Pre-Harvest Treatments for Fruit Quality Improvement in Rainy Season Guava (*Psidium guajava*)

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Abstract: ***Rainy season or Ambe bahar guava crop gives low quality fruits having poor shelf life. The quality is poor due to infestation by insect pest like fruit fly and infection by disease like anthracnose. Various pre-harvest treatments viz. spraying of $CaCl_2$ 2%, spraying of $CaSO_4$ 2%, polythene bagging, brown paper bagging, spraying of $CaCl_2$ 2% + polythene bagging, spraying of $CaCl_2$ 2% + brown paper bagging, spraying of $CaSO_4$ 2% + polythene bagging, spraying of $CaSO_4$ 2% +brown paper bagging were tried at Faizabad, Uttar Pradesh, India during 2015-16 to find out ways for improving fruit quality. All treatments increased quality of guava fruits significantly. Among the treatments, $CaCl_2$ 2% + polythene bagging proved the best in enhancing post harvest quality attributes viz. fruit size, fruit weight, fruit firmness, organoleptic quality, total soluble solids(TSS), acidity, TSS: acid ratio, ascorbic acid, reducing sugar, non reducing sugar and total sugar.***

Keywords: *Ambe bahar*, calcium chloride, calcium sulphate, polythene bag, post-harvest quality

1. Introduction

Guava (*Psidium guajava* Linn.) is one of the most common fruits in India. Among the three fruiting seasons of the crop, fruits harvested in rainy season are insipid, watery, poor in quality, attacked mostly by diseases and pests. Anthracnose (*Gloeosporium psidii*) is one of major disease that adversely affects quality of fruits in this season. Infestation with fruit fly (*Dacus dorsalis*) has been a major impediment to guava marketing. Keeping quality of *ambe bahar* guava fruits is very poor. Hence fruit production during this season is often minimized or removed by crop regulation or bahar treatment methods. It is a big hurdle in the annual production of guava. Therefore, to resolve all these problems a proper management programme should be incorporated.

2. Literature Survey

Several attempts have been carried out by various research workers to overcome this problem. Bagging is an effective eco-friendly and non-chemical method for the control of post harvest diseases and fruit fly infestation. It also improves the fruit quality, organoleptic quality in terms of appearance , uniform coloration, taste, flavour and overall acceptance at ripening and also prolongs the shelf life as reported in rainy season guava (Abbasi *et al*., 2). Bagging may produce spot free, attractive and high quality fruit at harvest on ripening leading to export and better price for guava growers. Calcium plays an important role in a number of physiological and biochemical processes in the plant concerning membrane structure, function and enzyme activities. It helps in retaining fruit firmness, reducing respiration, decreasing storage breakdown, rotting and browning (Jakhar *et al*.,8) . It helps in creating a protecting layer on fruit surface which protects against pathogens and insects. Calcium nitrate is not useful for spraying at mature stage of guava fruits. Hence the present investigation was formulated with pre-harvest $CaCl_2$ and $CaSO_4$ spray and/or fruit bagging with polythene bag and brown paper bag to enhance quality and appearance of rainy season guava fruits.

3. Materials and Methods

The experiment was carried out at the guava orchard at Main Experiment station of Horticulture and Post Harvest Technology laboratory, Department of Post Harvest Technology, College of Horticulture and Forestry, Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad (U.P.), India during the *kharif* season of 2015-16. Four year old bearing trees of guava cv. 'Lucknow-49', having uniform vigour and healthy fruits were selected for the study. The trees were spaced at 8m x 8m spacing and uniform crop management practices were followed for all the plants. The nine pre-harvest treatments viz., T_1 ($CaCl_2$@ 2%), T_2($CaCl_2$ @ 2% + Polythene bag), T_3($CaCl_2$ @ 2% + Brown Paper bag) , T_4($CaSO_4$ @ 2%) ,T_5 ($CaSo_4$ @ 2% + Polythene bag), T_6 ($CaSO_4$ @ 2% + Brown Paper bag), T_7 (Polythene bag), T_8 (Brown Paper bag) and T_9 (Control) were tried in randomized block design with three replications. Single tree was considered as an experimental unit. The nine treatments in each block were randomised. Altogether there were twenty seven trees. A total of 10 uniform sized fruits/tree present in all directions of tree canopy were selected and tagged for the study. Bagging of fruits with various bags was done about 30 days before harvesting of fruits. Spraying of $CaCl_2$ @ 2% alone in T_1 and $CaSO_4$ @ 2% alone in T_4 were done twice at 15 and 30 days before harvest of fruits. Bagging of fruits with polythene bag alone in T_7 and brown paper alone in T_8 were done one month before harvest of fruits. Bagging of fruits with polythene and brown paper bags was done in T_2 and T_3, respectively, in addition to single spraying with $CaCl_2$@ 2% 30 days before harvesting. Similarly, in case of T_5 and T_6, bagging with polythene bag and brown paper bag was done, respectively, in addition to single spraying with $CaSO_4$ @ 2%. In case of treatments where spraying and bagging both were combined, the bagging was done immediately after the spraying.

Fruits marked for study in all treatments were separately harvested by hand carefully to avoid any damage to fruits in morning hours on 1st August, 2015. The field heat of harvested fruits was reduced by showing to stream of hand pumped water and kept in shade for drying of water sticking to surface of fruits. These fruits were transported from orchard to Post Harvest Technology laboratory with proper packing in CFB boxes to avoid physical damage including bruising. Individual weight of 4 fruits per treatment was recorded by physical balance. Length and width were measured by using Vernier callipers. Two fruits of each treatment were separately packed in polythene bags and bags were sealed properly. Six to eight small holes were made in polythene bags for air exchange. All bags were marked as per treatments and then stored at ambient temperature in the laboratory of Post Harvest Technology for further observations on changes during storage.

The fruit size was measured using Vernier callipers. Fruit weight (g), physiological loss in weight and spotted fruits were recorded using the standard procedure mentioned in (AOAC,1). The TSS(%) was determined with hand refractometer. Acidity (%) and ascorbic acid (mg/ 100g) were determined by the standard procedures. Fehling solution method was used for estimating sugar content. The TSS: acid ratio was calculated by dividing the TSS (%) to acidity (%) of fruits. The organoleptic evaluation for assessing sensory attributes of stored fruits was conducted by a panel of eight judges and samples were rated on the nine-point Hedonic Rating Scale.

4. Results and Discussion

4.1 Fruit Size

Among all treatments, application of $CaCl_2$@2% + polythene bag proved the best with fruit length and width of 4.8 cm and 5.1 cm, respectively(Table 1). The minimum fruit length and width of 3.5 cm and 3.8 cm, respectively, were obtained in control. Improvement in fruit size with application of $CaCl_2$ was reported in mango by Rubyrani and Brahmachari(10). Calcium plays a major role in cell elongation due to which size of fruit increases.

4.2 Fruit Weight

The treatment of $CaCl_2$@ 2%+ Polythene bag produced the heaviest fruit with average fruit weight of 155.33 g. The minimum fruit weight of 100.3g was recorded in control. The appreciable improvement in fruit weight in mango with application of $CaCl_2$ has been reported earlier by Rubyrani and Brahmachari(10).

4.3 Fruit firmness

The highest firmness was recorded in treatment of $CaCl_2$@ 2%+ Polythene bag (10.48 kg/cm^2) followed by the treatment of $CaSO_4$ @ 2%+ Polythene bag (9.53 kg/cm^2). The lowest fruit firmness (7.97 kg/cm^2) was recorded in control. Several workers have also reported earlier regarding the effect of pre harvest application of Ca^+ on improvement in firmness of fruits (Tingwa and Young,15 ; Scott and Wallis,11; Singh *et al.,12*; Cheor *et al.,* 3).

4.4 Spotted fruit (%)

The minimum spotted fruits were noted with the treatment of $CaCl_2$@2% + Polythene bag(1.70%) followed by $CaSO_4$ @2%+ Polythene bag(5.30%).The maximum spotted fruits were noted in control(65.33%). Spots on fruits occur mainly due to high humidity condition creating congenial conditions for pathogen attack. This can only be minimised by protecting the fruits from adverse environment. Bagging creates a microenvironment safe for fruits and also avoids pathogen attack and spot formation.

4.5 Infested fruit (%)

No infested fruit was found with the pre harvest treatments of poltythene bag alone and its combination with spraying treatments i.e. $CaCl_2$@ 2% + Polythene bag and $CaSO_4$ + Polythene bag. The highest infested fruits were recorded in control (13.5%). Infection with disease like anthracnose and infestation with insect pest like fruit fly mainly occur during rainy season due to availability of congenial micro-climate. Dieng *et al.* (5) have reported that the incidence of fruit fly infestation was observed to the tune of 70% on unbagged fruits as against 0.45% in bagged fruits.

4.6. Organoleptic quality

Calcium chloride+ polythene bag recorded the maximum organoleptic quality as indicated by the value of 8.80 (like very much) followed by 8.50 (like very much) with calcium chloride + brown paper bag. The minimum organoleptic quality with value of 6.20 (like slightly) was found in control. Abbasi *et al.* (2) reported that bagging of guava fruits in summer helped in improving organoleptic taste.

4.7 TSS content

The maximum TSS content was recorded in fruits subjected to treatment of $CaCl_2$@2% + Polythene bag (15.0 %) followed by the fruits treated with $CaCl_2$@2% + brown paper bag (14.5%) and the minimum TSS content was found in control (Table 2). The TSS content of fruits increased during the ripening and storage due to hydrolysis of insoluble starch into soluble sugars and loss of moisture (Koksal *et al*., 9). Similar improvement in TSS content of fruits with pre harvest spray of calcium chloride was reported by Singh *et al*. (13) in Amrapalli mango and Goswami *et al*. (7) in Sardar guava.

4.8 Acid content

Rainy season guava are low in acid content because of leaching loss which causes very poor taste in fruits. It can be controlled by protecting fruits from such losses due to heavy rain. The maximum acid content was noted in treatment of $CaCl_2$@2% + Polythene bag (0.39%) because it creates a protective layer against leaching loss. The minimum was found in control (0.29%).

4.9 TSS: acidity ratio

The highest TSS: acidity ratio 39.67 was found in $CaCl_2$@2% + brown paper bag treatment followed by 38.26 in $CaCl_2$@2% + polythene bag treatment. The minimum was found in control (30.72).

4.10 Ascorbic acid content

The maximum ascorbic acid content was recorded in pre harvest treatment of $CaCl_2$@2% + Polythene bag(211.67mg/100g). The minimum ascorbic acid content was reported in control (113.33 mg/100g). This result conforms to the findings of Dhahiya *et al*.(4) in guava, Singh *et al*.(14) in ber fruits and Dutta (6) in guava.

4.11 Total sugars content

The pre harvest treatment of $CaCl_2$@2% + Polythene bag with total sugars content of 11.18% was found significantly superior to all other treatments(Table 3). The minimum total sugar conent was observed in control (6.95%). Similar improvement in the total sugar content of fruits by pre harvest spray of calcium chloride was reported by Singh *et al.(13)* in Amrapali mango.

4.12 Reducing sugar content

The highest reducing sugar content was recorded in pre harvest treatment of calcium chloride 2%+ polythene bag (6.04%), while the lowest was recorded in control (3.80%). Similar improvement in the reducing sugar content of fruits by pre harvest spray of calcium chloride was reported by Singh *et al*. (13) in Amrapali mango and Goswami *et al*.(7) in guava fruits.

4.13. Non-reducing sugar content

The maximum non-reducing sugar content in fruits was recorded in pre harvest treatment of calcium chloride 2%+ polythene bag (5.23%), while the minimum was recorded in control (3.15%). Similar increase in non-reducing sugars content of fruits by pre harvest spray of calcium chloride have been reported by Singh *et al*.(13) in Amrapali mango and Goswami *et al*.,(7) in guava.

5. Conclusion

All the pre harvest treatments were found better than control in improving fruit quality while the pre harvest treatment of $CaCl_2$ 2% + polythene bag was found superior to increase the fruit quality than all other treatments. This treatment was found to have very low spots and no infestation. Hence it should be practised in rainy season guava crop to produce fruits with good quality.

6. Future Scope

Study of several bagging materals, calcium chloride and calcium sulfate will help for developing a good sustainable research programme as the materials and chemicals are non-hazardous both for environment and human. It will provide a good rainy season guava crop to fruit growers and traders.

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Table 1: Effect of pre-harvest treatments on fruit size, weight, firmness, spotted fruits, infested fruits and organoleptic quality

Treatments	Fruit length (cm)	Fruit width (cm)	Fruit weight (g)	Fruit firmness (Kg/cm^2)	Spotted fruits (%)	Infested fruits (%)	Organoleptic quality
T_1 - $CaCl_2$ 2%	3.6	4.0	108.6	8.57	(11.00)* 2.78	(4.95)* 2.33	7.8
T_2 - $CaCl_2$ 2% + Polythene bag	4.8	5.1	155.3	10.48	(1.70) 1.48	(0.00) 0.71	8.8
T_3 - $CaCl_2$ 2% + Brown Paper bag	4.5	4.5	139.6	9.40	(14.00) 3.80	(2.46) 1.58	8.5
T_4 - $CaSo_4$ 2%	3.5	3.9	105.0	8.62	(16.67) 4.14	(6.75) 2.61	7.0
T_5 - $CaSo_4$ 2% + Polythene bag	4.6	4.5	140.0	9.53	(5.30) 2.37	(2.46) 1.58	8.0
T_6 - $CaSo_4$ 2% + Brown Paper bag	4.3	4.4	133.3	9.30	(17.67) 4.24	(6.75) 2.61	7.8
T_7 - Polythene bag	4.0	4.2	114.3	9.31	(8.17) 2.94	(0.00) 0.71	7.8
T_8 - Brown Paper bag	3.8	4.0	110.3	8.50	(20.33) 4.56	(9.5) 3.16	7.4
T_9 – Control	3.5	3.8	100.3	7.97	(65.33) 8.09	(13.5) 3.74	6.2
SEm$\pm$	0.1	0.1	4.72	0.15	0.19	0.01	0.15
CD at 5%	0.4	0.4	14.14	0.44	0.58	0.04	0.44

***$\sqrt{(X+0.5)}$ transformed values. Original values in parentheses**

Table 2: Effect of pre-harvest treatments on TSS, acidity, TSS : Acid ratio and ascorbic acid content

Treatments	TSS (%)	Acidity (mg/100g)	TSS:Acid ratio	Ascorbic acid (mg/ 100g)
T_1 - $CaCl_2$2%	12.3	0.34	36.60	175.00
T_2 - $CaCl_2$ 2% + Polythene bag	15.0	0.39	38.26	211.67
T_3 - $CaCl_2$ 2% + Brown Paper bag	14.5	0.37	39.67	183.00
T_4 - $CaSo_4$ 2%	11.0	0.33	33.38	164.64
T_5 - $CaSo_4$ 2% + Polythene bag	12.7	0.36	35.33	200.33
T_6 - $CaSo_4$ 2% + Brown Paper bag	12.0	0.35	34.65	151.67
T_7 - Polythene bag	12.4	0.33	37.54	140.33
T_8 - Brown Paper bag	11.2	0.31	36.20	131.67
T_9 - Control	9.0	0.29	30.72	113.33
SEm$\pm$	0.19	0.01	1.16	1.70
CD at 5%	0.56	0.04	3.46	5.11

Table 3: Effect of pre-harvest treatments on reducing sugars, non-reducing sugars and total sugars

Treatments	Reducing sugars	Non-reducing sugars	Total sugars
T_1 - $CaCl_2$ 2%	4.91	4.31	9.22
T_2 - $CaCl_2$ 2% + Polythene bag	6.04	5.23	11.18
T_3 - $CaCl_2$ 2% + Brown Paper bag	5.82	5.07	10.88
T_4 - $CaSo_4$ 2%	4.43	3.85	8.28
T_5 - $CaSo_4$ 2% + Polythene bag	5.00	4.40	9.40
T_6 - $CaSo_4$ 2% + Brown Paper bag	4.83	4.23	8.87
T_7 - Polythene bag	4.90	4.39	9.32
T_8 - Brown Paper bag	4.53	3.93	8.44
T_9 - Control	3.80	3.15	6.95
SEm$\pm$	0.12	0.21	0.31
CD at 5%	0.36	0.62	0.92

Author Profile

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