
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 most 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 (H₂O).

The project objectives are as follows:

1. **Field treatment application to determine the effect of single salts and salts combinations on *Varroa*.**
 - a) 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 research project and experimental design is a continuation of the investigation described above. During the first year the focus of the research was to test the solubility and determine toxicity levels of the mineral salts *in vitro*. Once the feeding concentrations were determined for each mineral salt, the *in vivo* field feeding trial was performed and run for five weeks.

Treatment colonies showed a decrease in 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 included in the Proceedings CD.

Materials and Methods:

The mineral salts Magnesium Gluconate and Potassium Citrate were used in the trial. The salts were dissolved in 1:1 ratio of High Fructose Corn Syrup (HFCS) and tap water (H₂O) and fed to the colonies during the five weeks period. A blank solution of HFCS and H₂O only was fed to untreated control colonies.

Salt treatment and blank solutions were administered to the colonies once per week using plastic nuc top feeders. Mite population was monitored bi-weekly in all colonies including untreated control using the sticky board method. A total of 20 nucleus colonies were used on the trial divided into five colonies per treatment.

The treatments consisted on:

- Magnesium Gluconate at 0.5% concentration dissolved in 1:1 ratio of HFCS + H₂O
- Potassium Citrate at 0.5% concentration dissolved in 1:1 ratio of HFCS + H₂O
- Magnesium Gluconate + Potassium Citrate at 0.5 % final concentration (obtained from 0.25% of both salts) dissolved in 1:1 ratio of HFCS + H₂O
- Blank solution of 1:1 ratio of HFCS + H₂O without mineral salts

Results and Discussion:

Mite Monitoring:

Each colony on both treatment and control was monitored over a period of five 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 five weeks of treatment, all the colonies received an Apistan strip to drop the remaining mites and record 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

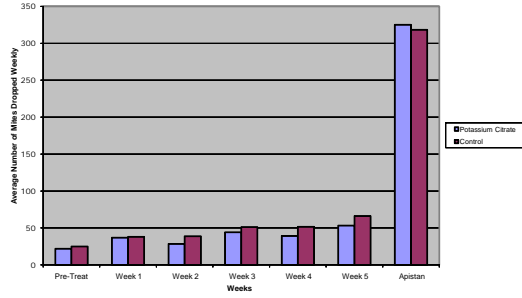


Figure 2. Average Mite Drop on Colonies Treated with Magnesium Gluconate at 0.5% Concentration

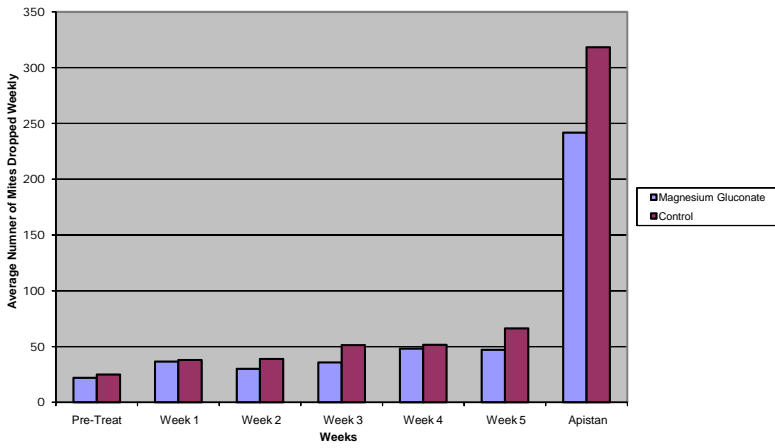
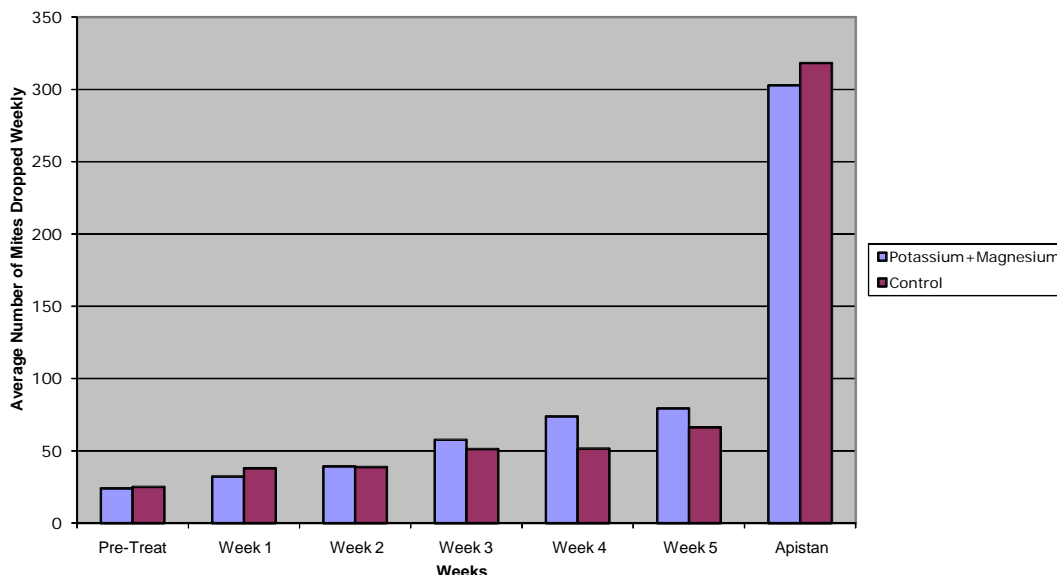


Figure 3. Average Mite Drop on Colonies Treated with Potassium Citrate-Magnesium Gluconate Combination at 0.5% Concentration

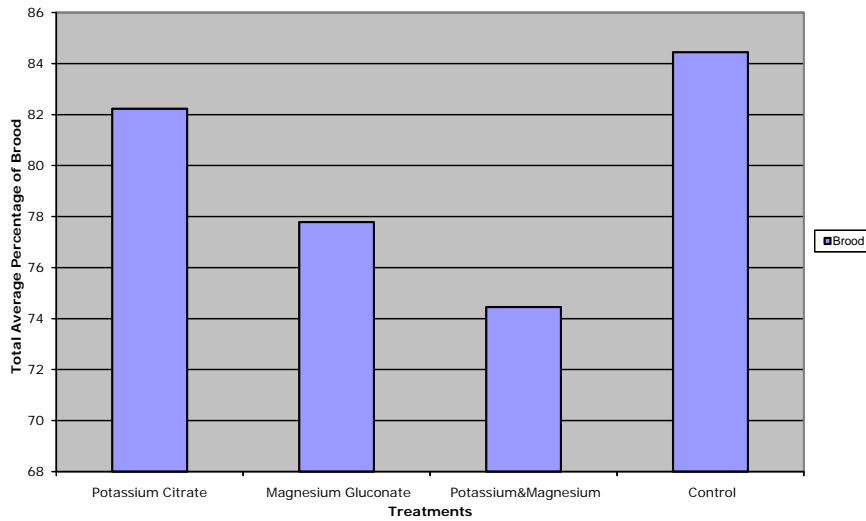


The graphs above show the effect of the treatments if any, on colonies fed single and a combination of mineral salts over five weeks. A small increase on mite drop was seen on the combination of Potassium Citrate and Magnesium Gluconate when compared to the control and the single salt treatment. The Apistan cleanup strip clearly reduced mite populations after the salt treatments were completed. Unfortunately the data can not 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 five weeks period to determine if the mineral salts had an effect on queen egg laying as well as on brood survivorship. Three colonies were randomly selected from each of the four treatments: Potassium Citrate, Magnesium Gluconate, Potassium Citrate + Magnesium Gluconate and Control making a total of twelve colonies. The queen was placed in a pushing cage and forced to lay eggs under that area. The queen was then released and 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 the most drastic effect was observed with the Potassium Citrate+Magnesium Gluconate treatment with a final brood survivorship of 74.5%.

Second largest negative impact on brood survivorship was Magnesium Gluconate with 77.8% square inches of brood. Brood survivorship on Potassium Citrate and Control was not significantly different than the control.

Conclusion:

The delivery of the treatments through the systemic application at 0.5% mineral salt did not have a significant impact on the mite population. The brood survivorship was affected by the treatment with the most notorious effect on the combination salt. Colony behavior on treated and control colonies was not affected by the treatments. Overall, we can conclude that the mineral salts tested did not provide an effective mite treatment over time and can have a negative effect on the brood and the colony.

Research Effort Recent Publications:

The results have not yet been published.

References Related to this Research:

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