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Management of Secondary Nutrients in Acid Soils and its Effect on Quality of Banana cv. Ney Poovan

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ABSTRACT: An experiment was conducted in farmer's field at Aldur village, Mudigere taluk, Chikkamagalur district during the year 2021-2022. The experiment was laid out in Randomized Block Design, comprising eleven treatments with three replications. Observations were recorded on various post- harvest and biochemical parameters. Maximum green life (5.60 days), shelf life (10.46 days), fruit weight at ripe stage (80.74 g), pulp weight (70.39 g), peel weight (10.35 g), pulp to peel ratio (6.80), firmness(1.56 lbs), TSS (27.73ºBrix), reducing sugars (17.51 %), non-reducing sugars (3.31 %), total sugars (20.82%) and sugar to acid ratio (79.08) were recorded in T_9 - RDF + 500g of Mixture -1 (Agricultural lime: Dolomite: Gypsum - 1:1:1) with minimum titratable acidity (0.26 %). The present findings are feasible in acid soils of Karnataka for profitable production of banana.

Keywords: Banana, Ney Poovan, Secondary nutrients, Biochemical and Postharvest.

INTRODUCTION

Banana (*Musa* spp.) is the second most important fruit crop in India next to mango. Its year- round availability, affordability, varietal range, taste, nutritive and medicinal value makes it the favourite fruit among all classes of people. It has also good export potential. Banana evolved in the humid tropical regions of South East Asia with India as one of its centres of origin. Modern edible varieties have evolved from the two species – *Musa acuminata* and *Musa balbisiana* and their natural hybrids, originally found in the rain forests of South East Asia. In India, area and production of banana are 924 thousand hectares and 33062 thousand MT. In Karnataka, area and production of fruit crops are 425.71 thousand hectares and 7995.97 thousand MT. The area and production of banana in Karnataka are 128.76 thousand hectares and 3367.67 thousand MT. In Karnataka, banana is growing in Bangalore, Chitradurga, Shimoga, Hassan and Chikkamagalur. Important banana varieties cultivated are Dwarf Cavendish, Robusta, Rasthali, Poovan, Monthan and Elakkibale (Anon., 2021). Among the different banana cultivars, 'Ney Poovan' is the most popular and commercially cultivated cultivar, especially in Tamil Nadu and Karnataka. It is also called Elakkibale (Puttabale). The fruits are small in size and extremely sweet (Marriott *et al.*, 1981).

Soils that have a pH value of less than 5.5 for most of the year are called acid soils. They are formed when the basic elements like calcium, magnesium, potassium etc. have been washed down by high rainfall. So, strongly acidic soils are always deficient in calcium in calcium and magnesium. Hence, in acid soils application of secondary nutrients are essential and applied in the form of agricultural lime, dolomite and gypsum.

Agricultural lime, dolomite and gypsum contains the secondary nutrients such as calcium, magnesium and sulfur which are required for growth and development of plants. Agricultural lime is calcium carbonate ($CaCO_3$) and it contains 37– 40 per cent calcium. It improves the physical, chemical and biological properties of the soil, increase the availability of nutrients to plants and reduces the toxicities in the soil. Dolomite is a form of limestone contains 22 per cent Ca and 13 per cent Mg respectively. It increases nutrient uptake in roots and strengthens the root system. Gypsum is calcium sulfate which supplies calcium and sulfur to plants. It is expressed as $CaSO_4$. 2 H_2O and it contains 23.3 per cent calcium and 18.6 per cent sulphur. It improves acid soils and treats aluminium toxicity and improves water infiltration. Gypsum does not reduce soil pH under non-sodic condition (Wallace, 1994).

MATERIALS AND METHODS

The experiment was conducted in farmer's field at Aldur village, Mudigere taluk, Chikamagalur district during the year 2021-2022. The experimental site comes under hill zone of Karnataka at 13°24´ North latitude, 75°64´ East longitude and at altitude of 1071 m above mean sea level (MSL).The experiment was laid out in Randomized Block Design comprising, eleven treatments with three replications. Total number of plants per treatment was 66 and were spaced at 2.1 m × 2.1 m. Treatments were as follows: T_1: RDF (200:100:300 g NPK/plant), T_2: RDF + 250g of Agricultural lime, T_3: RDF + 500g of Agricultural lime, T_4: RDF + 250g of Dolomite, T_5: RDF + 500g of Dolomite, T_6: RDF + 250g of Gypsum, T_7: RDF + 500g of Gypsum, T_8: RDF + 250g of Mixture -1 (Agricultural lime: Dolomite: Gypsum - 1:1:1), T_9: RDF + 500g of Mixture -1 (Agricultural lime: Dolomite: Gypsum - 1:1:1), T_{10}: RDF + 250g of Mixture -2 (Dolomite: Gypsum - 1:1), T_{11}: RDF + 500g of Mixture -2 (Dolomite: Gypsum - 1:1). The treatments are applied after 10 days of planting in the field. After harvesting, the selected five fingers from each treatment having true representation were analyzed for post- harvest and biochemical parameters and the average was worked out and subjected to statistical analysis.

RESULTS AND DISCUSSION

The findings were considerably interpreted and listed in Table 1 and 2 based on the observations recorded in the present research

Effect of different secondary nutrient sources on postharvest parameters. The data regarding green life, shelf life, fruit weight at ripe stage, pulp weight, peel weight, pulp to peel ratio and firmness at ripe stage showed significant difference among the treatments.

Green life (days). The green life (days taken for ripening of fruits) differed significantly among the treatments of secondary nutrient sources. The highest green life (5.60 days) of fruits was recorded in T_9 (RDF + 500g of Mixture -1 comprising of Agricultural lime: Dolomite: Gypsum in 1:1:1). Whereas, the minimum number of days (4.09 days) taken to turn the whole hand to yellow colour was noticed in control (Table 1).

Increase in green life of fruit might be due to reduced respiration rate. The authenticity of present results is supported by Tripathi and Shukla (2011) who reported that application of calcium nitrate at 1.5 per cent in gooseberry increased the green life of fruits.

Shelf life (days). The perusal of data indicated that there is a significant difference of shelf life among the treatments. The maximum shelf life of 10.46 days was found in RDF combined with 500g of Mixture -1 comprising of Agricultural lime: Dolomite: Gypsum in 1:1:1 (T_9) and minimum shelf life of 7.34 days was found in T_1 (control) (Fig. 1).

Increase in shelf life of fruits other than control is due to the maintenance of firmness which has direct relation with calcium as it interacts with pectic polymers of cell wall and act as cementing agent which gives strength to the cell wall.

Fruit weight at ripe stage (g). The data regarding fruit weight at ripe stage showed significant difference among treatments. Application of RDF + 500g of Mixture -1 consisting of Agricultural lime: Dolomite: Gypsum in 1:1:1 (T_9) was found maximum fruit weight at ripe stage (80.74 g). While, minimum (59.89 g) was found in RDF (T_1) (Table 1).

Secondary nutrient applications have reduced the respiration rate and also minimized physiological loss in weight. This might have contributed to the increase in fruit weight at ripe stage in all other treatments except control. The increase in the yield parameters like fruit weight in magnesium treated plants is due to the account of stimulating plant metabolism. This result is in agreement with Raese (1987) in apple cv. Golden Delicious.

Pulp weight (g), Peel weight (g) and Pulp to peel ratio. The data recorded on pulp weight (g), peel weight (g) and pulp to peel ratio found significant differences among the treatments. Maximum pulp weight, peel weight and pulp to peel ratio (70.39 g, 10.35 g and 6.80) was noticed in T_9 (RDF combined with application of 500g of Mixture -1 consisting of Agricultural lime: Dolomite: Gypsum in 1:1:1) and control recorded minimum pulp weight, peel weight, pulp percent, pulp to peel ratio (50.99 g, 8.90 g and 5.73) (Table 1).

The more pulp weight in the treatments other than control may be due to supplying of additional plant nutrients through secondary nutrients might have resulted more uptake of these nutrients by the plants which ultimately resulted in good filling of the fruits.

The maximum peel weight might be due to increase in vegetative growth, accumulation of metabolites, better nutritional environment in the root zone and more availability of nutrients as compared to other treatments (Yadav and Babu 2005).

Maximum pulp to peel ratio might be due to proper supply of nutrients, translocation of water uptake, induction of hormones of fruits, better root development and deposition of nutrients throughout the growth, shooting and fruit growth stages (Venkatarayappa *et al.*, 1975). The study conducted by Kumar *et al.* (2008) in Robusta, Nandankumar *et al.* (2011) in cv. Nanjanagudu Rasabale, Kumar and Kumar (2007) in cv. Ney poovan and Sandhya *et al.* (2016) in cv. Grand Naine are in conformation with the present investigation.

Firmness at ripe stage (lbs). The results concerning to firmness showed significant difference among the treatments. The highest firmness of 1.56 lbs was recorded in T_9 (RDF combined with 500g of Agricultural lime: Dolomite: Gypsum in 1:1:1 (T_9). While, the least firmness (1.10 lbs) was noticed in RDF (control) (Table 1).

Increase in firmness of fruits might be by the role of calcium in the rigidity of skin tissue and consequently, in the decreased loss of water from the fruit and even in the reduction of respiratory rate, protein degradation

and the presence of opportunistic microorganisms (Bangerth *et al.*, 1972).

Effect of different secondary nutrient sources on biochemical parameters

TSS (°Brix). Results from the present study indicated that the treatment T_9 (RDF + 500g of Mixture -1 comprising of Agricultural lime: Dolomite: Gypsum in 1:1:1) recorded the highest TSS of 27.73 ºBrix and lowest (23.51ºBrix) was recorded in control (T_1) (Table 2). Higher TSS induced by nutrients *viz.*, calcium and magnesium, might be due to lesser utilization of sugars in metabolic processes as a result of reduced respiration. The results were in accordance with the findings of Pandey and Singh (1999) and Dawood *et al.* (2001).

Reducing sugars, non-reducing sugarsand total sugars (%)

Reducing sugars (17.51 %), non-reducing sugars (3.31 %) and total sugars (20.82%) were observed maximum in RDF + 500g of Mixture -1 comprising of Agricultural lime: Dolomite: Gypsum in 1:1:1 (T_9) and minimum (14.97 %, 2.68 % and 17.65 %) were found in RDF (T_1) (Table 2). Secondary nutrients play an important role in activating the amylase enzyme responsible for the conversion of starch into sugar on ripening, thus increasing reducing, non- reducing sugar and total sugar level. Similar findings were reported by Moustafa and Omran (2006) and Bisen *et al.* (2014).

Sugar-acid ratio. The treatment consisting of RDF + 500g of Mixture -1 comprising of Agricultural lime: Dolomite: Gypsum in 1:1:1 (T_9) recorded maximum sugar to acid ratio (79.08) and minimum sugar to acid ratio (44.5) was recorded in T_1 (Control) (Table 2). The increase in sugar-acid ratio is mainly due to the decrease in acidity. Similar findings were found by Yadav and Babu (2005) and Tripathi and Shukla (2011).

Titratable acidity (%). The treatment T_9 (RDF + 500g of Mixture -1 comprising of Agricultural lime: Dolomite: Gypsum in 1:1:1) recorded lowest acid percentage (0.26 %) while the highest (0.40 %) was recorded in control (Table 2). The reduction in acidity might be due to more accumulation of sugars in the fruit. Similar findings were in line with Zhang *et al.* (2020) and Tripathi & Shukla (2011).

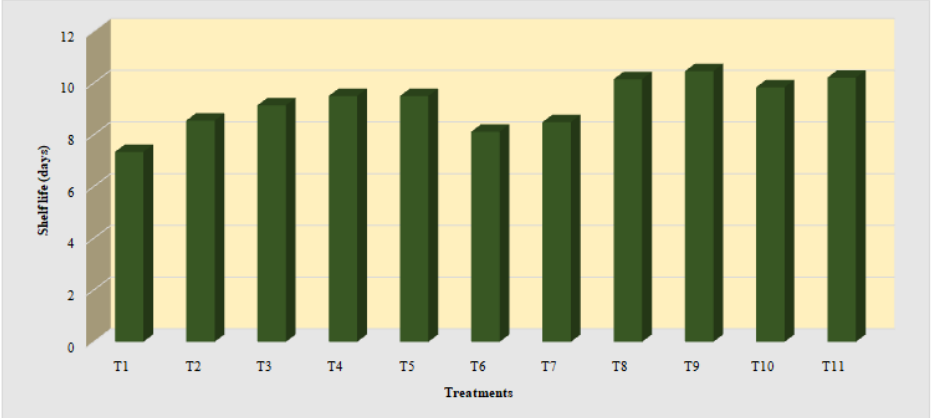

Fig. 1. Effect of different secondary nutrient sources on shelf life of banana cv. Ney Poovan.

Table 1: Effect of different secondary nutrient sources on post – harvest parameters of banana cv. Ney Poovan.

Tr. No.	Treatments	Green life (days)	Fruit weight at ripe stage (g)	Pulp weight (g)	Peel weight (g)	Pulp to peel ratio	Firmness at ripe stage (lbs)
T_1	RDF (Control)	4.09	59.89	50.99	8.90	5.73	1.10
T_2	RDF + 250g of Agricultural lime	4.56	65.93	56.55	9.38	6.03	1.24
T_3	RDF + 500g of Agricultural lime	4.81	71.57	61.99	9.58	6.47	1.32
T_4	RDF + 250g of Dolomite	4.78	67.68	58.19	9.49	6.13	1.29
T_5	RDF + 500g of Dolomite	5.00	72.21	62.48	9.73	6.42	1.36
T_6	RDF + 250g of Gypsum	4.14	61.98	52.92	9.06	5.84	1.16
T_7	RDF + 500g of Gypsum	4.35	63.78	54.61	9.17	5.95	1.19
T_8	RDF + 250g of Mixture -1 (Agricultural lime: Dolomite: Gypsum - 1:1:1)	5.25	73.76	63.82	9.94	6.42	1.44
T_9	RDF + 500g of Mixture -1 (Agricultural lime: Dolomite: Gypsum - 1:1:1)	5.60	80.74	70.39	10.35	6.80	1.56
T_{10}	RDF + 250g of Mixture -2 (Dolomite: Gypsum - 1:1)	5.04	73.49	63.62	9.87	6.45	1.40
T_{11}	RDF + 500g of Mixture -2 (Dolomite: Gypsum - 1:1)	5.34	78.44	68.23	10.21	6.68	1.50
	S.Em ±	0.07	0.77	0.92	0.15	0.08	0.03
	CD @ 5%	0.21	2.28	2.71	0.44	0.25	0.10

Note: RDF- 200:100:300 g NPK/plant

Table 2: Effect of different secondary nutrient sources on biochemical parameters of banana cv. Ney Poovan.

Tr. No.	Treatments	TSS (°Brix)	Reducing Sugars (%)	Non-reducing sugars (%)	Total Sugars (%)	Sugar to acid ratio	Titratable Acidity (%)
T_1	RDF (Control)	23.51	14.97	2.68	17.65	44.55	0.40
T_2	RDF + 250g of Agricultural lime	24.54	15.81	2.85	18.66	53.94	0.35
T_3	RDF + 500g of Agricultural lime	26.00	16.65	3.00	19.65	63.56	0.32
T_4	RDF + 250g of Dolomite	25.39	16.34	2.94	19.28	60.99	0.30
T_5	RDF + 500g of Dolomite	26.67	16.80	3.12	19.91	65.55	0.31
T_6	RDF + 250g of Gypsum	23.67	15.10	2.75	17.85	46.61	0.38
T_7	RDF + 500g of Gypsum	24.13	15.49	2.79	18.27	49.86	0.37
T_8	RDF + 250g of Mixture -1 (Agricultural lime: Dolomite: Gypsum - 1:1:1)	27.22	17.10	3.24	20.34	72.82	0.28
T_9	RDF + 500g of Mixture -1 (Agricultural lime: Dolomite: Gypsum - 1:1:1)	27.73	17.51	3.31	20.82	79.08	0.26
T_{10}	RDF + 250g of Mixture -2 (Dolomite: Gypsum - 1:1)	27.02	16.94	3.22	20.16	72.06	0.28
T_{11}	RDF + 500g of Mixture -2 (Dolomite: Gypsum - 1:1)	27.32	17.26	3.28	20.54	76.55	0.27
	S.Em ±	0.28	0.10	0.04	0.10	1.95	0.01
	CD @ 5%	0.84	0.30	0.12	0.31	5.76	0.03

Note: RDF- 200:100:300 g NPK/plant

CONCLUSION

The application of lime based fertilizers are considered to be an beneficial approach for the amelioration of acidic soils of Western Ghats of Karnataka. The use of RDF combined with 500g of Mixture -1 (Agricultural lime: Dolomite: Gypsum – 1:1:1) -T_9 proved to be best for improving biochemical parameters along with applicable post- harvest parameters in banana. Among this, it is observed that various biochemical parameters like TSS, titratable acidity, reducing sugars, non-reducing sugars, total sugar and sugar to acid ratio were found to be best with better appearance and firmness and this proved to promising for fetching fruits with good quality in banana cv. Ney Poovan in acid soils under hill zone of Karnataka.

FUTURE SCOPE

Future studies need to be carried out with different banana varieties in order to study the secondary nutrient management through soil application.

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Conflict of Interest. None.

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