ZADCO FOR QUALITY GRO P/L

BIOMIN CALCIUM TRIAL ON PINK LADY APPLES

ROLE OF BIOMIN CALCIUM IN THE PRODUCTION OF PINK LADY APPLES COMPARED TO A STANDARD CALCIUM CHLORIDE PROGRAM.

WRITTEN BY

ASMA ROUHANA (HORTICULTURIST/ VITICULTURIST)

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Calcium Nutrition of Tree Fruit using Biomin™ Calcium and Calcium Chloride

CALCIUM DEFICIENCIES AND BIOMIN CALCIUM

Global competition is increasing the pressure on agriculture to produce higher quality, affordable food products. The grower who prospers in the future must use their resources productively, manage their risks wisely, and maximize their returns on the investments in their crop.

Partially due to the above factors, for many years, there has been increasing interest in the use of Calcium foliar sprays because of the effect Calcium has on fruit quality and shelf life.

Calcium is an extremely important element in maintaining the strength of stems and stalks of plants. This mineral also regulates the absorption of nutrients across cell membranes. Calcium plays an important role in plant cell elongation and division, structure and permeability of the cell, nitrogen metabolism and carbohydrate metabolism[1]. Calcium is nontoxic, even in high concentrations and serves as a detoxifying agent by tying up toxic compounds and maintaining the cation-anion balance in cells. Further to this, Calcium is part of the cell wall and acts as the cement that binds the cell walls together it is one of the most significant factors affecting firmness and storage life of fruit.

There are a myriad of different formulations of Calcium available to growers with Calcium Chloride being amoung the least expensive and most commonly used. Biomin Calcium is a true chelate produced by J.H Biotech, Inc. which was specifically designed for use on plant crops. However, the methods of delivery of this element are not conventional, like the delivery methods of products such as Calcium Nitrate and Calcium Chloride. The latter products can marginally reduce a Calcium deficiency, but the speed by which the Calcium released from these products and transported into the growing points (such as fruit) is very slow compared to the transportation of the associated ions such as the nitrate or chloride components of these products which have negative effects on fruit quality.

Biomin Calcium is the only product on the market that can effectively and economically deliver Calcium to the growing points of the crop without the risk of phytotoxicity. Biomin Calcium is a Glycine chelated product. This means that every Calcium ion is bonded with two Glycine molecules creating a fully chelated Calcium product. The plant recognizes this molecule as a proteinaceous molecule allowing it to travel in the phloem instead of forcing it to use the xylem where Calcium is normally transported. This allows the Calcium to be a mobile element in the Glycine chelated form. This is the edge Biomin Calcium has over all other products existing in the marketplace.

AIM

The purpose of this trial was to compare Calcium levels in tree fruit production, both in the leaves and in the fruit; however, leaf levels never give a true indication of potential fruit Calcium content. Further to this, comparisons of fruit firmness between Biomin Calcium treated apples and Calcium Chloride treated apples are made in order to ascertain the benefits of using foliar Calcium products and their effects on fruit firmness and fruit Calcium content.

Nutrient Balance was also monitored to see if this has an effect on Calcium uptake.

MATERIALS AND METHODS

One block of Pink Lady apples was split into half and a leaf analysis was conducted before any fertiliser applications were made to ascertain the requirements of the trees and to assess the nutrient balances of elements.

A program was designed by Zadco for Quality Gro for the treated block. The Control block was the standard program used by growers in the Shepparton region.

Four applications of Biomin Calcium were applied to the treated blocks. Foliar applications of K-Forte, Synergizer and Biomin Iron were also accessory products used to better balance the elements in the trees.

Programs and leaf results detailing timing and applications rates are attached in report annex.

RESULTS

The two treatments compared gave very good indications as to how different formulations of Calcium react within the tree as well as the amount of absorption into the leaves as well as the fruit.

FRUIT ANALYSIS COMPARISONS

Element Analysis	Control (Calcium Chloride)	trial (biomin calcium)
Nitrogen (mg/100g)	27.9	29.7
Phosphorous (mg/100g)	11.4	11.5
Potassium (mg/100g)	97.0	92.5
Calcium (mg/100g)	4.8	4.7
Magnesium (mg/100g)	5.97	6.02
Boron (mg/100g)	0.27	0.29
Zinc (mg/100g)	0.09	0.08
Copper (mg/100g)	0.02	0.03
Manganese (mg/100g)	0.04	0.09
Sulphur (mg/100g)	14.1	13.3
K+Mg / Ca	21.45	20.96
K/Ca	20.21	19.68
K/N	3.48	3.11
N/P	2.45	2.59
N/Ca	5.81	6.33
Mg/Ca	1.24	1.28
Average Weight (grams)	177.6	166.5

Table 1 indicates the fruit analysis conducted by the Mega Lab from both blocks. The control was treated with Calcium Chloride as the predominant calcium application and the trial block was only treated with Biomin Calcium (an amino acid chelate).

Tests conducted on fruit samples sent to the Mega lab for the trial block indicate the following:-

- Nitrogen levels are quite good, however need to be looked at relative to the levels of Calcium found.
- Phosphorous level is very good for storage capacity of fruit. For fresh market fruit, the ideal Phosphorous levels have not been quantified.
- Potassium levels are adequate at 92.5. The higher the Potassium level, the more sugars, more acids and better fruit development. Fruit Brix readings will better

determine the sugar content of the fruit as a determination of maturity and harvest dates (found below).

- Calcium levels are determined to be slightly low by the Mega lab, however fruit firmness readings will better indicate the benefits of this Calcium reading (found below).
- Magnesium levels in the fruit are slightly higher than the control block and this may have a slightly antagonistic effect on Calcium and Potassium levels, however for overall fruit quality, Magnesium levels need to be slightly lower.
- Boron levels have been determined as slightly low by the Mega lab, however Boron will only determine fruit shape as a quality issues. The effects of lower fruit Boron levels will be better interpreted through fruit shape assessment.
- Other trace elements such as Zinc, Manganese, and Copper levels are not parameters determining fruit quality and are more directly related to mineral interactions and tree leaf levels.

The fruit analysis levels of elements indicate the following virtually the same results as the trial block. Analytically, there are very few differences between the two blocks treated. Based on the parameter of Calcium, the control block had 4.8mg/100g of Calcium compared to the trial block which had 4.7mg/100g of Calcium.

There is virtually no difference between the two Calcium treatments in terms of Calcium content of fruit, however Biomin Calcium was applied 4 times at 2kg/ha each time, totaling 8kg/ha and the Calcium Chloride formulation was used 8 times at a total of 37.5L/ha plus 20.25kg/ha. A combination of both liquid Calcium Chloride and Calcium Chloride flakes were used on this control block.

The total inputs of Calcium were higher in the control block, and the total inputs did not give a higher reading of Calcium in the fruit as would have been desired by the higher input of Calcium.

BRIX LEVELS AND PRESSURE READINGS

Product Name	Brix level	Firmness / Pressure	Fruit Calcium Content
Calcium Chloride (Control Block)	15.33	7.42	4.8 mg/100g
Biomin Calcium (Trial Block)	16.33	8.83	4.7 mg/100g

Table 2: Comparison of Calcium Chloride to Biomin Calcium for fruit quality.

DISCUSSION

Calcium is one of the most important elements in apple fruit production and fruit quality. The difficulty is supplying sufficient Calcium to the fruit is an integral point to ensure an adequate content of this element is supplied for harvest and cold storage of fruit.

Fruit nutrient absorption and accumulation is an interesting technique to manage and to improve the nutritional status of fruit trees in order to achieve the best nutrient balance and to reach a better quality product. Calcium is one of the most significant elements in fruit tree nutrients, but it is traditionally very difficult to accumulate enough in the fruit because it has low mobility in the tree. Although fruit Calcium accumulation is a continuous process, the intensity of that accumulation is highest during the first part of fruit development and it decreases during the second part of the season. However it is important to note that the accumulation of other elements is low early in the season and it increases during the middle of the season and final part of fruit development.

Calcium accumulation is affected by physiological internal factors as well as cultural practices. There are many cultivation and environmental factors that may affect the Calcium content of apple fruit at maturity. Knowledge of fruit tree nutrient supply is a good tool in order to get an adequate nutrient balance, to improve fruit quality and to have better economical results.

Calcium content in fruit is a very important attribute contributing to fruit quality however one of the most underestimated ratios is the (K+Mg)/Ca. The higher this ratio is the more fruits are predisposed to physiological disorders such as lenticel breakdown and bitter pit. Cation balance is very important because while the fruit Calcium absorption remains low and constant, other nutrients like Potassium (K), Magnesium (Mg) and Nitrogen (N) are highly absorbed by the fruit, particularly late in the season, contributing to a dilution in Calcium. Trees receiving a balanced nutrient program (treated) had a lower (K+Mg)/Ca than the control, meaning that fruit cation balance was better, resulting in lower susceptibility of this fruit to physiological disorders.

The results clearly indicate that the leaf tissue levels of Calcium which are required to decrease physiological disorders are usually higher than the concentrations that the fruit normally accumulates. Fruit Calcium levels can vary from year to year, between orchards, between fruit on the same branch and within the apple fruit itself.

Calcium accumulation within the plant and fruit is generally associated with the formulation of product applied and the cultural practices. Crop load and fruit size are important elements affecting Calcium accumulation, the positioning of fruit within the tree, the number of seeds per fruit and the effects of summer and winter pruning. This is why Calcium accumulation is not just about product, it is about a management technique. Growers should conduct cultural practices which promote Calcium uptake and distribution such as sound irrigation practices, summer pruning and controlled Nitrogen fertilization.

Further to this, the use of a high quality, bioavailable Calcium will aid in reducing labour and improve Calcium uptake and nutrient balance. Bioavailability is important because all nutrient intake must be available to the plant for growth and maintenance of tissues, reproductive organs and other performance factors. The treated block where Biomin Calcium was used, showed better tree balance of elements, almost equivalent levels of Calcium in the trees and overall better fruit quality.

The trial patch was picked on the 20th April 2003, 9 days earlier then the control. As can be seen above, the trial block had higher pressure readings. As a percentage increase, the trial block was 19% firmer than the control block on the same date. The Brix was 1 Brix higher for the trial block as compared to the control. The difference as a percentage was 6.5% more sugars in the trial block as compared to the control. There is more of a significant difference between firmness readings and the 19% difference is very significant favouring the Biomin Calcium application.

Further to this however is that the Brix was also higher in the trial block. As had been illustrated in previous years when Biomin Calcium was used in conjunction to a balanced nutrient program advised by Zadco, the brix has always been higher in the trial block compared to the control, and the firmness was significantly different also.

This indicates that the Biomin Calcium has the capacity to improve fruit firmness, despite increases in sugars which typically indicates maturity of fruit. Generally as brix levels increase, firmness slightly decreases, however the converse has occurred in the trial block.

It is worthy to note that on the 21st April, Calcium Chloride was applied to the control block. By this stage, the trial block had already been harvested. Obviously based on the firmness readings, it was determined that further Calcium was required to increase the firmness of the fruit, as it was not as high as the trial block.

According to visual assessment of the fruit, there were no significant differences in fruit colour between the two blocks. However it is best to determine the returns obtained from harvesting the trial block 9 days earlier than the control block and the quality parameters achieved by the use of Biomin Calcium in combination with a balanced nutrient program.

The additional 9 days the control fruit were left on the tree would have possibly allowed time for the fruit to further increase in Brix, however if pressure readings were taken at the time of harvest for the control, it would have been a true indication of final fruit quality levels compared to the trial block.

Therefore, it is undoubtedly evident that the results displayed through the use of Biomin Calcium as compared to Calcium Chloride flakes are far superior and warrant a widespread look at the use of true amino acid chelates in tree fruit production. With a 19% increase in fruit firmness and a 6.5% increase in sugar content through the use of Biomin Calcium, fruit has undeniably better eating and storage capacity compared to standard treatments. Better nutrient balance was also achieved through the program designed by Zadco for Quality Gro

which further illustrates the importance of balanced nutrition in horticultural production as well as tree fruit production.

ANNEX