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STUDIES ON BANANA BUNCH IMPROVEMENT THROUGH SUPPLEMENTATION OF BUNCH SPRAYS OF POTASSIUM

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ABSTRACT

The present experiment entitled "Studies on banana bunch improvement through supplementation of bunch sprays of potassium" was conducted at AICRP on Fruits (Banana), Banana Research Station, Jalgaon during 2020-2021, 2021-22 and 2022-23 for three years. The experiment was laid out in Randomized Block design with eight treatments and four replications. The treatments were control i.e. no spray (T_1), water spray (T_2), 0.5% KH_2PO_4 (Potassium dihydrogen phosphate)+1%Urea (T_3), 0.6% Potassium silicate (T_4), 0.2% Brassinosteroid (T_5), 2 % Sulphate of potash (T_6), 1.0% Potassium halite (T_7) and 1.0% Potassium shoenite (T_8). Two sprays of each treatment were given. First spray was given immediately after removal of male bud and second spray 15 days after first spray. The recommended dose of fertilizers was common to all the treatments and was given through fertigation. The results of the investigation revealed that the 2%Sulphate of potash increasesthe yield and quality. It recorded the highest finger length, girth, finger weight, bunch weight and yield (t/ha) and enhanced the fruit quality in terms of pulp: peel ratio, TSS, acidity, total sugars and shelf life. This treatment also recorded the higher net montary returns and highest B:C ratio.

Keywords **:** Banana, bunch improvement, supplementation, Sulphate of Potash.

Introduction

Maharashtra is the largest producer of banana and is coming up as the largest exporter of banana. Finger quality is vital to domestic a as well as export. Nutrient plays significant role in the finger quality. In general, nutrient schedules are designed so that complete dose of fertilizers is applied to banana before shooting stage. However, banana needs nutrients during bunch development stage also. Evidences suggest that post shooting bunch sprays respond well to the nutrients and growth regulators. Many workers have reported the positive results with the use of Sulphate of Potash (Nethravathi *et al*., 2021; Wagle *et al.* 2022). With this view present investigation was carried to study the effect of post shooting supplementation of different nutrients and growth regulators on bunch of banana cv. Grand Nain with the objective to improve the quality and grade of bunch

Materials and Methods

The experiment was carried out at AICRP on Fruits (Banana), Banana Research Station, Jalgaon during 2020-2021, 2021-22 and 2022-23 for three years. The experiment was set in Randomized Block design with eight treatments and four replications. The treatments were Control i.e. no spray (T_1), water spray (T_2), 0.5% KH_2PO_4 (Potassium dihydrogen phosphate) +1%Urea (T_3), 0.6% Potassium silicate (T_4), 0.2% Brassinosteroid (T_5), 2 % Sulphate of potash (T_6), 1.0% Potassium halite (T_7) and 1.0% Potassium shoenite (T_8). The treatment unit comprised of twelve (12) plants.

Two sprays of each treatment were given. First spray was given immediately after removal of male bud and second spray 15 days after first spray. The recommended dose of fertilizers was common to all the treatments and was given through fertigation. Observations were recorded on bunch and finger

parameters, bunch weight, TSS, acidity, reducing and non-reducing sugars, total sugars, pulp: peel ratio and shelf life. Economics of different treatments were also worked out.

Results and Discussion

The data regarding the effect of different post shooting bunch sprays on yield and yield attributing characters are presented in the Table.1. Results revealed significant influence due to all the spaying treatments on bunch parameters and yield.

Finger length (cm)

Significant differences were observed in finger length due to post shooting bunch sprays.Significantly highest finger length was recorded in the treatment T_6 (2 % Sulphate of potash) which recorded 23.06 cm finger length. However, it was on par with the treatment T_3 (0.5%KH_2PO_4 +1%Urea) and it recorded 22.85 cm finger length.Similar results were obtained by Kumar and Kumar (2007,2010)in *cv*. Ney Poovan; Nandan kumar *et al.* (2011); Patil *et al.* (2018); Garasangi *et al.* (2018) in Rajapuri ; Mude *et al*. (2020) in banana and Taram *et al*. (2023) in banana.

Increase in finger length due to bunch spray of 2 % Sulphate of Potash might be due its impact on cell development and cell division, along with the sulphur which has synergistic effect with zinc, which is essential for the cell elongation by increasing the cell permeability to water and osmotic solutes of the cells.

Finger girth (cm)

Finger girth was also significantly influenced by the post shooting sprays with different chemicals and significantly the highest finger girth of 13.57 cm was recorded by the treatment T_6 (2 % Sulphate of potash). It was statistically on par with the treatment T_3 (0.5%KH_2PO_4 +1%Urea) which had 13.39 cm finger girth. Kumar and Kumar (2007), Patil *et al.* (2018) and Taram *et al*. (2023); Kumar and Kumar (2010) in *cv*. Ney Poovan, Nandankumar *et al.* (2011); Garasangi *et al.* (2018) in banana cv. Rajapuri and Mude *et al*. (2020) in banana reported positive results with the spray of Sulphate of Potash. Paradava *et al*. (2021) reported maximum finger girth in banana cv. Grand Naine with GA_3 100 ppm bunch but it was on par with 1.5 per cent Sulphate of Potash indicating the importance of Sulphate of Potash in enhancing the finger girth.

Increased finger girth with spray of Sulphate of Potash might be due to the additional supply of potassium which would have helped in cell division and cell expansion by their effect on DNA and RNA synthesis. In addition, potassium have direct impact on photosynthesis, translocation of photosynthates and water balance in banana plant and presence of sulphur has synergistic effect with zinc which help to cell elongation by increasing the cell permeability to water and osmotic solutes of the cells and increase absorption of potassium and its action with nitrogen which cause more accumulation of food material cause increase in bunch width of banana.

Finger weight (g)

Finger wieght is imporatnt economic character as it directly contributes to the bunch weight and the yield.Significant influence of the post shooting sprays with different chemicals and significantly the highest finger weight was recorded by the treatment T_6 (2 % Sulphate of potash) which recorded 166.70 g finger weight. This treatment was statistically on par with the treatments T_3 (0.5%KH_2PO_4 +1%Urea) and T_4 (0.6 % Potassium silicate) recording 162.74 g and 158.06 g finger wieght. Results are in conformity with Kumar and Kumar (2007); Kumar *et al.* (2008) and Kumar and Kumar (2010) in banana *cv.* Robusta; Nandankumar *et al.* (2011) in Nanjangudu Rasabale; Shetty *et al.* (2015) and Sandhya *et al.,* (2018) in banana *cv*. Grand Naine; Patil *et al.* (2018) in Gran Naine; Garasangi *et al.* (2018) in Rajapuri; Mude *et al*. (2020); and Taram *et al*. (2023) in banana.

Increased finger length and finger girth along with the higher pulp content would have resulted in increased weight of finger.Rapid multiplication of cells and greater accumulation of sugars or carbohydrates and water in expanded cells after enlargement would also have contributed to the increase in finger weight (Kumar and Kumar, 2010).

Bunch weigth (kg)

Significant influence of the post shooting sprays with different chemicals was on the bunch weight was noticed. Significantly the highest bunch weight was observed in the treatment T_6 (2 % Sulphate of potash) which has recorded 27.42 kg bunch weight.This treatment was on par with the treatments T_3 (0.5% KH_2PO_4 + 1% Urea) which recorded 27.06 kg bunch weight. These findings are in accordnace with the findings of Shetty *et al.* (2015) who recorded highest bunch weight with bunch spray of 2 per cent Sulphate of Potash in banana cv. Grand Naine.Similar findings were reported by Kumar and Kumar (2007) in banana cv. Ney Poovan; Garasangi *et al.* (2018) in banana cv. Rajapuri; Paravada *et al*. (2021) in banana cv. Grand Naine and and Taram *et al.* (2023) in banana. Millik *et al*. (2018) also registered increased bunch weight in banana cv. Borjahji when bunches were fed with the

nutrient combination of 500 g fresh cow dung, 7.5 g each of SOP and urea.

The increase bunch weight can be attributed to the cumulative effect of yield contributing character such like finger length, finger girth and finger weight and also Pulp: Peel ratio. Availability of potash during bunch development stage would have increased the efficiency of metabolic processes resulting in increased growth of plant in general (Shetty *et al.*, 2015). Retention of chlorophyll pigment during the post-shooting growth stage helps fruit bunches accumulate photosynthates, thus contributing to fruit bunch size, days to maturity and yield. Potassium is a general metabolic activator, increasing the respiration and photosynthetic rate (Evans, 1971; Martin-Prevel, 1972). The favorable influence of K_2SO_4 as compared to other nutrients on the production of heavier bunches might be attributed to the heavier dry matter and starch accumulation and additionally promoted by the sulphur present in K_2SO_4 (Kumar *et al.,* 2008).

Yield (t/ha)

Post shooting sprays with different chemicals had significant influence on the yield (t/ha). The treatment T_6 (2 % Sulphate of potash) recorded the significantly highest yield of 121.84 t/ha yield and was on par with the treatments T_3 (0.5%KH_2PO_4 +1%Urea) and T_4 (0.6 % Potassium silicate) recording 120.24 t/ha and 115.84 t/ha yield. Similar findings were reported by Kumar and Kumar (2007) in banana cv. Ney Poovan; Patil *et al*. (2018) and Paravada *et al*. (2021) in banana cv. Grand Naine and Taram *et al.* (2023) in banana.

Increased yield might be due to collective increase in bunch and finger characters such as, finger length, finger girth, finger weight, pulp weight. Further, application of potassium in banana plants directly affects photosynthesis, translocation of photosynthates and the water balance in plants and fruits as well as presence of Sulphur in SOP had a synergistic effect with zinc, which is essential for carbon dioxide absorption and utilization and zinc is also participate in chlorophyll formation, which improves the photosynthetic activity of the crop (Kumar and Kumar, 2008; Patil *et al*. 2018). Sulphur application increased the yield since it is a constituent of amino acid and protein production (Ahmed *et al.,* 1998).

The observation on quality parameters namely Pulp : Peel ratio, TSS, acidity, total sugars and shelf life are depicted in Table 2.All these parameters exhibited significant differences due to post shootign spraying treatments.

Pulp : Peel ratio

As evident from the Table 2, significantly the highest pulp: peel ratio (3.37) was recorded in the treatment T_6 (2 % Sulphate of potash) over rest of treatments except the treatment T_3 (0.5% KH_2PO_4 + 1% Urea) which was on par with the treatment T_6 which had 3.23 pulp: peel ratio. Results are in close agreement with Kumar and Kumar, (2007) in Ney Poovan; Garasangi *et al.* (2018) in banana cv. Rajapuri; Sreekanth *et al.* (2018) in banana cv. Robusta; Nayak *et al.* (2022) in banana cv.Champa and Wagle *et al.* (2022) in banana cv. Grand Naine.

Higher pulp: peel ratio might be due to the beneficial role of potassium for better pulp recovery and less physiological loss in weight of fruits and thereby increasing the pulp weight and good pulp recovery. According to Nandankumar *et al.* (2011) nutrients supplied would have been utilized for cell elongation of fruits and formation of larger intercellular spaces during later part of fruit growth.

TSS (^{0}B)

Total soluble solids content of fruit differed significantly among the different treated bunches over control (Table 2). Total soluble solids (TSS) a prime factor which determine the quality of fruits was the significantly highest (20.28° Brix) in the treatment T_6 (2% Sulphate of potash). However, this treatment was statistically on par with the treatment T_3 (0.5%KH_2PO_4 +1%Urea) and T4 (0.6 % Potassium silicate) which registered 20.14^{0}B and 20.06 ^{0}B, TSS respectively. Results are accordance with Kumar *et al.* (2008); Kumar and Kumar (2010); Kachhadia *et al*. (2017); Sreekanth *et al.* (2018) in banana cv. Robusta and Paradava *et al*. (2022).

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.

Acidity (%)

The data with respect to the Acidity presented in Table 2, clearly indicated that the acidity was observed to higher in the treatments T_1(No spray) and T_2 (Water spray) and recorded 0.37 % acidity, Whereas the lowest acidity was recorded by the treatments T_6 (2 % Sulphate of potash) and T_3 (0.5%KH_2PO_4 +1%Urea) which had 0.30 % and 0.31 % acidity, respectively. Treatment T_4has also reported lower acidity.Akin results were reported by Kumar and Kumar (2007 and 2010) in *cv*. Neypoovan, Shira *et al*. (2012) in

Martman; Sreekanth *et al*. (2018) in Robusta; Sahu (2019) and Khalasi *et al.* (2021) in Grand Naine.

Increased level of potassium application results in reduced acid content of fruits. Under low potassium regime, phosphoenol pyruvate (PEP) was apparently shunted into alternate pathways resulting in a shortage of acetyl CO-A10. Hence, oxalo acetate appeared to be preferentially formed from PEP in plants with low levels of potassium and this organic acid derivative underwent accumulation Hasan *et al*. (1999).

Total sugars (%)

With regards to total sugars presented in the Table 2, revealed significant differences due to post shooting sprays of different chemicals. As evident from the Table 2, the treatment T_6 (2 % Sulphate of potash) had significantly the higehst total suagrs (17.91 %) and was on par with the treatments T_3 (0.5%) KH_2PO_4 +1%Urea) and T_8 (1.0 % Potassium shoenite) which recorded 17.69 (%) and 17.31 (%) total suagrs, respectively. Results are in line with Shira *et al.* (2013) in banana cv. Martman; Gamit *et al.* (2017); Sandhya *et al.* (2018); Patil *et al.* (2018)and Paradava *et al.* (2022) in banana cv. Grand Naine.

Sugar content is an important quality parameter and higher sugar content can be explained as potassium plays a major role in carbohydrate synthesis, breakdown and translocation and synthesis of protein and neutralization of physiologically important organic acids (Tisdale and Nelson, 1966). Potassium is involved in phloem loading and unloading of sucrose and amino acids which stores in the developing fruits in the form of starch as reported by Mengel (1997). Application of K_2SO_4 was found to be good in increasing sugar percent as potassium plays a major role in synthesis of carbohydrate and protein breakdown and translocation of organic acids.The potassiumwhen supplied in form of sulphate of potash favours conversion of starch into simple sugars during ripening activating the sucrose synthetase enzyme thus resulting in higher sugar percentage (Kumar and Kumar, 2007).

Shelf life

As regards the shelf life(Table 2), the treatment T_6 (2 % Sulphate of potash) had significantly the highest shelf life of 7.64 days. This treatment was on par with the treatments T_3 (0.5%KH_2PO_4 +1%Urea) and T_4 (0.6 % Potassium silicate) which recorded 7.42 and 7.40 days, respectively. Similar findings were reported by Kumar and Kumar (2007) with 1.5 percent Sulphate of Potash in banana cv. Ney Poovan. Kumar and Kumar, 2010 reported that extended shelf life by bunch fed with sulphate of potash might be due to the lesser Physiological loss in weight experienced in fruits. Similarly, the extended shelf life was found in Ney Poovan banana by Kumar and Kumar (2007 and 2010), Kumar *et al.,* (2008) in Robusta and Nayak *et al.* (2022) in Champa.

Extended shelf life might be due to the minimum respiration rate which is thought to be due to its anti-senescence properties, inhibition of ethylene biosynthesis or reduced rate of metabolism. Higher shelf life with bunch feeding was earlier recorded by Sahu (2019).

Economics

Economics of the post shooting spray treatments with different chemicals depicted in the Table 3 revealed that the treatment T_6,2 % Sulphate of potash realized the maximum grossreturns (Rs.1218073/-), net returns (864435/-) and the highest B:C ratio of 3.44. This was followed by the treatment T_3 (0.5%KH_2PO_4 +1%Urea) which record Rs. 1202388/- monetary returns and 848760/- net returns with 3.40 B:C ratio. Present findings are in corroboration with the findings of Kumar and Kumar (2007) in banana cv. Ney Poovan; Patil *et al*. (2018)in banana cv. Grand Naine and Nethravati *et al*., 2021 in banana cv. Rajapuri.

Conclusion

Post-shooting bunch spray significantly increased the yield and quality of banana.Sulphate of potash2% found to be promising as it recorded increase in yield and quality. It recorded the highest finger length, girth, finger weight, bunch weight and yield (t/ha) and enhanced the fruit quality in terms of pulp: peel ratio, TSS, acidity, total sugars and shelf life. This treatment found economically feasible asit realized higher net montary returns and higest B:C ratio.

Table 1 : Effect of post shooting sprays with different chemicals onbunch parameters and yield of banana cv. Grand Naine (Pooled over 3 years)

Tr. No.	*Treatment*	Finger length (cm)	Finger girth(cm)	Finger weight(g)	Bunch weight (kg)	Yield (t/ha.)
T_1	No spray	20.19	10.97	148.23	23.76	105.57
T_2	Water spray	20.26	11.13	149.12	23.90	106.23
T_3	0.5%KH_2PO_4 +1%Urea	22.85	13.39	162.74	27.06	120.24

T_4	0.6% Potassium silicate	21.35	12.17	158.06	26.07	115.84
T_5	0.2% Brassinosteroid	21.29	11.96	152.80	25.40	112.89
T_6	2 % Sulphate of potash	23.06	13.57	166.70	27.42	121.84
T_7	1.0% Potassium halite	21.12	12.01	153.32	25.75	114.43
T_8	1.0% Potassium shoenite	21.22	12.09	154.93	25.80	114.67
	SE ±	0.22	0.28	2.62	0.46	2.05
	CD at 5%	0.69	0.86	8.04	1.41	6.27

Table 2 : Effect of post shooting sprays with different chemicals onquality characters and shelf life of banana cv. Grand Naine(Pooled over3 years)

Tr.No.	*Treatment*	TSS (^{0}B)	Acidity (%)	Pulp : peel ratio	Total sugars (%)	Shelf life (Days)
T_1	No spray	18.72	0.37	2.47	15.55	5.69
T_2	Water spray	18.73	0.37	2.54	15.65	5.86
T_3	0.5% KH_2PO_4 + 1% Urea	20.14	0.31	3.23	17.69	7.42
T_4	0.6 % Potassium silicate	20.06	0.32	3.01	17.24	7.40
T_5	0.2% Brassinosteroid	19.54	0.35	2.73	16.88	6.64
T_6	2 % Sulphate of potash	20.28	0.30	3.37	17.91	7.64
T_7	1.0 % Potassium halite	19.58	0.34	2.93	17.11	7.16
T_8	1.0 % Potassium shoenite	19.64	0.33	2.97	17.31	7.19
	SE ±	0.09	0.006	0.10	0.20	0.14
	CD at 5%	0.28	0.020	0.32	0.60	0.44

Table 3 : Economics of post shooting sprays of differentchemicals on banana cv. Grand Naine. (Pooled mean of 3 years)

Tr.No.	Treatment	Yield (t/ ha)	Gross income (Rs. ha^{-1})	Cost of cultivation (Rs. ha^{-1})	Net income (Rs. ha^{-1})	B:C ratio
T_1	No spray	105.57	1056728	352293	704435	3.00
T_2	Water spray	106.23	1063272	353397	709875	3.01
T_3	0.5%KH_2PO_4 +1%Urea	120.24	1202388	353629	848760	3.40
T_4	0.6% Potassium silicate	115.84	1159358	353416	805942	3.28
T_5	0.2% Brassinosteroid	112.89	1123453	354604	768850	3.17
T_6	2 % Sulphate of potash	121.84	1218073	353638	864435	3.44
T_7	1.0% Potassium halite	114.43	1149413	353462	795951	3.25
T_8	1.0% Potassium shoenite	114.67	1152702	353760	798942	3.26

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