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Effect of Post Shooting Spray and Bunch Bagging on Fruit Quality of Banana (*Musa paradisiaca* L.) cv Grand Naine

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ABSTRACT

The present study was aimed to determine the effect of post shooting spray and bunch bagging on fruit quality of banana (*Musa paradisiaca* L.) cv Grand Naine at Horticultural Research Farm, Department of Horticulture, BA College of Agriculture, AAU, Anand during the years 2017-18 and 2018-19. The experiment comprises of involving six levels of post shooting sprays namely; control, humic acid 2 %, 2, 4-D 30 mg/l, gibberellic acid (GA_3) 100 mg/l, CPPU 4 mg/l and sulphate of potash (SOP) 2 % with two levels of bunch covering material viz., non- woven material bag and blue color polyethylene sleeve (6 % perforated) bag covering. Experiment was laid out in a Completely Randomized Design (Factorial) with three repetitions. Post shooting sprays were given twice i.e., 1st spray after complete opening of inflorescence and 2nd spray after 30 days of first spray with covering the bunch immediately after second spray. Results revealed that the banana bunches spraying of CPPU 4 mg/l was showed significantly minimum PLW and higher pulp: Peel ratio. Whereas, post shooting spray of SOP 2 % was recorded maximum TSS, reducing sugar as well as total sugar. In case of bunch covering materials, the non-woven material bag covering was significantly better among all qualitative parameters compared to blue color polyethylene sleeve bag covering.

Keywords Banana, Quality, Post shooting spray, Bunch covering bag.

INTRODUCTION

Banana (*Musa paradisica* L.) belongs to family Musaceae and it is the cheapest, plentiful and most nourishing fruit crop of the world. It is a premier fruit having great socio-economic significance in India. Indeed many consider the banana to be one of man's first food. Now-a-days, the practices of application of chemicals on banana bunch for improving the growth, maturity, yield and quality of fruits is gaining popularity. Banana is potassium loving crop and high potassium availability is important at fruiting stage. Any limitation in the supply of nutrients at the shooting stage affects bunch size and quality of banana.

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Among the several factors affecting fruit quality, adequate potassium application is considered to be important in banana cultivation. Potassium is known to influence fruit yield in general and fruit quality in particular (Tandon and Sekhon 1988). The study the effects of CPPU [N-(2-Chloro-4-pyridyl)-N-phenylurea] application on fruit carbohydrate accumulation and metabolism during growth and ripening, with attention given to evaluating the consequences of CPPU treatment on fruit quality attributes related to changes in carbohydrate metabolism. The understanding of how CPPU modifies fruit metabolism has an overall importance in improving the understanding of the physiological aspects linked to fruit growth and quality.

Fruit protection bags of various color, perforated and non-perforated, have been extensively used in both tropical and subtropical banana growing countries to improve yield and quality (Stover and Simmonds 1987). Some of these quality parameters include acceptable skin appearance and color, increase in finger length and bunch weight as well as reduce fruit defect for example sunburn and fruit splitting (Amarante *et al*. 2002).

MATERIALS AND METHODS

An experiment was conducted at Horticultural Research Farm, Department of Horticulture, BA College of Agriculture, Anand Agricultural University, Anand during the years 2017-18 and 2018-19. Experiment was laid out in a Completely Randomized Design (Factorial) with three repetitions. The experimental plot was prepared by deep ploughing, harrowing and levelling. The pits of 30 x 30 x 30cm were dug out at a spacing of 1.8 x 1.8 m^2 and well decomposed fine textured Farm Yard Manure (FYM) at the rate of 10 kg per pit was applied at planting. Well hardened, healthy, Uniform tissue cultured tissue culture plants of Grand Naine banana having 5-6 leaves were used for planting. The experiment comprises of involving six levels of post shooting sprays namely; control, humic acid 2%, 2, 4-D 30 mg/l, gibberellic acid (GA_3) 100 mg/l, CPPU 4 mg/l and sulphate of potash (SOP) 2% with two levels of bunch baggingviz., non- woven material bag covering and blue color polyethylene sleeve (6% perforated) bag covering. Post shooting sprays were given twice i.e., 1st spray after complete opening of inflorescence and 2nd spray after 30 days of first spray with bunchbagging immediately after second spray. Observations were recorded daily for quality characters i.e., Pulp Peel ratio, TSS (^{0}Brix), Acidity (%), Reducing sugars (%), Total sugars (%) and Physiological loss in weight (%) were recorded. The fruits which were used for recording the weight loss during ripening, were used to calculating pulp: Peel ratio. Pulp to peel ratio was calculated by dividing respective pulp weight by respective peel weight. The TSS value of the fruit was recorded by using hand refractometer having range of 0-32 ^{0}Brix. Acidity (%) was calculated by the method described by Rangana (1979) was adopted for estimation of titrable acidity. The data recorded during the course of investigation were subjected to statistical analysis following standard procedure described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Physiological loss in weight (%)

Effect of post shooting spray

The data (Table 1) revealed that the post shooting spray CPPU 4 mg/l (S_5) recorded significantly lower physiological loss in weight (13.28 %) and which was statistically found at par with rest of the treatments except control (S_1) during the year 2018-19. Whereas, in the year 2017-18 and pooled analysis significantly minimum physiological loss was recorded in spraying of CPPU 4 mg/l (12.47 and 12.87 %) which was found at par with treatments S_6 i.e. SOP 2% (12.80 and 13.30 %) and S_4 i.e., GA_3 100 mg/l (12.88 and 13.35 %) in the year 2017-18 and pooled analysis, respectively. However, control treatment was noted maximum physiological loss in weight (17.19, 17.63 and 17.41 %) during both the experimental years as well as in pooled data, respectively. This might be due to CPPU plays vital role in enhancing the physiological activities in suppressed fruit softening in association with the delayed peaks of respiration and the inhibition of the peaks of ethylene production rate in banana (Huanga *et al*. 2014 and Rajan 2017).

Table 1. Effect of post shooting sprays and bunch bagging on physiological loss in weight and pulp: Peel ratio.

Treatments	Physiological loss in weight (%)			Pulp: peel ratio		
	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled
Post shooting spray (S)						
S_1 : Control	16.87	16.92	16.89	2.58	2.56	2.57
S_2 : Humic acid @ 2%	13.95	14.48	14.22	2.83	2.76	2.79
S_3 : 2,4-D @ 30 mg/l	13.85	14.23	14.04	2.86	2.72	2.79
S_4 : GA_3 @ 100 mg/l	12.88	13.81	13.35	3.03	2.97	3.00
S_5 : CPPU @ 4 mg/l	12.47	13.28	12.87	3.09	2.99	3.04
S_6 : SOP @ 2%	12.80	13.80	13.30	3.05	2.95	3.00
SEm ±	0.34	0.42	0.27	0.09	0.08	0.06
CD at 5%	0.98	1.22	0.76	0.25	0.22	0.16
Bunch bagging (B)						
B_1: Non- woven material bag covering	12.84	13.61	13.23	3.09	2.99	3.04
B_2: Blue color polyethylene sleeve	14.76	15.23	15.00	2.72	2.66	2.69
SEm ±	0.19	0.24	0.15	0.05	0.04	0.03
CD at 5%	0.57	0.70	0.76	0.15	0.13	0.16
Interaction effect (S × B)						
SEm ±	0.47	0.59	0.39	0.12	0.11	0.12
CD at 5%	NS	NS	NS	NS	NS	NS
Pooled interaction						
Source	Y x S	Y x B	YxSxB	Y x S	Y x B	YxSxB
SEm ±	0.38	0.22	0.54	0.08	0.05	0.12
CD at 5%	NS	NS	NS	NS	NS	NS
CV %	5.95	7.11	6.58	7.35	6.58	6.99

Effect of bunch bagging

Significantly minimum physiological loss in weight was recorded under non-woven material bag covering (B_1) with numerically value 13.05, 13.88 and 13.46 % as compared to blue color polythene sleeve (B_2) with numerically value 15.03, 15.54 and 15.29 % during both individual years and in pooled, respectively. This might be due to decreased in fruit weight during the storage period could be due to physiological process such as higher rate of respiration and transpiration from fruit surface degradation of reserve carbohydrate with release of water and transpiration through fruit skin. It could be also due to decrease in peel thickness with passage of ripening period which accelerates the weight loss of fruit. Similar findings are reported by Patil and Shanmugasundaram (2015). Santosh *et al.* (2017) and Aryama *et al.* (2019). The decline in fruit weight has faster rate in control as compare to non-woven bags. These results are accordance with Pathak *et al.* (2017) in banana.

Pulp: Peel ratio:

Effect of post shooting spray

The post shooting spray with CPPU 4mg/l (S5) recorded significantly maximum pulp: Peel ratio (3.09 and 2.99) which was found at par with treatments S6 i.e., SOP 2% (3.05 and 2.95), S_4 i.e. GA_3 100mg/l (3.09 and 3.00) and S_3 i.e., 2, 4-D 30 mg/l (2.86 and 2.72) during both experimental years, respectively. Whereas in pooled analysis, significantly maximum pulp: Peel ratio was recorded with spraying of CPPU

Table 2. Effect of post shooting sprays and bunch bagging on total soluble solids and acidity.

Treatments	Total soluble solids (ºBrix)			Acidity (%)		
	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled
Post shooting spray (S)						
S_1 : Control	19.66	19.22	19.44	0.308	0.319	0.314
S_2 : Humic acid @ 2%	20.94	20.47	20.71	0.306	0.315	0.311
S_3 : 2,4-D @ 30 mg/l	21.40	20.63	21.02	0.302	0.311	0.307
S_4 : GA_3 @ 100 mg/l	22.47	21.62	22.04	0.300	0.308	0.304
S_5 : CPPU @ 4 mg/l	22.33	21.60	21.97	0.302	0.311	0.306
S_6 : SOP @ 2%	22.78	22.32	22.55	0.306	0.316	0.311
SEm ±	0.44	0.39	0.30	0.006	0.014	0.008
CD at 5%	1.30	1.15	0.85	NS	NS	NS
Bunch bagging (B)						
B_1: Non- woven material bag covering	22.67	21.78	22.23	0.302	0.311	0.306
B_2: Blue color polyethylene sleeve	20.52	20.17	20.34	0.306	0.316	0.311
SEm ±	0.26	0.23	0.17	0.003	0.008	0.004
CD at 5%	0.75	0.66	0.85	NS	NS	NS
Interaction effect (S X B)						
SEm ±	0.63	0.56	0.59	0.008	0.020	0.004
CD at 5%	NS	NS	NS	NS	NS	NS
Pooled interaction						
Source	Y x S	Y x B	YxSxB	Y x S	Y x B	YxSxB
SEm ±	0.42	0.24	0.59	0.011	0.006	0.015
CD at 5%	NS	NS	NS	NS	NS	NS
CV %	5.04	4.61	4.84	4.73	10.87	8.47

4 mg/l (3.04) and it was found at par with S_6 i.e., SOP 2% (3.00), S_4 i.e., GA_3 100mg/l (3.00) as compared to other treatments. When, the significantly minimum pulp: Peel ratio was found under control (2.58, 2.56 and 2.57) in the years 2017-18, 2018-19 and in pooled analysis, respectively. This might be due to the reason that CPPU plays vital role in enhancing the physiological activities in suppressed fruit softening in association with the delayed peaks of respiration and the inhibition of the peaks of ethylene production rate in banana (Huanga *et al*. 2014 and Rajan 2017).

Effect of bunch bagging

Data pertaining in Table 2, significantly better pulp: Peel ratio was observed with non-woven material bag covering (B_1) i.e., 3.09, 2.99 and 3.04 as compared to blue color polythene sleeve (B_2) i.e. 2.72, 2.66 and 2.69 during the years 2017-18, 2018-19 and in pooled, respectively. Pulp: Peel ratioof banana fruit tends to increase with the advancement from harvest to ripening. In banana fruit moisture content of peel reduced gradually during ripening while that of the pulp increased with ripening hence pulp : Peel ratio increased gradually (Burdon *et al*. 1994). Pulp portion continues to grow even in later stage of maturation and bunch protection material enhances the fruit quality (Nakasone and Paul 1998) in banana. Similar results were also noted by Amarante *et al.* (2002), Sarkar (2014) and Santosh *et al*. (2017).

Total soluble solids (ºBrix)

Effect of post shooting spray

Post shooting spray with SOP 2 % (S_6) recorded significantly higher total soluble solids (22.78, 22.32 and 22.55 ºBrix) which was found at par with treatments

Table 3. Effect of post shooting sprays and bunch bagging on reducing sugar and total sugar (%).

Treatments	Reducing sugar (%)			Total sugar (%)		
	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled
Post shooting spray (S)						
S_1 : Control	11.37	11.02	11.19	19.40	18.58	18.99
S_2 : Humic acid @ 2%	12.01	11.72	11.87	20.50	19.77	20.13
S_3 : 2,4-D @ 30 mg/l	11.98	11.68	11.83	20.45	19.69	20.07
S_4 : GA_3 @ 100 mg/l	12.91	12.48	12.70	22.03	21.07	21.55
S_5 : CPPU @ 4 mg/l	13.20	12.70	12.95	22.53	21.42	21.98
S_6 : SOP @ 2%	13.31	12.96	13.13	22.72	21.85	22.28
SEm ±	0.29	0.26	0.19	0.52	0.48	0.35
CD at 5%	0.85	0.75	0.55	1.53	1.40	1.01
Bunch bagging (B)						
B_1: Non- woven material bag covering	13.06	12.64	12.85	22.28	21.32	21.80
B_2: Blue color polyethylene sleeve	11.87	11.55	11.71	20.26	19.47	19.87
SEm ±	0.17	0.15	0.11	0.30	0.28	0.20
CD at 5%	0.49	0.43	0.55	0.88	0.81	1.01
Interaction effect (S X B)						
SEm ±	0.41	0.36	0.38	0.74	0.68	0.65
CD at 5%	NS	NS	NS	NS	NS	NS
Pooled interaction Source	Y x S	Y x B	YxSxB	Y x S	Y x B	YxSxB
SEm ±	0.27	0.16	0.39	0.50	0.29	0.71
CD at 5%	NS	NS	NS	NS	NS	NS
CV %	5.71	5.21	5.47	6.03	5.74	5.90

spraying of CPPU 4 mg/l (22.33, 21.60 and 21.97 ºBrix) and GA_3 100 mg/l (22.47, 21.62 and 22.04 ºBrix) as compared to the rest of the treatments. While, lower TSS was observed under control treatment (19.66, 19.22 and 19.44 ºBrix) during the years 2017-18, 2018-19 and in pooled analysis, respectively. The maximum TSS was noted in bunch spray with SOP 2% treatment might be due to post-shooting application of K favors the conservation of starch into simple sugars during ripening by activating sucrose syntheses enzyme, resulting higher total soluble solid content in fruits. Similar results were also noted by Kumar *et al.* (2008), Kumar and Kumar (2010), Gamit *et al*. (2017) and Kachhadia *et al*.(2017) in banana.

Effect of bunch bagging

Significantly maximum total soluble solids was recorded under non-woven material bag covering (22.67, 21.78 and 22.23 ºBrix) as compared to blue color polythene sleeve (20.52, 20.17 and 22.23 ºBrix) during both the years as well as in pooled, respectively. It might be due to during the climacteric stage, the accumulated polysaccharide is rapidly degraded and most of it is converted into soluble sugars which form a large proportion of TSS in the banana (Seymour *et al.*1993).The present result of non-woven bag is coincide with findings of Sarkar (2014) and Santosh *et al.*(2017) in banana.

Acidity (%)

Effect of post shooting spray

All the treatments of post shooting sprays, bunch bagging and all interaction were found non-significant in respect to acidity content in fruit of banana during the years 2017-18, 2018-19 and in pooled analysis.

Reducing sugar (%)

Effect of post shooting spray

Significantly maximum reducing sugar was recorded

with spraying of SOP 2% (13.31, 12.96 and 13.13 %) and which was statistically found at par with spraying of CPPU 4 mg/l (13.20, 12.70 and 12.95 %) and $GA_3$100 mg/l (12.91, 12.48 and 12.70 %). Whereas, minimum non-reducing sugar was recorded in control (11.37, 11.02 and 11.19 %) in the years 2017-18, 2018-19 and in pooled analysis, respectively. This might be due to potassium plays a vital role in carbohydrate synthesis, breakdown, translocation and synthesis of protein as well as neutralization of physiologically important organic acids (Tisdale and Nelson 1966). Potassium is also involved in phloem loading and unloading of sucrose and amino acids and storage inform of starch in developing fruits by activating the enzymes starch synthase (Mengel and Kirkby 1987). In plants well supplied with K, the osmotic potential of the phloem sap and the volume flow rate are higher than untreated plants and as a result, sucrose concentration in the phloem sap is increased. Similar results were also reported by Kumar *et al.* (2008), Kumar and Kumar (2010), Kachhadia *et al.* (2017) and Pebbudi *et al*. (2017) in banana.

Effect of bunch bagging

Data showed that the reducing sugar was recorded significantly higher with non-woven material bag covering (B_1) with numerical value 13.06, 12.64 and 12.85 % as compared to blue colour polythene sleeve (B_2) with numerical value 11.87, 11.55 and 11.71 % during the years 2017-18, 2018-19 and in pooled, respectively. It might be due to significantly positive association with temperature. The covered bunches had more reducing sugar, probably because of higher temperature inside bunch covered favorable for conversion of starch into sugar. A similar result was reported by Sarkar (2014) in banana.

Total sugar (%)

Effect of post shooting spray

Post shooting spray with SOP 2% (S_6) recorded significantly higher total sugar (22.72, 21.85 and 22.28 %) and which was found at par with spraying of CPPU 4 mg/l (S_5) with numerical value 22.53, 21.42 and 21.98 % and spraying of GA3100 mg/l (S_4) with numerical value 22.03, 21.07 and 21.55 %. While, significantly lower total sugar was recorded under control treatment (19.40, 18.58 and 18.99 %) in both individual years as well as in pooled analysis, respectively.

Effect of bagging

Significantly higher total sugar was recorded with non-woven material bag covering (B_1) with numerical value 22.28, 21.32 and 21.80 % as compared to blue color polythene sleeve (B_2) with numerical value 20.26, 19.47 and 19.87 % during the years 2017-18, 2018-19 and in pooled, respectively.

Interaction effect

The all interaction effects of post shooting sprays x bunch bagging were found non-significant with respect to physiological loss in weight, pulp : Peel ratio, total soluble solid, acidity, reducing sugar and total sugar of banana during both experimental years 2017-18, 2018-19 and in pooled data.

CONCLUSION

From the two years of field study and pull analysis, it can be concluded that the post shooting spraying of CPPU 4 mg/l with non-woven material bag covering was showed significantly minimum PLW and higher pulp: Peel ratio. Whereas, post shooting spray of SOP 2 % was recorded maximum TSS, reducing sugar and total sugar with non-woven material bag covering on bunches of banana cv Grand Naine.

REFERENCES

Amarante C, Banks NH, Max S (2002) Effect of preharvest bagging on fruit quality and postharvest physiology of pear (*Pyrus-communis*). *New Zealand J Crop Hort Sci* 30 (2), 99-107.

Aryama D, Shashi Kala, Prem Prakash (2019) Impact of different types of pre-harvest bunch bagging on postharvest physiological quality of banana cv Grand Naine. *Int J Chem Stud* 6 : 791-793.

Burdon JN, Dori S, Lomaniec E, Marinansky R, Pesis E (1994) The post-harvest ripening of water stressed banana fruits. *The J Horticul Sci* 69 (5) :799-804.

Gamit S, Patil SJ, Prajapti D (2017) Effect of post shooting foliar spray of fertilizers on quality parameters of banana (*Musa-paradisiacal* L.) cv Grand Nainc *Int J Cheml Stud* 5(4): 959-960.

Gomez KA, Gomez A A (1984) Statistical procedures for agricultural research (2nd edn.), John Wiley and Sons, New York.

Huanga H, Jimh G, Wanga H, Duana X, Qua H, Jianga Y (2014) The combined effects of phenylurea and gibberellins on quality maintenance and shelf life extension of banana fruit during storage. *Scientia Horticulturae* 167 : 36-42.

Kachhadia P, Tank RV, Bhanderi DR, Vagadia PS (2017) Response of post-shooting bunch spray of chemicals on yield of ratoon banana (*Musa paradisiaca* L.) cv Grand Nain *Trends Biosci* 10 (16) : 2951-2953

Kumar AR, Kumar N (2010) Effect of post-shooting spray of certain nutrients on yield and quality of banana cv. Ney Poovan (AB). *Agric Sci Digest,* 30(2), 125-128.

Kumar AR, Kumar N, Jeyakumar P (2008) Effect of post-shooting spray of Sulphate of Potash (SOP) on yielgical Sci 4(6): 655-659.

Mengel K, Kirkby EA (1987) Principles of Plant Nutrition, Inter national Potash Institute,Bern, pp 436- 437.

Nakasone HY, Paul R E (1998) Tropical fruits. CAB International New York.

Pathak P, Baruah K, Bhattacharyyaa RK, Kalita P, Baishya BK (2017). Influence of bunch covers on yield of banana cv. Jahaji (AAA) under high density planting system. *Int J Pure Appl Biosci* 5 (6) :1488-1493.

Patil SK, Shanmugasundarm S (2015) Physicochemical changes during ripening of Monthan banana. *Int J Technol Enhance ments Emerging Eng Res* 3 (2) : 18-21.

Pebbudi A, Bauri FK, Sarkar SK (2017) Effect of potassium spray on fruit quality and shelf life of banana cv Grand Naine (AAA). *Environ Ecol* 35 (1A) : 368-371.

Rajan R (2017) Effect of post shooting bunch spray of chemicals on bunch characters and yield of banana (*Musa paradisiaca* L.) cv. Grand Naine. MSc (Horti.) in Fruit Science thesis Submitted to Navsari Agricultural University, Navsari, Gujarat.

Ranganna S (1979) Manual of analysis of fruit and vegetable products. Tata McGraw Hill Publishing Company Ltd. New Delhi.

Santosh DT, Tiwari KN, Reddy RG (2017) Banana bunch covers for quality banana production – A review. *Int J Curr Microbiol Appl Sci* 6 (7) : 1275-1291.

Sarkar S (2014) Shooting-harvest interval and physico-chemical properties of banana (Musa AAA cv Grand Naine) in relation to micro climate inside the bunch cover. *The Asian J Hort* 9 (1): 40-42.

Seymour GB, Taylor JE, Tucker G A (1993). Biochemistry of fruit ripening Seymour GB, ed. Chapman and Hall, London, pp 83-106.

Stover RH, Simmonds NW (1987) Bananas. 3rd edition. Longman, Essex.

Tandon HLS, Sekhon GS (1988) Potassium Research and Agricultural Production in India. CAB Direct.

Tisdale SL, Nelson WL (1966) Soil Fertility and Fertilizers, Macmillan Co., London, pp 81.