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Influence of bunch feeding and bunch spraying on Post-harvest quality of tissue culture banana cv. Ney poovan

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Abstract
The present study was conducted to know the effect of post shooting bunch management practices like bunch feeding and bunch spraying on Post-harvest quality of tissue culture banana cv. Ney poovan. The distal stalk of banana bunches were fed with different nutrient sources like urea, sulphate of potash, banana special and organic formulations like panchagavya and amritpani. The bunch spraying was done with 2,4-D (30 ppm). The results revealed that bunch feeding with urea (7.5g)+ SOP(7.5g) along with bunch spraying with 2,4, -D (30 ppm)has recorded significantly more green life (5.90 days), shelf life (7.52 days), peel weight (73.80 g), pulp weight (11.00 g), pulp to peel ratio (6.78), dry weight (23.59 g) and lowest PLW (12.70%).Whereas bunch feeding with SOP(7.5g) and banana special (0.2%) along with bunch spraying with 2,4, -D (30 ppm)has recorded significantly higher total soluble solids (23.80 ^{0}Brix), reducing sugar (18.35%), non-reducing sugar (3.35%), total sugar (21.70%), sugar to acid ratio (89.18%), ascorbic acid (0.89 mg/ 100g),lower fruit cracking (3.30%)and lowest titratable acidity (0.24%)as compare to control (without bunch feeding and bunch spraying).

Keywords: Banana, bunch feeding**,** bunch spraying, Ney poovan. quality

Introduction
Banana (*Musa accuminata* L.) belongs to the family Musaceae. It is one of the oldest fruits known to mankind. Banana is the leading fruit crop in tropical and subtropical regions of the world. It is a staple food of millions of people across the globe. It is rich source of easily digestible carbohydrates with a calorific value of 67-137 per100 g fruit vitamins and minerals and it does not contain fat, cholesterol or sodium. Ney Poovan (Elakkibale) is the choicest diploid cultivar, which is under commercial cultivation on a large scale, especially in hill zone of Karnataka. It is medium tall plant takes 12 -13 months to complete its crop cycle. Fruit is highly fragrant, tasty and firm. Among all the cultivars Ney Poovan fetches higher price in the market due to its good keeping quality.

Banana is a heavy feeder of nutrients and requires continuous supply of nutrients and water in large quantities for its growth, development and yield. Any limitations in the supply of photosynthates at crucial stages affect the bunch size and quality. Because of this problem poor filling and development of finger is often reported in all most all cultivars of commercial importance (Jeyakumar *et al*., 2010). Banana plant is supplied with nutrients through soil, foliar spray, de-navelling (removal of male inflorescence for nutrient diversion) and post-shoot feeding of nutrients through the distal stalk-end of rachis and bunch spray of various nutrients and growth regulators to achieve higher yields. After shooting the rate of nutrient uptake slowdowns therefore direct application of nutrients through distal stalk and direct bunch spraying helps in increasing the yield and quality of banana

Material and Methods
The present investigation was carried out at department of fruit science, College of Horticulture, Mudigere during 2017-18. The principle objective was to study the effect of bunch feeding and bunch spraying on pos-harvest and quality attributes of tissue culture banana cv. Ney poovan. The primary hardened tissue culture plants were brought from well-maintained private tissue culture laboratory near AHRS, Sringeri. The plants were subjected for secondary hardening in the naturally ventilated poly house and open field condition for 15-20 days and then healthy, vigorous, pest and disease free plants were selected and used for

planting. The plots were kept free from weeds by regular weeding. Irrigation schedule was followed according to the requirements. Earthling up was followed whenever soil became compact. De-suckering was done regularly till shooting and a single sucker was allowed to grow after shooting in opposite direction of existing bunch. Along with de-suckering other cleaning activities and plant protection measures were also carried out accordingly. Bunch feeding was done by using fresh cow dung (500g) and water (100 ml) in a polythene bag after the opening of last female hand by removing the male bud (Denavelling). Bunch spray was done three times i.e, first spary at the time of shooting, second at one month after first spray, third spray at two months after first spray.

The experiment was laid out in a Randomized complete block design(RCBD) with three replications and eight treatments *viz.*, T_1 (Control -without bunch feeding and bunch spraying), T_2(Bunch feeding with Urea 7.5 g + SOP 7.5 g),T_3 (Bunch feeding with Panchagavya 5% + Amritpani 5%), T_4(Bunch feeding with SOP 7.5g + Banana special 0.2%), T_5 (Bunch spray with 2, 4-D 30ppm + T_2-Bunch feeding with Urea 7.5 g + SOP 7.5 g), T_6(Bunch spray with 2,4-D 30ppm + T_3 - Bunch feeding with Panchagavya 5% + Amritpani 5%), T_7(Bunch spray with 2, 4-D 30ppm +T_4- bunch feeding with SOP 7.5g + Banana special 0.2%) and T_8(Bunch spray with 2, 4-D 30ppm).

Results and Discussion

The results revealed that bunch feeding and bunch spraying has significantly influences the post -harvest and fruit quality parameters of tissue culture banana cv. Ney poovan.

Post-harvest attributes

In the present experiment the post-harvest attributes like green life, shelf life, peel weight, pulp weight, pulp to peel ratio, dry weight, physiological loss (PLW) in weight and fruit cracking percent were studied (Table 1). Among different treatments T_5 (Bunch spray with 2, 4-D 30 ppm + T_2-Bunch feeding with Urea 7.5 g + SOP 7.5 g) has shownmoregreen lifeie., number of days taken for complete yellowing of harvested fruit (5.90 days), shelf life (7.52 days), peel weight (73.80 g), pulp weight (11.00 g), pulp to peel ratio (6.78), dry weight (23.59 g) and lowest PLW (12.70%).This could be attributed to the potassium nutrient supplied through bunch feeding enhances storage and shipping quality of bananas and also extends their shelf life (Mengel, 1997). Among the various nutrients, potassium not only improves yields but also benefits various aspects of fruit quality. It also promotes long shelf life and adequate processing quality for the industry. This is evident from the fact that, low potassium nutrition results in thin and fragile bunches with a shortershelf life (Uexkll, 1985). This can also be attributed to increase in peel thickness of the fruits, which resulted in more firmness of the fruits. Increase in green life of fruit might be due to a reduced rate of respiration and ethylene production by potassium application, as reported by Singh and Chuhan (1982) [18]. In addition to this, potassium element is also responsible for maintaining cytokinin level concentration in the plants which delay senescence, in turn contributing to enhanced green life (Bose *et al.*,1998) [4]. Extended shelf life with sulphate of potash might be due to the lesser physiological loss in weight experienced in fruits (Kumar and Kumar, 2010) [9]. Similarly, the extended shelf life was observed in Ney Poovan banana by Kumar and Kumar (2010) [9] by spraying 1.5 per centsulphate of potash, Kumar *et al*. (2008) [7] in Robusta, Nandan Kumar *et al*. (2011) [12] in cv. Nanjanagudu Rasabale and Kumar and Bangarusamy (2006) [10] in cv. Rasthali by spraying 1.0 per cent potassium chloride.

The increase in pulp thickness may be related to the role of potassium in influencing the developing fruit, which acts as a strong sink for potassium than for other nutrients. (Kumar *et al.*, 2006) [10]. Peel thickness was significantly influenced by potassium application, which has multiple enzymatic and catalytic functions used in many photosynthetic and metabolic processes in plants and increased the peel thickness of orange fruit (Omaima and Metwally, 2007) [13]. The increase in fruit dry weight is due to increase in finger weight and pulp weight due to urea and potassium which have direct effect on the total dry matter production in banana. Similar findings were recorded by Kumar *et al*. (2008) [7] in Robusta, Nandankumar *et al*. (2011) [12] in cv. Nanjanagudu Rasabale, Kumar (2007 and 2010) [9] in cv. Neypoovan.

Quality attributes

The fruit quality is measured by various biochemical constituents of the fruit. In the present experiment influence of bunch feeding and bunch spraying on fruit quality parameters like Total soluble solids, reducing sugar, non-reducing sugar, total sugar, sugar to acid ratio, ascorbic acid and titratable acidity and was studied (Table 2).

T_7(Bunch spray with 2, 4-D 30ppm + T_4- bunch feeding with SOP 7.5g + Banana special 0.2%) has recorded significantly higher total soluble solids (23.80 ^{0}Brix), reducing sugar (18.35%), non-reducing sugar (3.35%), total sugar (21.70%), sugar to acid ratio (89.18%).Total sugars are the combination of both reducing and non reducing sugars. In the present investigation both total, reducing and non reducing sugar content of the Ney poovan banana fruits varies significantly among the treatments. This might be due to potassium is involved in carbohydrate synthesis, breakdown and translocation and synthesis of protein and post shooting application of potassium favours the conversion of starch into simple sugars during ripening by activating sucrose synthase enzyme, resulting in high sugar content of the fruit. Result of this investigation is in close confirmation with findings of Nandan Kumar *et al.*, 2011 [12] in cv. Nanjangudurasabale and Kumar *et al.* (2008) [7] in cv. Robusta. Enhanced quality of fruits particularly the sugar content might be due to the role of sulphate (SO_4) ions released from sulphate of potash as sulphate favoured, while chloride reduced, the activity of anabolic enzymes and resulted in accumulation of highly polymerized carbohydrates (starch), which would have subsequently disintegrated into sugars on ripening (Alagarsamy and Neelakandan, 2008) [1]. Further, application of 2,4-D stimulates the synthesis of protein, sucrose phosphate synthase, an enzyme important for the synthesis of sucrose in leaves was also affected by the 2,4-D treatment. The results showed that net photosynthetic rate and sucrose phosphate synthase activity of treated plants increased with 2,4-D. (Mohammad *et al.*, 2015) [11].

Table 1: Effect of bunch feeding and bunch spraying on post- harvest parameters of tissue culture banana cv. Ney poovan

Treatment No.	Treatment details	Green life (days)	Shelf life (days)	Physiological loss in weight (%)	Pulp weight (g)	Peel weight (g)	Pulp to peel ratio	Dry weight (g)	Fruit cracking (%)
T_1	Control	4.07	5.83	16.81	48.07	8.41	5.73	18.90	6.14
T_2	Bunch feeding with Urea 7.5 g + SOP 7.5 g	5.17	7.13	13.05	64.97	10.28	6.36	21.10	4.25
T_3	Bunch feeding with Panchagavya 5%+Amritpani 5%	4.50	6.40	13.50	53.40	9.20	5.77	19.88	4.37
T_4	Bunch feeding with SOP 7.5 g +Banana special 0.2%	4.97	6.93	13.32	60.00	9.57	6.27	20.85	3.31
T_5	Bunch spray with 2, 4-D 30 ppm + T_2	5.90	7.52	12.70	73.80	11.00	6.78	23.59	4.13
T_6	Bunch spray with 2,4-D 30 ppm + T_3	5.07	7.07	13.18	60.76	9.67	6.30	21.07	4.33
T_7	Bunch spray with 2, 4-D 30 ppm + T_4	5.64	7.20	12.94	70.83	10.50	6.61	22.75	3.27
T_8	Bunch spray with 2, 4-D 30 ppm	4.97	6.60	13.40	54.97	8.98	5.83	20.10	4.26
S.Em+		0.15	0.11	0.18	1.05	0.17	0.18	0.31	0.14
C.D @ 5%		0.46	0.33	0.56	3.19	052	0.55	0.94	0.43

Table 2: Effect of bunch feeding and bunch spraying on quality parameters of tissue culture banana cv. Ney poovan

Treatment No.	Treatment details	TSS (^{0}Brix)	Reducing sugar (%)	Non reducing sugar (%)	Total sugar (%)	Titaratable acidity (%)	Sugar to acid ratio	Ascorbic acid (%)
T_1	Control	19.66	15.75	1.80	17.55	0.38	46.18	0.58
T_2	Bunch feeding with Urea 7.5 g + SOP 7.5 g	21.33	17.48	2.26	19.73	0.30	66.52	0.89
T_3	Bunch feeding with Panchagavya 5% +Amritpani 5%	20.00	16.73	2.04	18.77	0.33	57.45	0.61
T_4	Bunch feeding with SOP 7.5 g + Banana special 0.2%	21.40	17.55	2.32	19.87	0.28	70.95	0.86
T_5	Bunch spray with 2, 4-D 30 ppm + T_2	22.82	17.83	3.31	21.14	0.26	81.31	0.93
T_6	Bunch spray with 2,4-D 30 ppm + T_3	21.10	17.04	2.07	19.07	0.32	60.22	0.81
T_7	Bunch spray with 2, 4-D 30 ppm + T_4	23.80	18.35	3.35	21.70	0.24	89.18	0.90
T_8	Bunch spray with 2, 4-D 30 ppm	20.40	16.81	2.23	19.07	0.29	66.51	0.63
S.Em+		0.33	0.21	0.09	0.21	0.01	2.44	0.33
C.D @ 5%		1.00	0.65	0.28	0.65	0.03	7.40	0.19

Higher ascorbic acid (0.89 mg/ 100g), lower fruit cracking (3.30%) and lowest titratable acidity (0.24%) was recorded in T_7 (Bunch spray with 2, 4-D 30 ppm + T_4- bunch feeding with SOP 7.5g + Banana special 0.2%) as compare to control (without bunch feeding and bunch spraying).Increased ascorbic acid content in the fruits might be of potassium and sulphur could have helped to slow down the enzyme system that encouraged the oxidation of ascorbic acid, thus helping the plants to accumulate more ascorbic acid content in the fruits (Ananthi *et al.*, 2004) [2]. The lower percentage of fruit cracking might be due to the micronutrients might have stimulated overall growth of banana fruits and thereby reduced fruit cracking in this study. The findings are in agreement with those of Belsare (2011) [3] who observed reduced fruit cracking in pomegranate due to foliar application of micronutrients. Since boron is required for the stability and extensibility of the cell wall, thus responsible for the cell turgidity (Ram and Bose, 2000) [16].

The decrease in the level of titratable acidity due to Increased potassium application reduced the acid content of fruits, this could be due to the fact that under low potassium regime, phosphoenol pyruvate (PEP) was apparently shunted into alternate pathways resulting in a shortage of acetyl CO-A (Pattee and Teel 1967) [15]. Hence, oxalo acetate appeared to be preferentially formed from PEP in plants with low levels of potassium and this organic acid derivative accumulated. Neutralization of organic acids due to a high potassium level in tissues could have also resulted in the reduction in acidity (Tisdale and Nelson 1966) [20]. Micronutrient mixture (Banana special) treatments resulted in a reduction of acidity, this might be due to more accumulation of sugar in fruit (Singh and Rajput, 1976) [19]. These results were in close conformity with the findings in cv. Basrai (Patel *et al.*, 2010) [14]

Conclusion

Banana being a nutrient loving plant requires large amount of nutrients for its proper growth and to produce good quality produce. But usually after emergence of shoot (beginning of reproductive stage) the rate of nutrient uptake from the soil decreases, hence farmers have to find the alternate methods of nutrient application in order to get good yield with quality fruits with this context direct providing nutrients through denavelled bunch stalk (bunch feeding) and bunch spraying of nutrients and growth regulators are the sustainable bunch management practices to improve quality of the fruits. Hence from the results obtained in the present study, it can be concluded that the treatment T_5 (Bunch spray with 2, 4-D 30 ppm + T_2 -Bunch feeding with Urea 7.5 g + SOP 7.5 g) proved to be best for improving post-harvest parameters like green life, shelf life, peel weight, pulp weight, pulp to peel ratio, dry weight. Whereas, T_7 (Bunch spray with 2, 4-D 30 ppm + T_4- bunch feeding with SOP 7.5 g + Banana special 0.2%) proved to best for quality parameters like Total soluble solids, reducing sugar, non-reducing sugar, total sugar, sugar to acid ratio, ascorbic acid, with lower titra table acidity and lower fruit cracking percent.

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