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Effect of pre-harvest treatments of growth regulators, chemicals and fungicides on storage behaviour of seedless grapes cv. SONAKA

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ABSTRACT : The physical parameters were influenced by different pre-harvest sprays of NAA, $CaCl_2$, Ca $(NO_3)_2$, *Trichoderma harzianum*, Carbendazim and Thiophanate methyl were studied. Among the Pre-harvest treatments, 2 per cent calcium nitrate sprayed grape bunches 10 days before harvest was recorded minimum per cent physiological loss in weight (15.02 %) and physical damage (0.47 %) at 35 days of storage (DAS). With respect to berry drop and rotting, minimum per cent berry drop (9.53 %) and rotting (12.93 %) was found in the pre-harvest spray of 200 ppm NAA and 0.2 per cent thiophanate methyl, respectively. Maximum per cent total soluble solids (25.07%), total sugars (24.42%), and reducing sugars (23.00 %) and non-reducing sugars (1.41%) were recorded in treatments imposed with calcium nitrate. It was on par with calcium chloride treatment and 200 ppm NAA with respect to TSS and reducing sugar. Maximum per cent of total soluble solids and acid ratio (67.57) and ascorbic acid content (3.28 mg/ 100 g pulp) were observed in 2 per cent calcium nitrate bunches followed by 2 per cent calcium chloride and 200 ppm NAA. Among the pre-harvest treatments calcium nitrate treated grapes recorded maximum organoleptic scores(Out of 5.00) with respect to general appearance (2.69), taste and flavour (3.46), firmness (2.8) and overall acceptability (3.01) and it was on par with carbendazim and calcium chloride when compared to control, but maximum score was recorded in the thiophanate methyl treated grape bunches 3.01 (out of 5.00) with respect to the absence of defects of the grapes and it was followed by carbendazim.

KEY WORDS : Pre-harvest spray, Growth regulators, Chemicals on grape storage

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Fruits are a part of Indian heritage and culture. Grape (*Vitis vinifera* L.) is one of the most delicious, refreshing and nourishing subtropical fruit, with its origin being Asia minor. It belongs to family Vitaceae which has 12 genera's and about 600 species. The ripe berries are rich in Calcium, Phosphorus, Iron, Sugar and Vitamins like B_1, B_2 and C. The fruits are consumed in fresh form as a table fruit and in the processed forms as raisin, fresh juice and wine. The popular seedless grape varieties of South India are Thompson Seedless, Sonaka, Beauty Seedless, Sharad Seedless, Pusa Seedless, Dilkhush, Manikchaman and Tas-A-Ganesh. Among them Sonaka variety is gaining more popularity for table and raisin purpose because of high total soluble solids, thin skin and berries of oblong shape.

The post-harvest loss of fresh fruits is one of the most pressing problems of the fruit industry especially in tropical countries like India. A large quantity goes as waste due to lack of proper post-harvest handling. It is estimated that the total loss of fruits in India for want of adequate post-harvest care, transportation and storage is around 20-30 per cent of the fruits harvested (Madan and Ullasa, 1993). The shelf-life of fruits including grapes can be extended by proper handling. Fruits are living entities and they carry out all the vital physiological activities even after the harvest. Extension of shelf-life can be made possible by reducing rate of transpiration, respiration and microbial infection. This can be achieved by proper storage methods with various techniques like pre-cooling, refrigeration, controlled or modified atmosphere storage, use of wax and pre-harvest and /or post-harvest spraying of chemicals. Considering these factors, the present investigation was undertaken.

RESEARCH METHODS

The experiment was conducted at Kittur Rani Chennamma College of Horticulture, Arabhavi. The elevation of location is 573 m above mean sea level. It is situated at Tikota, near Bijapur, Karnataka, with an latitude of $15^0 49^1$N, longitude of $75^0 43^1$ E. The investigation was carried out on 12 year old plants with a spacing of 3.6 x 1.8 m. A 20 uniform bunches of same maturity were randomly selected for each treatment from the vine. Chemicals were sprayed according to the treatments details using hand sprayer *i.e.*, Ganesh sprayers. Tekepol was used as a wetting agent, 10 days before harvest of the bunches. The chemicals were sprayed between 9.00 am and 3.00 pm under bright sun shine. The experiments were laid out in CRD design and the treatments are T_1 – NAA 200 ppm, T_2 – $CaCl_2$ 2 per cent, T_3 – Ca $(NO_3)_2$ 2 per cent, T_4 – *Trichoderma harzianum* @ 5 g/lit, T_5 - Carbendazim 0.1 per cent, T_6 – Thiophanate methyl 0.2 per cent and T_7- Control.

The grape bunches were harvested at ripe firm stage. Each treatment was divided into 4 replication of 2 kg each. Three replication for observations, fourth replication was used for destructive sampling process to analyses of TSS, Organoleptic qualities, etc.

RESEARCH FINDINGS AND DISCUSSION

Biochemical changes along with water loss was responsible for deterioration of shelf-life and fruit quality during transportation and storage. Grapes being a highly perishable produce, about 20-30 per cent of produce is subjected to post-harvest losses due to improper storage and transportation. Efforts have been made to enhance the shelf-life and to maintain the postharvest quality of fruits by using like growth regulators, calcium compounds, fungicides and provided proper storage conditions.

Physical parameters :

During storage, irrespective of treatments physiological loss in weight (PLW) of grapes increased with storage period. This might be attributed to loss of moisture due to evapotranspiration and respiration from the berries after prolonged storage. Similar results were also observed by, Saran *et al.* (2004) and Randhawa *et al.* (2009) in ber. The minimum PLW was recorded in 2 per cent calcium nitrate treated berries Application of calcium nitrate significantly reduced PLW in apple cv SPARTAN (Mason *et al.*, 1975) and calcium chloride spray in ber (Randhawa *et al.*, 2009), they concluded that calcium is known to retard the rate of respiration and prevent the cellular disintegration by maintaining protein and nucleic acid synthesis there by reduced the weight loss.

In the present study Berry drop was significantly reduced by growth regulators and calcium nitrate treatments. NAA treated berry showed the minimum

Table 1 : Effect of pre-harvest sprays of growth regulators, chemicals and fungicides on physical parameters of grapes cv. SONAKA

Treatments	Physiological loss in weight (%)	Berry drop (%)	Rotting (%)	Physical damage (%)
	Days after storage	Days after storage	Days after storage	Days after storage
T_1	17.67	9.53	19.95	0.50
T_2	15.23	13.24	17.61	0.49
T_3	15.02	13.07	18.05	0.47
T_4	18.14	17.04	15.40	0.85
T_5	18.98	15.19	13.27	0.89
T_6	16.85	16.75	12.93	0.80
T_7	24.47	20.05	23.47	0.95
S.E. ±	0.41	0.34	0.39	0.02
C.D. (P=0.05)	1.24	1.03	1.19	0.05

T_1 - NAA 200 ppm T_2 - $CaCl_2$ 2% T_3 – Ca $(NO_3)_2$ 2% T_4 - *Trichoderma harzianum* 5g/lit
T_5 - Carbendazim 0.1% T_6 - Thiophanate methyl 0.2% T_7 - Control

berry drop This might be due to NAA is involved in formation of cell wall modification or synthesis to maintain normal organization of cell wall and ultimately the detachment of berries from the pedicels of the rachis is delayed (Table 1). Yadav and Rana (2006) reported that the prevention of fruit drop in ber under field condition by use of NAA at lower concentration might be attributed to the prevention of abscission layer formation. Similar result was also reported by Pardeep and Bajwa, (2007) and Kachave and Bhosale (2007) in Kannow mandarin and Kagzi lime, respectively.

Investigations on berry rot revealed that, there were significant differences among treatments 0.2 % thiophinate methyl recorded the minimum berry rotting. Nene and Thapliyal (1993) reported the mode of action of the thiophanates, they acts by interference with DNA synthesis or some closely related process such as nuclear or cell division. Possibility of their acting as antimetabolites of nucleotides of their precursors also exists.

Physical/Mechanical damage causes physiological changes ethylene, polyamines (PAs) and abscissic acid (ABA) with concentrations being significantly higher in mechanically damaged fruit, probably a response to mechanical stress (Martinez *et al.*, 2004). Minimum physical damage was recorded in 2 per cent calcium nitrate treatment. Ethylene levels may increased immediately after mechanical damage. This ethylene is so called "Wound ethylene", which was found to be proportional to impact intensity in peaches. Mahmud *et al.* (2008) the effect of calcium in tissue firmness is generally explained by complexing cell wall and middle lamella polygalacturonic acid residues imparting improvement of structural integrity. The destrecrified pectin chains may cross link with either endogenous calcium or added calcium to form a tighter and firmer structure.

Chemical parameters :

During storage, TSS content increased upto 30 days and later decreased in all the treatments. Calcium nitrate treated fruits having the maximum total soluble solids contents throughout the storage period. Calcium nitrate also recorded maximum TSS content when compared with control. Such increased in TSS content was also reported from Gupta *et al.* (1980) in grapes and Ramakrishna *et al.* (2001) in papaya. Mason *et al.* (1975) reported that calcium laters intercellular and extra cellular processes which are intimately associated with reduced senescence by reduction in respiration rate and slow microbial fermentation thus, improves fruit quality in terms of increased TSS content (Table 2).

In this present study the least per cent of acidity was recorded in 2 per cent calcium nitrate treated grape This might be due to increased utilization of acids under the influence of calcium. They also emphasized that the acids under the influence of these chemicals might have either been converted into sugars and their derivatives by the reactions involving reversal of glycolytic path way or might be used in respiration or both. Lower concentrations of calcium nitrate showed little bit higher acidity because of insufficient calcium to convert acids to sugar form.

The treatment NAA at 200 ppm also recorded least acidity throughout storage period. This may be probably due to involvement of NAA in accelerating metabolic activities within the berries. Mahmud *et al. (*2008) opinioned that the decrease in titratable acidity in papaya during storage probably due to decrease in citric acid and calcium causing inhibition of enzymetic activity

Table 2 : Effect of pre-harvest sprays of growth regulators, chemicals and fungicides on chemical parameters of grapes cv. SONAKA

Treatments	Total soluble solids (%)	Titratable acidity (%)	TSS: acid ratio (%)	Ascorbic acid (mg/100g Pulp)
	Days after storage	Days after storage	Days after storage	Days after storage
T_1	22.52	0.425	52.95	3.26
T_2	23.87	0.371	67.23	3.25
T_3	25.07	0.355	67.57	3.28
T_4	23.55	0.446	52.76	3.11
T_5	23.17	0.502	46.14	3.00
T_6	23.06	0.457	50.42	2.98
T_7	19.95	0.513	38.87	2.69
S.E. ±	0.51	0.009	1.219	0.07
C.D. (P=0.05)	1.56	0.029	3.698	0.21

T_1 - NAA 200 ppm T_2 - $CaCl_2$ 2% T_3 – Ca $(NO_3)_2$ 2% T_4 - *Trichoderma harzianum* 5g/lit
T_5 - Carbendazim 0.1% T_6 - Thiophanate methyl 0.2% T_7 - Control

leading to delay in the use of organic acid in the enzymatic reaction of respiration.

The mean TSS and acid ratio increased with increase in storage period. The maximum TSS and acid ratio was observed in 2 per cent calcium nitrate treated fruits. This increase in ratio was due to either rapid increase in TSS or rapid decreases in acidity. However, there was not much variation with respect to TSS and acid ratio in cold storage (Table 3).

In the present investigation, the ascorbic acid content decreases during storage. Whereas maximum ascorbic acid retention was recorded in calcium nitrate treatment and least ascorbic acid content was observed with control. Saran *et al*. (2004) reported that maximum ascorbic acid content in calcium treatment might be due to the fact that application of various chemicals and fungicides retarded the oxidation process and hence, the rate of conversion of L-ascorbic acid into dehydro ascorbic acid was slowed down in ber fruits.

Generally in grapes, sugars like total, reducing and non-reducing sugars increased gradually upto 30 DAS and decreases at the end storage period. Maximum per cent of sugars was recorded in 2 per cent calcium nitrate. This increase in sugars might be merely due to moisture loss by transpiration and inhibition effect of enzymes responsible for degradation which resulted in accumulation of sugars. Ramakrishna (2001) coated a reason for the initial rise in reducing and total sugars was due to the conversion starch into surges, while decrease in later period due to consumption of sugars for respiration and converted into alcohol. Similar finding were reported in Jayachandran *et al.* (2005) in guava.

Organoleptic evaluations :

The effect of various pre-harvest treatments on the organoleptic qualities of the grape berries were satisfactory upon thirty five days after storage and they maintained good appearance, taste and flavour, texture, with minimum defects and overall acceptability. All the organoleptic rating was reduced as the storage period increased. It may be due to loss of moisture resulting in berries shriveling and loss of appearance. In present work all the organoleptic score were non-significant upto 5 days thereafter significant results obtained. Calcium

Table 3 : Effect of pre-harvest sprays of growth regulators, chemicals and fungicides on chemical parameters of grapes cv. SONAKA

Treatments	Total sugar (%)	Reducing sugar (%)	Non reducing sugar (%)
	Days after storage	Days after storage	Days after storage
T_1	22.65	21.40	1.24
T_2	22.61	21.40	1.20
T_3	24.42	23.00	1.41
T_4	22.07	20.91	1.15
T_5	22.50	21.40	1.10
T_6	21.86	20.77	1.09
T_7	19.51	18.40	1.08
S.E. ±	0.50	0.47	0.03
C.D. (P=0.05)	1.50	1.42	0.06

T_1 - NAA 200 ppm T_2 - $CaCl_2$ 2% T_3 – Ca $(NO_3)_2$ 2% T_4 - *Trichoderma harzianum* 5g/lit
T_5 - Carbendazim 0.1% T_6 - Thiophanate methyl 0.2% T_7 - Control

Table 4 : Effect of pre-harvest sprays of growth regulators, chemicals and fungicides on Organoleptic parameters of grapes cv. SONAKA

Treatments	General appearance (out of 5.0)	Firmness (out of 5.0)	Taste and flavour (out of 5.0)	Absence of defects (out of 5.0)	Overall acceptability (out of 5.0)
	Days after storage	Days after storage	Days after storage	Days after storage	Days after storage
T_1	2.21	2.77	3.32	2.23	2.21
T_2	2.51	2.80	3.42	2.32	2.43
T_3	2.69	2.80	3.46	2.56	3.01
T_4	1.91	2.66	3.02	2.49	2.27
T_5	2.68	2.60	2.61	2.68	2.83
T_6	2.57	2.46	3.11	3.01	2.53
T_7	1.00	2.21	2.76	2.03	1.96
S.E. ±	0.05	0.06	0.07	0.06	0.05
C.D. (P=0.05)	0.15	0.18	0.21	0.17	0.17

T_1 - NAA 200 ppm, T_2 - $CaCl_2$ 2%, T_3 - Ca $(NO_3)_2$2% T_4 - *Trichoderma harzianum* 5g/lit
T_5 - Carbendazim 0.1% T_6 - Thiophanate methyl 0.2% T_7 - Control NS=Non-significant

nitrate sprayed bunches recorded highest score with respect to general appearance (2.69), taste and flavour (3.46), and oral acceptability (3.01). Whereas calcium chloride recorded the maximum firmness, and thiophanate methyl recorded absence of defects (3.01) (Table 4).

With respect to taste and flavour calcium nitrate and NAA treated grape berries recorded highest rating. These chemicals might have maximum total soluble solids, sugars with good blend, TSS acid ratio causing acceptable taste and flavours, However, taste and flavours decreased with increasing storage period and it was much faster rate in untreated bunches (Ranjitkumar and Charia 1990). Texture of grape was decreased as storage period increased. This may be due to reduced firmness (Aguayo *et al.*, 2006). Among the treatments calcium nitrate treated fruits had better texture throughout storage period when compare to control. Over all acceptances was reduced as advancement of storage period. This could be due to advancement moisture loss, shrinkage, and shriveling of grapes.

These results were confirmative with the reports of Ranjitkumar and Charia (1990). NAA and calcium nitrate sprayed bunches maintained good rating with acceptance even upto 35 DAS. This could be due to the increased quality attributes for a longer period by reducing enzymatic activity responsible for degradative change (Ranjitkumar and Charia (1990).

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