Mineral Salts: An Innovative Approach for *Varroa* Control

Project No.: **09-POLL7-Ahumada/Wardell**

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Objectives:

Our main research objective was to combine the more effective mineral salt treatments from the previous research and study their synergetic effect on mite treatment and the colony in general. Along with mite data collection, we monitored queen egg laying activity, brood survivorship, adult population and colony health. The mineral salts tested were: Magnesium Gluconate and Potassium Citrate dissolved in 1:1 ratio of High Fructose Corn Syrup (HFCS) and tap water (H_2O).

The project objectives are as follows:

1. Field treatment application to determine the effect of single salts and salts combinations on *Varroa*.
   Mite monitoring
   1. Mite drop method.
   2. Mite cell infestation levels.
2. Determine the effect of single salts and salts combinations on the colony during the field trial.
   a) Queen egg laying activity.
   b) Brood survivorship.
   c) Adult population.
   d) Bee Behavior.

Interpretive Summary:

The present proposal is a continuation of the investigation described above. During the first year of the research the solubility of the mineral salts was tested and *in vitro* cage studies were performed to determine toxicity levels and the appropriate concentrations for the *in vivo* feeding trials. Once the feeding concentrations were determined *in vitro* for each mineral salt, the field feeding trial was performed and run for 5 weeks. Treatment colonies showed a drastic decreasing number of mites over the treatment period. For a complete report on the results obtained on phase I please refer to 2008-2009 Final Reports on CD (Project 08-POLL7-Ahumada/Wardell) included with the Proceedings.

Salt treatment solutions and control were administered once per week followed by weekly mite counts in all colonies, including control. A total of 20 colonies were used on the trial divided into 5 colonies per treatment.

The treatments consisted of:

1. Magnesium Gluconate at 0.5% concentration dissolved in 1:1 ratio of High Fructose Corn Syrup (HFCS) + H_2O
2. Potassium Citrate at 0.5% concentration dissolved in 1:1 ratio of HFCS + H_2O
3. Magnesium Gluconate + Potassium Citrate at 0.5 % final concentration (obtained from 0.25% of both salts) dissolved in 1:1 ratio of HFCS + H_2O
4. Control solution of 1:1 ratio of HFCS + H_2O without mineral salts.

Mite Monitoring:

Each colony on both treatment and control was monitored over a period of six weeks and mite counts in all colonies were performed using the sticky board method. The sticky boards were placed in the colonies weekly and retrieved after 3 days upon time the mite counts were recorded. Following 5 weeks of treatment, all the colonies received an Apistan strip to drop the remaining mites and assess a total mite count. The results obtained from the treatments are shown in **Figures 1 through 3**.

Figure 1. Average Mite Drop on Colonies Treated with Potassium Citrate at 0.5% Concentration

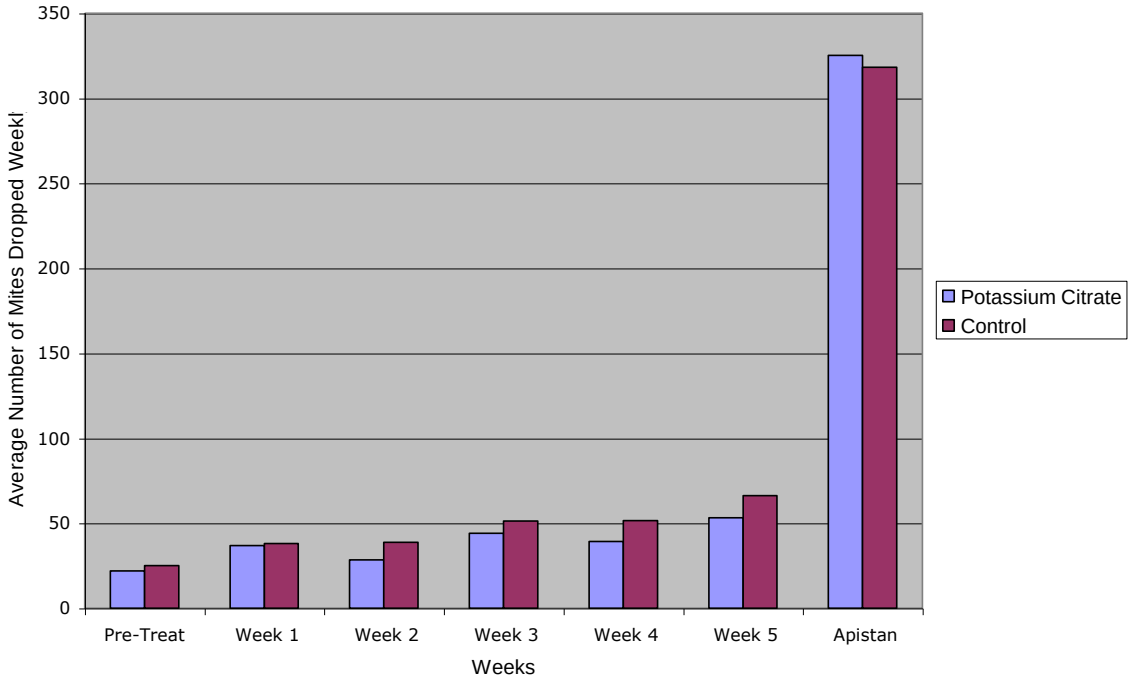


Figure 2. Average Mite Drop on Colonies Treated with Magnesium Gluconate at 0.5% Concentration

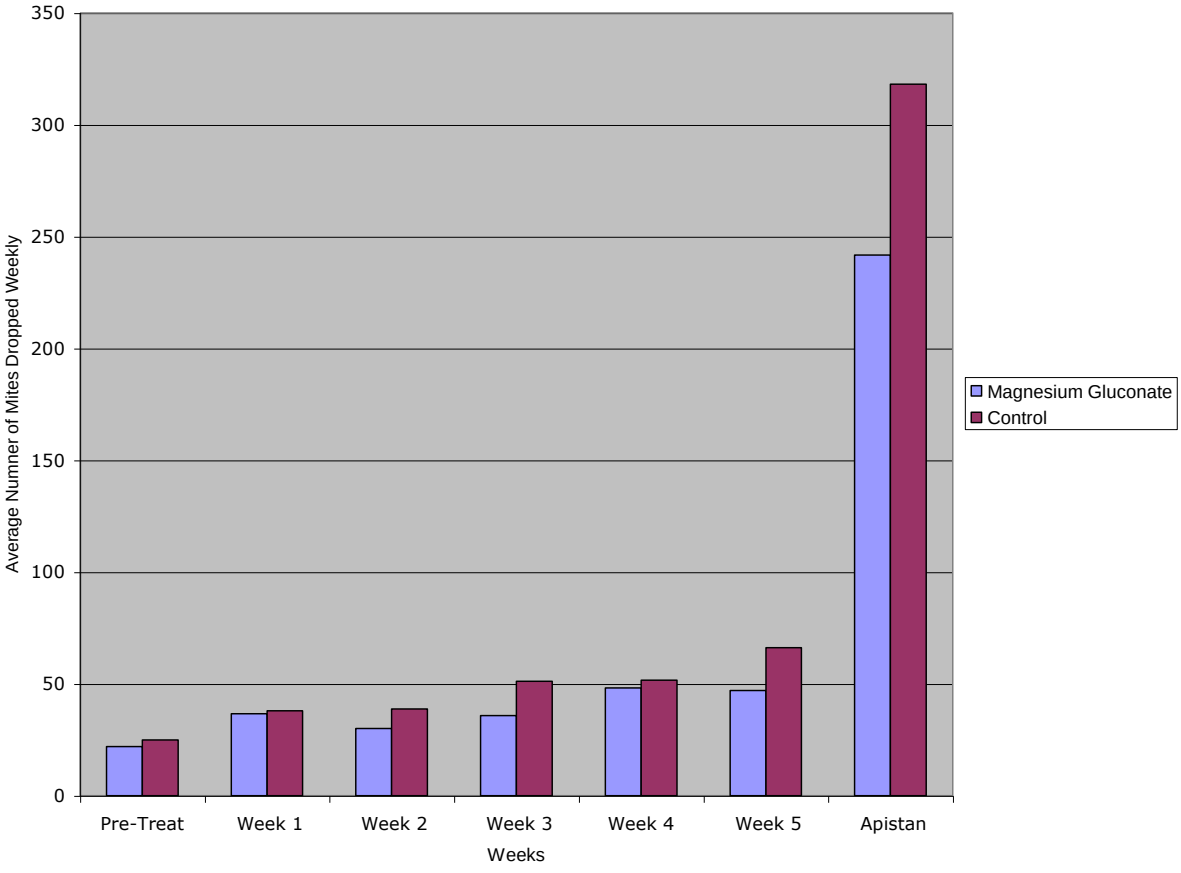
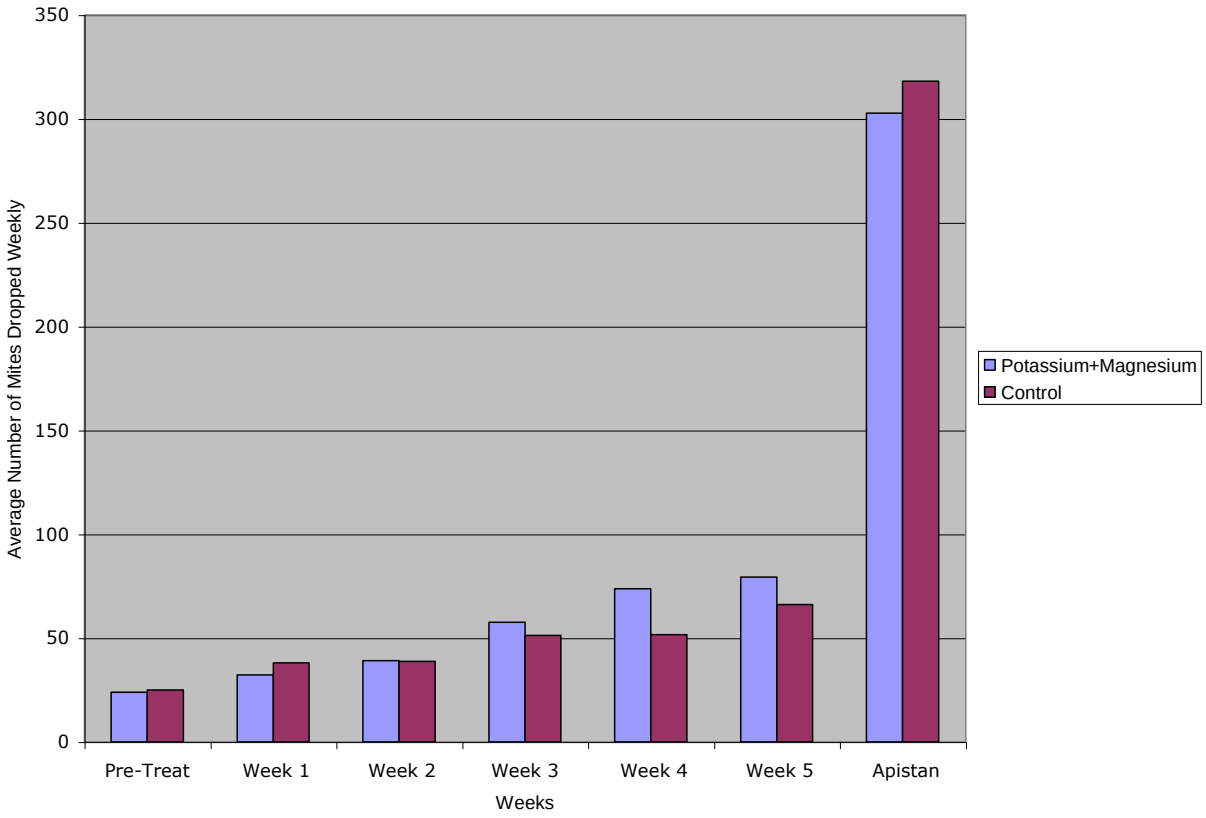


Figure 3. Average Mite Drop on Colonies Treated with Potassium Citrate-Magnesium Gluconate Combination at 0.5% Concentration

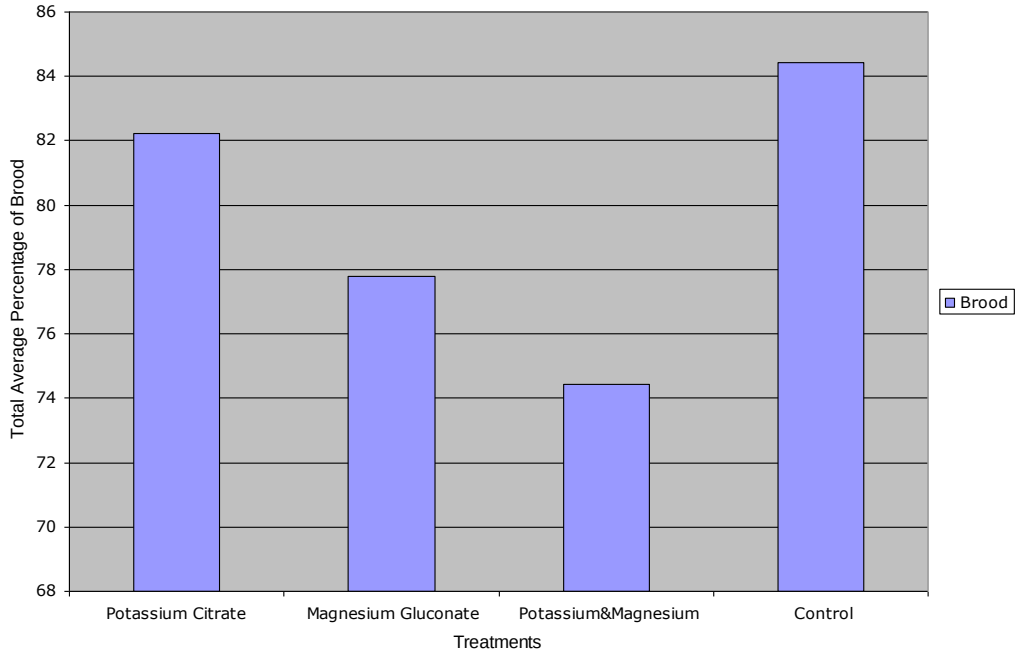


The graphs above show the effect of the treatments if any, on colonies fed single and a combination of mineral salts over 5 weeks. A small increase on mite drop was seen on the combination of Potassium Citrate and Magnesium Gluconate when compared to the control and the single salt treatment. The Apistan strip clearly showed the difference on mite population after the treatments were applied and they can't be compared due to the nature of both applications. The Apistan strip is a contact application and the salt treatment a systemic application.

Brood Survivorship:

Treatment and Control colonies were monitored over the treatment period to determine if the mineral salts had an effect on queen egg laying as well as on brood survivorship. Three colonies were selected at random for each of the four treatments: Potassium Citrate, Magnesium Gluconate, Potassium Citrate + Magnesium Gluconate and Control with a total of twelve colonies. Brood measurements were taken at three intervals during the study: egg to 4 day-old larvae, 8 day-old larvae and purple eye pupae. Data collected from each of the colonies at the mentioned brood stages was recorded as "square inches of brood" that was analyzed and compared. The results obtained from the study are shown on **Figure 4.**

Figure 4. Average Percentage of Total Brood Survivorship



The initial brood data recorded was strong throughout the colonies and as the weeks progressed the decrease on square inches of brood was observed in the treatment colonies. The average percentage of brood survivorship shown on the graph above clearly shows that the most drastic effect was observed on the Potassium Citrate+Magnesium Gluconate treatment with a final brood survivorship of 74.5%. The second largest reduction was Magnesium Gluconate with 77.8% square inches of brood. In the case of Potassium Citrate and Control there were not significant differences among the average percentage of brood survivorship.

Conclusion:

The delivery of the treatments through the systemic application at 0.5% mineral salt did not have an impact on the mite population. The brood survivorship was negatively affected by the treatments and the most negative was the combination salt. Overall, we can conclude that the mineral salts tested did not provide an effective mite treatment over time and can harm the brood if not applied properly.

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