two foliar applications were made, at early bloom and again about 4 weeks later . Foliar applications were done with a hand held Solo backpack sprayer and a flat-fan nozzle tip. Each row within the plot was sprayed. Plots were hand harvested August 13, 1998, by sampling the center 10 feet (3 meters) from each plot in tomatoes, and 17.4 feet (5.3 meters) from each plot in cotton. Tomatoes were separated into red, green, and culls, and weighed in the field. On August 18, red tomato samples were taken to run quality analysis. Fruit taken from individual replications were combined to form one composite sample per treatment, then taken to a certified grading station for pH, color, and soluble solids determination. Cotton plots were hand harvested and weighed in the field. A six-pound (2.7 kg) sample was sent to a research cotton gin for gin turnout and lint percent determinations. Quality characteristics are being determined.

Plot yield data were analyzed using PROC ANOVA (SAS Institute) for the analysis of variance, and Duncan's Multiple Range Test was used for mean separation. Because quality data were composite samples, statistical analysis was not performed on tomato color, soluble solids, or yield of soluble solids.

## SUMMARY FOR TOMATO

This was not a normal year for California weather in the San Joaquin Valley due to the effects of El Niño. The abnormally cool and wet spring delayed planting and resulted in slow early season growth. Fusarium and Verticillium Wilt were suspected and may have reduced average yields.

Results of soil and tissue analysis are presented in Table 2. The results from the June 18 sample were used to determine the spray protocol for treatment 2, whereas the results from the July 17 sample date were used to determine the second application protocol for treatment 2 (Table 1). Compared to University of California Cooperative Extension guidelines for tissue analysis on tomatoes, N and P were within the sufficiency range at all sampling periods, but K was always deficient. This in spite of the additional K sidedressed and foliar applied. Treatment 2 appeared to have little effect on nutrient concentrations in the leaves and petioles at the time of the last tissue sampling (July 17). The high levels of Fe and Al after the first sampling event were because the grower applied fungicides during this time.

Yield data showed no significant differences among treatments for reds, greens, or culls at the 90% or 95% probability (Table 3). Though not significant, three Albion treatments and the ESP treatments did improve yields by nearly 10 tons per acre (22 tonnes/ha) over the untreated control. Treatment 4 (Crop-Up plus Potassium Metalosate) was the best treatment, giving the highest average yield and the highest soluble solids content of 6.0%. Yield of soluble solids for treatment 4 was double that of the untreated check.

At the contract rate this year of around $55 per ton ($60 per tonne), the average yield for the three highest yielding Albion treatments (treatments 4, 2, and 6; 32.3 ton/A, 72.5 tonne/ha) would give a gross return of $1778.33/A ($4392.48/ha). The control treatment would return $1221.00/A ($3015.87/ha). Since the cost of the spray materials is not known, the net difference can not be calculated at this time.

One of the objectives of this trial was to determine if a tailored spray program would be better than blanket coverage with a multimineral analysis. The results from this study suggest that while Albion's recommended spray protocol (treatment 2) was somewhat effective in increasing yields, it was not substantially better (or worse) than simply applying a pre-mixed, multinutrient solution such as Multimineral Metalosate.

Another objective was to determine if Albion's particular method of chelating potassium with amino acids was superior to that of potassium applied in its ionic form as potassium sulfate. In this test, ESP yielded 32.3 tons/A (72.5 tonne/ha), whereas K Metalosate alone yielded 27.5 tons/A (61.7 tonne/ha). These values are not significantly different. However, these results are difficult to compare, as 4.4 lbs/A (4.9 kg/ha) of $K_2O$ were applied with each application of ESP, but only 2.7 lbs/A (3.0 kg/ha) $K_2O$ for K Metalosate. Because of this, no determination of the advantage of amino acid chelation can be drawn.

## SUMMARY OF COTTON

Since analyses of the soil samples from the field to be planted to cotton were very similar to the tomato soil samples, it was decided to use the same treatments of Albion Laboratories Metalosate materials for treatments.

A number of parameters were measured during the growth of the cotton crop. Table 4 shows the Analyses of Variance for nine of the growth characteristics that are of interest. There were significant differences among the means of the average number of fruiting branches with the treatment of 3 quarts/A (7.2 L/ha) Crop-Up giving the highest numeric value. Although not significantly different, the same treatment resulted in the highest values for numbers of total bolls, average number of fruiting branches, plant height, total bolls per plant, and number of first position bolls. Treatments were superior to the untreated control in all categories.

Table 5 shows the lint yields resulting from the Metalosates treatments. There were no significant differences among lint means.

## CONCLUSIONS

In conclusion, the results from this experiment show that yields were improved through foliar applications of nutrients to processing tomatoes at first bloom and first fruit set. Best yields were obtained with K Metalosate combined with Crop-Up, however, these yield increases were not significantly different than the untreated control or any of the other treatments. The yield results combined with the lab data suggest that potash may be limiting in this field, and that foliar applications of this nutrient are a viable way to improve yields.

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**Table 2.**
**Metalosates Foliar Nutrients On Processing Tomatoes**

**Soil and Tissue Analysis**

| Sample | Date | Treatment | NO3-N | S | P | K | Ca | Mg | Na | Zn | Mn | Fe | Cu | B | E.C. | CEC | OM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | ppm | | | | | | dS/cm | meq | % |
| Soil | 1-Apr-98 | Field | 28 | 2 | 68 | 130 | 2348 | 391 | 105 | 2 | 4 | 18 | 0.9 | 1.4 | 0.6 | 15.7 | 2 |
| | | | **N** | **S** | **P** | **K** | **Ca** | **Mg** | **Na** | | **NO3-** | **Fe** | **Al** | **Mn** | **B** | **Cu** | **Zn** |
| | | | | | | % | | | | | | | | ppm | | | |
| **Leaf and petiole** | 4-Jun-98 | Composite 1 | 5.30 | 0.82 | 0.61 | 2.18 | 3.70 | 0.55 | 0.41 | | 5462 | 167 | 262 | 35 | 60 | 160 | 38 |
| | | Composite 2 | 5.40 | 0.82 | 0.65 | 2.17 | 3.44 | 0.53 | 0.38 | | 4097 | 144 | 118 | 34 | 52 | 113 | 38 |
| **Leaf and petiole** | 18-Jun-98 | Composite | 5.50 | 0.96 | 0.53 | 1.66 | 2.49 | 0.73 | 0.28 | | 1956 | 1095 | 1752 | 42 | 37 | 18 | 26 |
| **Leaf and petiole** | 17-Jul-98 | Control | 4.60 | 1.14 | 0.45 | 1.5 | 2.75 | 0.74 | 0.35 | | 1429 | 406 | 521 | 60 | 75 | 15 | 35 |
| | | Albion (Trt. 2) | 4.40 | 1.36 | 0.38 | 1.45 | 3.28 | 0.88 | 0.58 | | 1336 | 405 | 529 | 72 | 81 | 26 | 46 |

Composite samples: 30 - 40 leaf and petioles randomly selected throughout test

**Table 3.**
**Metalosate Foliar Nutrients on Processing Tomatoes**
**Yield and Quality Data**

| | Treatment | Reds | | Greens | | Culls | | pH | LED | Brix | SS Yield | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | T/A | MT/ha | T/A | MT/ha | T/A | MT/ha | | Color | (SS) | T/A | MT/ha |
| 4. | Crop Up & K | 32.8a | 73.5a | 10.12a | 22.68a | 3.07a | 6.88a | 4.29 | 22 | 6.00 | 1.97 | 4.41 |
| 7. | Foliar $K_2O$ | 32.3a | 72.4a | 14.36a | 32.18a | 3.12a | 6.99a | 4.35 | 24 | 4.35 | 1.41 | 3.16 |
| 2. | T.E.A.M. | 32.2a | 72.2a | 8.32a | 18.64a | 2.81a | 6.30a | 4.31 | 22 | 4.31 | 1.39 | 3.11 |
| 6. | Multimineral | 32.0a | 71.7a | 10.28a | 23.04a | 2.35a | 5.27a | 4.33 | 22 | 5.70 | 1.82 | 4.08 |
| 5. | K Metalosate | 27.5a | 61.6a | 11.83a | 26.50a | 3.19a | 7.15a | 4.30 | 23 | 4.30 | 1.18 | 2.64 |
| 3. | Crop Up | 25.2a | 56.5a | 9.93a | 22.25a | 3.39a | 7.60a | 4.35 | 21 | 4.35 | 1.10 | 2.46 |
| 1. | Control | 22.2a | 49.7a | 11.64a | 26.08a | 4.01a | 8.99a | 4.27 | 22 | 4.27 | 0.95 | 2.13 |
| | | | | | | | | | | | | |
| | Average | 29.17 | 65.20 | 10.92 | 24.47 | 3.13 | 7.01 | 4.31 | 22.29 | 4.75 | 1.40 | 3.14 |
| | LSD 0.05 | 11.32 | 25.37 | 10.50 | 23.53 | 3.33 | 7.46 | | | | | |
| | LSD 0.01 | 9.34 | 8.16 | 8.66 | 19.41 | 2.75 | 6.16 | | | | | |
| | CV | 26.12 | | 64.67 | | 71.47 | | | | | | |

Note: See Table 1 for a more detailed description of the treatments.
pH: pH of red fruit, composite sample from all plots within each treatment.
LED Color: Measure of red color using an LED analytical spectrometer. Lower numbers are deeper red.
Brix (SS): Measure of the soluble solids content, composite sample.
LSD: Least significant difference need at the 90 and 95% probability levels to call adjacent means significantly different. Means followed by the same letter are not significantly different using Duncan's Multiple Range Test. This test was not performed on the quality data because the samples were composite.
CV: Coefficient of variation.

**Table 4.**
**Cotton Plant Characteristics During Growing Season**

| Metalosate Treatments | Total Bolls | Fruiting Branches | Plant Height in | Plant Height cm | Height to Node Ratio | Bolls per Plant | First Position Bolls |
|---|---|---|---|---|---|---|---|
| Control | 37.2 | 10.7a | 33.4 | 84.8 | 2.0 | 7.5 | 10.1 |
| K, Cu, Mn, Zn | 40.0 | 11.9ab | 33.3 | 84.6 | 1.8 | 8.0 | 10.2 |
| Crop Up | 43.8 | 12.1ab | 35.2 | 89.4 | 1.9 | 8.8 | 11.5 |
| Crop Up + K | 39.0 | 11.6abc | 34.0 | 86.4 | 1.9 | 7.6 | 10.5 |
| K Metalosate | 40.0 | 11.2 b | 34.3 | 87.1 | 2.0 | 8.0 | 10.5 |
| Multimineral | 39.0 | 11.4 b | 33.0 | 83.8 | 1.9 | 7.8 | 10.8 |
| Foliar $K_2O$ | 39.3 | 11.6 c | 34.5 | 87.6 | 1.9 | 7.9 | 10.3 |
| LSD (0.05) | ns | 2.9 | ns | ns | ns | ns | ns |
| CV (%) | 16.4 | 4.8 | 4.2 | 10.7 | 4.7 | 16.3 | 7.8 |

**Table 5.**
**Cotton Lint Yields**

| Metalosate Treatments | Yield Pounds per Acre | Yield Kilograms per Hectare |
|---|---|---|
| Untreated Control | 932.3 | 1044.5 |
| K+Cu+Mg+Zn Metalosates | 1038.5 | 1163.5 |
| Crop Up | 852.4 | 955.0 |
| Crop Up + K Metalosate | 974.3 | 1091.6 |
| K Metalosate | 935.9 | 1048.6 |
| Multimineral | 963.8 | 1079.8 |
| Foliar $K_2O$ | 960.9 | 1076.6 |
| LSD (0.05) | ns | ns |
| CV (%) | 11.6 | 11.6 |

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