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EFFECT OF SOILAND FOLIAR APPLICATION OF SILICON ON FRUIT QUALITY PARAMETERS OF BANANA cv. NEYPOOVAN UNDER HILL ZONE

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Abstract

A field experiment was conducted at College of Horticulture, Mudigere to know the effect of soil and foliar application of silicon on fruit quality of banana cv. Neypoovan. Potassium silicate was given 90 days after planting as a foliar spray at a concentration of 2.0 and 4.0 ml/lit per plant at 15 and 30 days interval. Similarly, soil application of calcium silicatev @ 1000 g per plant at once and in combination with foliar spray of potassium silicate was tried during the same period. The quality parameters *viz.*, days taken for full ripening of the fruits, acidity, total soluble solids, shelf life, reducing sugar, non reducing sugars and pulp peel ratio of the fruit were significantly influenced by foliar and soil application of silicon compare to control.

Key words : Banana, silicon, foliar, quality, randomized complete block design (RCBD), total soluble solids.

Introduction

Banana (*Musa* spp.) is considered as a queen of tropical fruit cultivated by man since prehistoric times. Banana provides nutrition and well-balanced diet to millions of people around the globe and also contributes to livelihood through crop production, processing and marketing (Singh, 2002). It grows well in humid tropical low lands and is predominantly distributed between 30^0 N and 30^0 S of equator.

Banana provides dessert fruit or starch staple to millions of people in the world. It is easy to digest, nearly fat free with high nutritive value and relatively cheaper than other fruits. The total energy provided by 100g edible ripe pulp is 116 K calories, 1.2 g protein, 0.3 g fat, 27.2 g carbohydrates, 0.4 g fibre, 7 mg vitamin C and 0.8 g of minerals (Gopalan *et al*., 1989).

Neypoovan (Elakkibale) once a delicate backyard cultivar of choice, now assumes commercial monoclonal cultivation. It is a slender, medium tall banana taking 12-13 months for its crop cycle and occupies large areas in Karnataka. Average bunch weight is 18-20 kg with small fruits packed closely having a wind-blown appearance.

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Silicon is the most abundant element in the earth's crust region next to oxygen and comprises 28% of its weight, 3-17% in soil solution (Epstein, 1999). It is most commonly found in soils in the form of solution as silicic acid (H_4SiO_4) and is taken up directly as silicic acid (Ma *et al*., 2001). Being a dominant component of soil minerals, it has many important functions in environment, although silicon is not considered as an essential plant nutrient because of its ubiquitous presence in the biosphere and most plants can be grown from seed to seed without its presence. Many plants can accumulate Si concentrations higher than essential macronutrients (Epstein, 1999).

Silicon deposited in the walls of epidermal cells after absorption by plants, contributes considerably to stem strength. Silicon is not much mobile element in plants (Savant *et al*., 1999).

The role of silicon in plant biology is to reduce multiple stresses including biotic and abiotic stresses. It is also known to increase drought tolerance in plants by maintaining plant water balance, photosynthetic activity, erectness of leaves and structure of xylem vessels under high transpiration rates (Melo *et al*., 2003). Gong *et al*.

(2003) observed improved water economy and dry matter yield by silicon application and it enhanced leaf water potential under water stress conditions, reduced incidence of micronutrient and metal toxicity (Matoh *et al*., 1991). It is most commonly applied as foliar spray to correct the deficiency of specific element rather than complete requirement of that element. They are essential for many enzymatic reactions.

With this background information and based on the possible benefits of silicon, the present study was carried out to know the effect of soil and foliar silicon on fruit quality of banana cv. Elakkibale (Neypoovan) was taken up with the following objectives.

Materials and Methods

A field experiment on quality parameters of banana as influenced by soil and foliar application of silicon was carried out during March, 2011 to February, 2012 at Regional Horticultural Research and Extension Centre, Mudigere, Chikmagalur district situated in hill zone of Karnataka, India.

The experiment was carried out on three months old banana plants spaced at 2 m × 2 m and planted in square system. Ten plants were selected as one replication. The experiment was tried with eight treatments in Randomized Complete Block Design (RCBD) and replicated thrice. The details of different treatments are mentioned below:

T_1: Control (No silicon application)

T_2: Foliar spray of Potassium silicate @ 2 ml L^{-1}/plant at 15 days interval

T_3: Foliar spray of Potassium silicate @ 4 ml L^{-1}/plant at 15 days interval

T_4: Foliar spray of Potassium silicate @ 2 ml L^{-1}/plant at 30 days interval

T_5: Foliar spray of Potassium silicate @ 4 ml L^{-1}/plant at 30 days interval

T_6: Soil application of Calcium silicate @ 1000 g/plant

T_7: Soil application of Calcium silicate @ 1000 g/plant + foliar application of Potassium silicate @ 2 ml L^{-1}/ plant at 30 days interval

T_8: Soil application of Calcium silicate @ 1000 g/plant + foliar application of Potassium silicate @ 4 ml L^{-1}/ plant at 30 days interval

The observations like days taken for full ripening of the fruits, acidity, total soluble solids, shelf life, reducing sugar, non reducing sugars and pulp peel ratio were recorded.

Results and Discussion

The quality parameters *viz*., days taken for full ripening of the fruits, acidity, total soluble solids, shelf life, reducing sugar, non reducing sugars and pulp peel ratio of the fruit were significantly influenced by foliar and soil application of silicon. The total soluble solids, acidity, reducing sugar, non reducing sugar and pulp peel ratio of the fruit were significantly influenced by foliar applied silicon spray than soil application and control. Because of the reduced total soluble solids and increased fruit firmness, the shelf life of the fruits was increased when stored in room temperature. The similar observation was made by Bhavya (2010) in Bangalore blue grapes.

The maximum number of days taken for ripening was observed in treatment **T_3** (foliar application of potassium silicate @ 2 ml L^{-1}/plant at 15 days interval) (7.67 days). Whereas, early ripening (6.00 days) was recorded in control (**T_1**) Babak and Majid (2011) reported that, the use of silicon increased vase life of carnation as it lowers the ethylene production. Potassium improved fruit quality due to suppression of respiration and reduction in ethylene evolution.

The pulp peel ratio was found to differ significantly among the treatments. **T_3** (foliar application of potassium silicate @ 2 ml L^{-1}/plant at 15 days interval) recorded highest pulp peel ratio (7.44), which was on par with **T_8** (7.22). Lowest was noticed in control (6.05), which indicated the beneficial role of potassium in getting good pulp recovery.

The significant difference was noticed in the total soluble solids with soil and foliar application of silicon on banana cv. Elakkibale. The maximum total soluble solids (26.67^0 brix) was found in the treatment **T_3** (foliar application of potassium silicate @ 4 ml L^{-1}/plant at 15 days interval), which was statistically on par with other treatments. Whereas, the lowest total soluble solid (22.53^0 brix) content was recorded in control (**T_1**). Silicon and potassium helped in synthesis of more sugars in the fruit and thus helped in increasing total soluble solids the results are in accordance with Bhavya (2010) in Bangalore blue grapes.

The titratable acidity was less (0.26 per cent) in foliar application of potassium silicate @ 2 ml L^{-1}/plant at 15 days interval (**T_9**), which was followed by soil application of calcium silicate @ 1000 g/plant + foliar application of potassium silicate @ 4 ml L^{-1}/plant at 30 days interval (**T_8**). The decrease in acidity might be due to increase in the total soluble solids and it was also because of boron which might have either involved in fast conversion of metabolites into sugar and their derivatives. Similar,

Table 1: Effect of soil and foliar application of silicon on fruit quality of banana *cv.* Elakkibale.

Treatments	Days to ripe	Shelf life	TSS (^{0}Brix)	Pulp weight (g)	Peel weight (g)	Pulp-peel ratio (%)	Acidity (%)	Reducing sugars	Non reducing sugars
T_1	6.00	5.11	22.53	40.49	6.92	6.05	0.35	18.35	1.52
T_2	7.11	5.78	24.93	54.76	7.93	6.90	0.26	19.93	2.42
T_3	7.67	6.33	26.67	56.93	7.65	7.44	0.29	19.03	2.34
T_4	6.89	5.33	23.50	48.42	7.03	6.89	0.31	18.45	1.81
T_5	7.44	5.72	24.70	55.13	7.67	7.19	0.30	19.35	2.28
T_6	6.78	5.22	23.13	45.29	6.96	6.52	0.35	18.36	1.61
T_7	7.00	5.56	24.00	54.79	7.98	6.86	0.33	18.73	1.91
T_8	7.22	6.11	26.07	59.40	8.23	7.22	0.28	19.13	2.36
F- test	*	*	*	*	*	*	*	*	*
S.Em.±	0.27	0.20	0.74	1.03	0.16	0.08	0.01	0.23	0.04
CD at 5%	0.82	0.62	2.26	3.12	0.49	0.24	0.02	0.69	0.11

* Significant.

observations were made by Bhavya (2010) in Bangalore blue grapes. The increased in total soluble solids in the berries leads to decrease in acidity content.

The influence of soil and foliar application of silicon on shelf life of banana cv. Elakkibale was found significant and the treatment with foliar application of potassium silicate with 4 ml per litre at 15 days interval extended its shelf life up to 6.33 days, which was statistically on par with other treatments. Whereas, the minimum number of days (5.11) was recorded in control. Babak and Majid (2011) reported that the use of silicon increased vase life of carnation as it lowered the ethylene production and silicon formed complexes with organic compounds in the cell wall of epidermal cells therefore, increased their resistance in degrading enzymes. Potassium improved fruit quality due to suppression of respiration and reduction in ethylene evolution. The similar results were noticed by Kaluwa *et al.* (2010). Stamatakis *et al.* (2003) reported that, application of silicon with higher concentration resulted in more fruit firmness.

The reducing sugar content (19.93%) was more in foliar application of potassium silicate @ 2 ml L^{-1}/plant at 15 days interval and it was followed by (T_5). This progressive increase could be related to increase in total soluble solids. Since, the reducing sugars constituted a major part of solid present in banana. The maximum non reducing sugars (2.34%) was noticed in foliar application of potassium silicate @ 2 ml L^{-1}/plant at 15 days interval (T_2) followed by the on par treatments, whereas the lowest in control (T_1). The similar results obtained by Bhavya (2010) in Bangalore blue grapes.

Thus, the quality parameters were found to be increased with the soil and foliar application of silicon compared to control. This revealed that application of foliar applied silicon 4 ml and 2 ml @ 15 days interval proved to be better in improving the quality parameters.

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