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By Hand

फा. सं. NRCG/PME/CR29/2016-17 /165
दिनांक: 11 जून 2018

प्रति
डॉ. अक्षय महेश भोसले
तकनीकी कार्यकारी (पश्चिम)
इंडोफिल इंडस्ट्रीज लिमिटेड
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To
Dr. Akshay Mahesh Bhosale
Technical Executive (West)
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Kalpataru Square, 4th Floor, Kondivita
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Andheri (E), Mumbai 400 059.

विषय: अनुबंध अनुसंधान परीक्षण "Evaluation of Ca metalosate on grapes" की अंतिम रिपोर्ट और स्वीकृति प्रमाणपत्र प्रस्तुत करने के बारे में

Sub: Submission of final report and Certificate of Acceptance of the contract research trial on "Evaluation of Ca metalosate on grapes"

महोदय Sir,

उपरोक्त अनुबंध अनुसंधान परीक्षण की अंतिम रिपोर्ट, दो प्रतियों में, इस पत्र के साथ संलग्न है। रिपोर्ट के लिए स्वीकृति प्रमाण पत्र की दो प्रतियां भी संलग्न हैं। हस्ताक्षर करने के बाद आपको एक कॉपी वापस करने का अनुरोध किया जाता है। अगर अंतिम रिपोर्ट के रिलीज़ होने के एक महीने के भीतर कोई जवाब नहीं मिला, तो यह माना जाएगा कि रिपोर्ट स्वीकार कर ली गई है और हम आपके किसी भी टिप्पणी या सुझावों को स्वीकार नहीं करेंगे जो आपके या तृतीय पक्ष द्वारा रिपोर्ट की किसी भी समीक्षा के कारण भविष्य में उत्पन्न हो सकती हैं।

Kindly find enclosed herewith, in duplicate, the final report of the above contract research trial. Two copies of Certificate of Acceptance for the report are also enclosed. You are requested to return one copy after signing. In case no reply received within one month of release of the final report, it will be considered that the report has been accepted and we will not accept any comment or suggestions that may arise in future on account of any review of the report by you or third party.

कृपया संबंधित शोधकर्ताओं द्वारा उचित पत्रिका में परिणाम के प्रकाशन के लिए आप अपनी सहमति भी व्यक्त कर सकते हैं।

You may also kindly convey your consent for publication of result in suitable journal by the concerned research workers.

भवदीय,
11-6-18
(सं.दी. सावंत)
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संलग्नक Encl.: उपरोक्त अनुसार As above

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मा.कृ.अनु.प
ICAR

Report on Contract Research Trial

on

To evaluate effect of Calcium metalosate on quality and yield of Grapes

Sponsored By

M/s Indofil Industries Ltd.

Conducted by

ICAR-National Research Centre for Grapes, Pune

2016 - 2017

PROJECT REPORT

Project Title : To evaluate effect of Calcium metalosate on quality and yield of Grapes

Conducted by : ICAR - National Research Centre for Grapes
Manjri Farm, Pune-Solapur Road, Pune – 412307
Phone :020-26956001, Fax :020-26956099

Conducted during : Oct., 2016 to Oct., 2017

Project Workers :

Dr. A. K. Upadhyay
Principal Scientist (Soil Science)

Dr S. D. Sawant
(Director)

To evaluate effect of Calcium metalosate on quality and yield of Grapes

1. Introduction

Grape being a non-climateric fruit is subject to serious physiological and parasitic disorders before and after harvest. Unseasonal rains play havoc at the time of harvest of grapes. Last few years have been tough for the grape growers of Nasik, Sangli and Pune where unseasonal rains and hails have destroyed the crop. The main issue being cracking of berries. The losses could be as high as 100%, thereby affecting livelihood of the farmers. The cracking occurs either from the distal end or from sides and not from the top where the berry is fixed to the pedicel. Matthews et. al. (1987) showed that skin extensibility remained relatively constant during Stage I of fruit growth when cell division is occurring. The same was also true for Stage II when growth is minimal. Observations by Considine *et. al.* (1979) indicate the berry skin's cell walls are thickening at this time. Matthews *et. al.* (1987) further reported a marked increase in extensibility at the beginning of Stage III, the period of rapid cell enlargement. At this same time, Considine et. al. (1979) observed that the berry skin cell walls became thinner, perhaps as a result of enzyme activity. Towards the end of Stage III, (two to three weeks before harvest) a rapid decrease in berry skin extensibility was observed by Matthews et. al. (1987). This "hardening-off" of the skin tissue may pre-dispose it to cracking should the berry experience a sudden change in water status.

Calcium is an essential and major plant nutrient, and is required as a divalent cation (Ca^{2+}) in a variety roles, such as structural function in the cell wall and membranes, as a counterion for inorganic and organic anions in the vacuole, as a cytoplasmic secondary messenger related to environmental or developmental stimuli to their physiological responses (Sugimura et al., 1999; White, 2001). Calcium moves in xylem, but is substantially immobile in phloem thus as xylem vessels become non-functional upon the transition to veraison, calcium transport within the berry ceases after this stage (During et al., 1987). Some studies indicate that Ca accumulates in grape berries throughout their development (Rogiers et al., 2000; Schaller et al., 1992), whereas others indicate Ca accumulation stops after Veraison stage (Cabanne and Doneche, 2001; Cabanne and Doneche, 2003). This shows that there is a possibility to augment Ca supply in the vines through external sources like foliar sprays.

Calcium regulates the ripening of fruits and stimulates their coloring, ethylene production and flesh firmness (Gerasopoulos and Richardson, 1999). Additionally, as a constituent of the cell wall, calcium plays an important role in forming cross-bridges which influence cell wall strength (Fry, 2004). Exogenous applied calcium, therefore stabilizes the plant cell wall and protects it from cell wall degrading enzymes which have major influences on firmness (White and Broadly, 2003). Thus, it slows ripening and softening of fruit flesh by lowering respiration rates and reducing ethylene production (Siddiqui and Bangerth, 1995).

Calcium metalosate is a chelated calcium formulation with amino acid. According to the manufacturers, the Metalosate formula bonds through a patented chelation process the calcium mineral to an amino acid creating the Metalosate Calcium Molecule. This molecule, with calcium at its core, is seen by the plant as an amino acid and can now move at the speed of nitrogen through the plant's phloem instead of the slower xylem route. The grape growers are using calcium chloride or Calcium EDTA as source of calcium to the vines. Calcium chloride is the most common source. Thompson Seedless and its clone are the most dominant variety in the country covering approximately 70% of the vineyards. Unseasonal rains during ripening period leads to berry cracking and hence, the farmers realizes lower returns from the sale of produce. Hence, keeping the above in view, an experiment was conducted at NRC Grapes to study the effect of Calcium metalosate formulation vis a vis calcium chloride and amino acid on calcium accumulation in berries, leaf and subsequently on yield and quality of Thompson Seedless grapes.

2. Material and Methods

The experiment was conducted on Thompson Seedless vines grafted on 110R rootstock, planted at 10 x 6 feet and trained on Y trellis system. The vines in general were uniformly fertilized with 108 kg N, 70 kg P_2O_5 and 108 kg K_2O on per hectare basis. The source of N were ammonium sulphate, for P_2O_5 it was SSP and phosphoric acid and for K_2O it was sulphate of potash. Before the start of the experiment soil samples were collected. Ten composite soil samples upto 30 cm depth were collected from different vine rows and analyzed for different chemical parameters. The vines were irrigated with canal water having pH 7.67 and EC 0.267 dS/m during the experimental period. The soils of the experimental area were clayey in texture. The fertility status of the soil is given in Table 1.

The Calcium metalosate formulation as three different treatments namely 2ml/ L, 3ml/L and 4 ml/L were compared with Control (No calcium application), Calcium chloride (solid powder) and Aminoacid. A total of six treatments were there. The treatment details are given in Table 2.

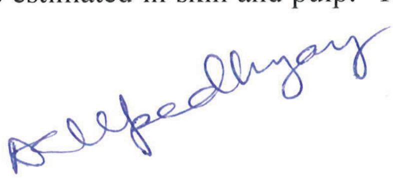
Table 1: Initial fertility status of soil

Soil parameters with unit	Test values
pH (1:2.5)	7.82
EC(1:2) dS/m	0.39
Extractable Chloride (ppm)	99.84
$CaCO_3$(%)	7.38
Org. C (%)	1.29
Av. N ppm	83.30
Av. P (ppm)	112.58
NH_4OAc Extractable K (ppm)	663.38
NH_4OAc Extractable Ca (%)	7583.50
NH_4OAc Extractable Mg (ppm)	3099.50
NH_4OAc Extractable Na (ppm)	648.44
DTPA extractable Cu (ppm)	8.51
DTPA extractable Fe (ppm)	5.93
DTPA extractable Zn (ppm)	7.14

Table 2: Treatment details

Treatment	Details
T1	Control – No Calcium spray
T2	Calcium metalosate – 2ml/L
T3	Calcium metalosate – 3ml/L
T4	Calcium metalosate – 4ml/L
T5	Amino acid (2ml/L)
T6	Calcium chloride – 2g/L (Standard dose)

The above treatments were sprayed five times during Fruit pruning season namely, Prebloom, Berry growth stage (4 mm berry size), Berry growth stage (8 mm berry size), Veraison and 10 days after Veraison. The spray volume was 200L. Observations on berry cracking, nutrient content in berries and yield and quality was recorded. Nutrient content in petioles was estimated during prebloom (2 days after application), flowering stage, 8-10 mm berry size (2 days after application), veraison and 10 days after Veraison (2 days after application). Calcium content in the berries was estimated at 10 days after Veraison (2 days after application) and at harvest. Separate calcium content was estimated in skin and pulp. The observations on berry cracking were recorded on actual



weight basis. The vines were harvested on 20th Feb., 2017 and yield and quality of the berries (TSS, Acidity) were recorded. Shelf life studies was also carried out after harvest in terms of physiological loss of weight (PLW) and berry firmness also recorded. In case of berry firmness studies, the selected bunches had non-significant differences in berry firmness at the initial stage. Resulting firmness was tested after PLW (%) was reached.

3. Results:

The yield and quality of the Thompson Seedless grapes are given in Table 3. The highest yield values were recorded in case of Treatment T4 (Calcium Metalosate @4 ml/L) which was on par with other calcium treatments and but significantly superior over T1 (Control) and T5 treatment were Amino acid was used. The yield is dependent upon a no. of factors and practices done during Foundation pruning season has direction bearing on bunch no. and yield in Fruit pruning season. The TSS and acidity did not differ significantly between the treatments. The 50 berry weight also showed that weight of bunches was significantly higher in T3 and T4 treatment over T1 (Control) and T5 (Amino acid) whereas all other treatments were on par. The berry size was significantly higher in Treatment T4 (Calcium Metalosate @4 ml/L) over T1 (Control), T5 (Amino acid) and T6 (Calcium chloride). No berry cracking was recorded in all the treatments. The weather conditions were not conducive as unseasonal rains were not recorded during the period of experiment. The physiological loss of weight which determines the shelf life of the crop differed significantly between the treatments at 4th day but were all below 5%. But after 5th day, all the treatments recorded shelf life more than 5% but treatment T4 where Calcium Metalosate (4 ml/L) was used had lower PLW than all other treatments. The increase in one day in shelf life will have significant bearing on the returns from the produce as the crop can be transported to distant markets for better price realization by the farmers. This could be clearly corroborated from the results of berry firmness studies which showed that berry firmness after 5 days of shelf life studies was significantly higher in treatment T4 where Calcium Metalosate (4 ml/L) was used. This suggests that the treatments have a role in increasing berry firmness and subsequently affecting PLW.

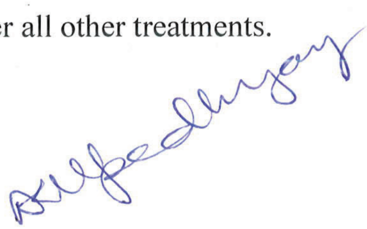
Table 3: Yield and quality of Thompson Seedless

Treatment	Yield (t/ha)	TSS (°B)	Acidity (g/L)	PLW 5% *		Berry Firmness%		50 berry weight (g)	Berry size (mm)
				Day 4	Day 5	Initial (0 day)	After (6^{th} day)		
T1	26.61	18.13	4.20	4.89	6.29	62.40	55.03	132.00	14.9
T2	28.19	18.00	4.05	4.75	6.00	62.03	56.60	134.00	15.6
T3	30.95	18.18	4.00	4.80	5.55	62.88	59.88	135.25	15.9
T4	31.39	18.08	4.05	4.44	5.22	63.08	61.43	137.50	16.3
T5	26.35	18.15	3.95	4.83	5.97	62.20	57.95	130.25	15.6
T6	29.93	18.10	4.05	4.75	5.97	62.45	53.93	136.75	15.7
SEm±	2.24	0.09	0.08	0.15	0.26	0.53	1.75	2.61	0.3
CD (p=0.05)	4.76	NS	NS	0.32	0.55	NS	3.74	5.56	0.6

* PLW – Physiological loss in weight. This was taken every day after harvest till such time the PLW was more than 5% of the weight.

Foliar application of calcium sources increased the calcium content in petioles vis a vis T1 treatment at all the stages of sampling (Fig. 1). In the petiole, application of Calcium metalosate increased calcium content in the petioles immediately after application as compared to T1 (Control) and T5 (amino acid application) treatment. All the calcium treatments had higher calcium contents over T1 and T5 treatment. The treatment T4 (Calcium Metalosate @ 4ml/L) was significantly superior over T1 and T5 treatments. Though on par with other calcium treatments, still it had higher calcium content in the petiole at all the growth stages. Infact, the Calcium metalosate treatment T3 and T4 led to higher calcium content in the petioles (Fig.1).

In case of berries, the calcium content in the whole berry declined after 10 days after veraison to harvest (Fig.2). These observations are similar to the findings recorded by Cabanne and Doneche (2001) and Cabanne and Doneche (2003) which states that calcium content in the berries decline after Veraison stage. This is because after Veraison, calcium absorption through berry skin declines drastically around lag phase as a consequence of loss in stomata functionality (Blanke and Leyhe, 1987; Rogiers et al., 2001). During et al. (1987) has shown that calcium moves in xylem, but is substantially immobile in phloem thus as xylem vessels become non-functional upon the transition to Veraison, calcium transport within the berry ceases after this stage. However, between the treatments, treatment T4 (calcium metalosate@ 4ml/L) recorded significantly higher calcium contents in the berries over all other treatments.



On segregating the berry into skin and pulp at harvest, highest Ca accumulation was recorded in skin as compared to pulp (Table 4). In skin, significantly higher Ca content was recorded in treatment T4 (calcium metalosate@ 4ml/L) over other treatments (Table 4). Similar results were observed in pulp. Increased calcium content suggests that higher Ca content might have been involved in stabilizing the plant cell wall thereby improving the berry firmness (Fry, 2004).

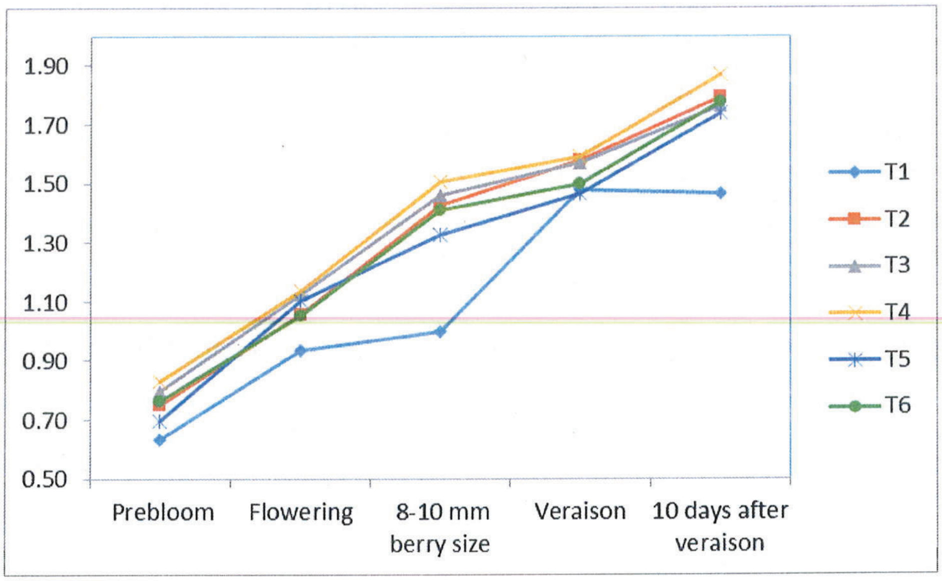


Fig.1: Variation in the calcium content in the petiole at different stages of sampling

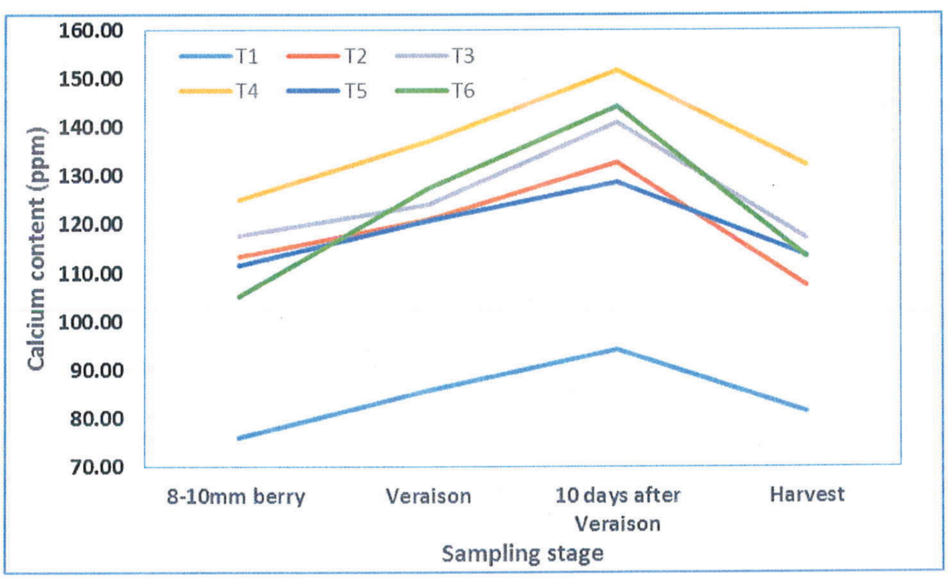


Fig.2: Calcium content in whole berry at different stage of sampling

Table 4: Calcium content (ppm) in berry skin and pulp of Thompson Seedless grapes

Treatment	Pulp			Skin		
	Veraison	10 days after Veraison	Harvest	Veraison	10 days after Veraison	Harvest
T1	58.19	33.88	42.81	195.63	160.78	112.03
T2	70.63	79.31	72.63	257.19	225.47	223.28
T3	73.20	86.31	71.63	265.94	290.31	224.06
T4	81.13	95.13	78.31	293.75	295.16	238.28
T5	69.56	68.82	62.58	272.50	253.75	210.00
T6	73.25	85.06	68.06	275.00	267.19	220.16
SEm±	2.80	2.56	2.88	4.39	12.84	4.45
CD ($p<0.05$)	5.97	5.46	6.13	9.35	27.37	9.48

Conclusion:

Calcium metalosate is a chelated calcium formulation with amino acid used for foliar sprays. Significantly higher yield were recorded in Treatment Calcium Metalosate where 4 ml/L dose was used. Foliar application of calcium improved the calcium content in the berry as well as petiole over control and amino acid application. The physiological loss of weight which determines the shelf life of the crop differed significantly between the treatments at 4th day where all the treatments were significantly superior over control. Even though after 5th day shelf life of the crop did not differ significantly between the treatments, nevertheless trends clearly showed the superiority of treatment Calcium Metalosate @ 4 ml/L over other treatments. The berry firmness an important indicator of shelf life was significantly higher in the treatment Calcium Metalosate @ 4 ml/L. Hence, foliar spray of Calcium Metalosate @ 4 ml/L can be recommended as a source of Calcium in grapes for improving quality of grapes.

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