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EFFECT OF SOIL AND FOLIAR APPLICATION OF SILICON ON PHYSICAL CHARACTER, NUTRIENT CONTENT OF SOIL AND LEAF LAMINA OF BANANA CV. NEYPOOVAN UNDER HILL ZONE

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Abstract

A field experiment was conducted at College of Horticulture, Mudigere (Karnataka), India to know the effect of soil and foliar application of silicon on nutrient content of soil and leaf lamina 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 nutrients like nitrogen, phosphorous, potash and silicon were significantly influenced by foliar and soil application of silicon compare to control.

Key words : Banana, silicon, foliar, nutrients.

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, India. Average bunch weight is 18-20 kg with small fruits packed closely having a wind-blown appearance.

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,

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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 physical character, nutrient content of soil and leaf lamina of banana *cv.* Elakkibale (Neypoovan) was taken up with the following objectives.

Materials and Methods

A field experiment on growth, yield and 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 N, P, K and Si were recorded in soil and leaf lamina.

Results and Discussion

Physical characters

The pH of soil did not vary significantly among the treatments. The maximum soil pH (6.43) was observed in the treatment **T_7** (soil application of calcium silicate @ 1000 g/plant + foliar application of potassium silicate @ 2 ml L^{-1}/plant at 30 days interval).

An electrical conductivity in the soil did not vary significantly among the treatments and the highest electrical conductivity (EC) (0.037 ds/m) was recorded in treatment with foliar application of potassium silicate @ 4 ml L^{-1} at 30 days interval.

The lowest organic carbon content (0.56%) was recorded in soil application of calcium silicate @ 1000 g/ plant + foliar application of potassium silicate @ 4 ml L^{-1}/plant at 30 days interval and the highest was recorded in control. The nutrient uptake increased with the help of silicon resulting in lower organic content in soil. The similar observations were made by Sadgrove (2006) and Satish (2003) observed that decrease in organic carbon in soil increased physiological disorder in sapota.

Nutrient content of soil

The available nitrogen in soil was significantly influenced among the treatments. The minimum nitrogen content in soil (131.20 Kg/ha) was recorded in treatment with foliar application of potassium silicate @ 4 ml L^{-1}/ plant at 15 days interval. The low amount of available nitrogen in the soil might be due to banana being a heavy feeder had utilized higher levels of nitrogen and potash. Regan and Peter (2011) stated that nutrients were retained in soil without leaching and silicon helped in uptake of nutrients. The similar results were noticed by Matichenkov and Bocharnikova (2010).

The minimum available phosphorous content in soil (18.52Kg/ha) was recorded in treatment with foliar application of potassium silicate @ 4 ml L^{-1} at 15 days interval. Whereas, the maximum available phosphorous was recorded in treatment **T_1** (control). Silicon application resulted in more uptake of phosphorous as it avoided fixation of phosphorous in the soil complex. The similar observations were made by Matichenkov and Bocharnikova (2010).

Availability of potassium was found significant among the treatments and the least potassium (18.52 Kg/ha) was recorded in treatment with soil application of calcium silicate @ 1000 g/plant + foliar application of potassium silicate @ 4 ml L^{-1}/plant at 30 days interval. The similar observation were made by Nalina (1999) and stated that the decrease in soil potash at harvest might be due to

Table 1 : Effect of soil and foliar application of silicon on N, P, K and Si content in leaf lamina, soil and physical characters of banana cv. Elakkibale.

Treatments	Leaf lamina				Soil				Physical characters		
	N (%)	P (%)	K (%)	Si (%)	N (Kg/ha)	P (Kg/ha)	K (Kg/ha)	Si (Kg/ha)	pH	EC (ds/m)	OC (%)
T_1	3.23	0.26	2.30	1.92	176.77	31.97	167.30	132.37	6.13	0.023	0.86
T_2	3.50	0.29	2.60	2.46	169.47	25.50	163.83	95.77	6.25	0.025	0.76
T_3	3.63	0.32	2.63	2.63	131.20	18.52	132.47	66.57	6.26	0.030	0.59
T_4	3.49	0.28	2.33	2.41	172.98	26.27	152.70	114.41	6.32	0.033	0.79
T_5	3.55	0.31	2.59	2.59	136.17	20.40	133.07	87.70	6.38	0.037	0.63
T_6	3.33	0.27	2.31	2.51	176.63	30.41	162.53	114.41	6.14	0.023	0.82
T_7	3.59	0.29	2.62	2.57	156.00	19.80	145.33	75.31	6.43	0.024	0.66
T_8	3.68	0.32	2.81	2.61	133.77	19.33	131.40	62.62	6.36	0.026	0.56
F- test	*	*	*	*	*	*	*	*	NS	NS	*
SEm±	0.07	0.010	0.08	0.01	1.76	1.00	2.85	1.84	0.10	0.004	0.05
CD at 5%	0.22	0.029	0.24	0.02	5.34	3.03	8.64	5.59	0.29	0.011	0.15

*- Significant

higher amounts of potash being absorbed and utilized for the development and improvement of size and quality of bunch, because mobility of potash towards sink could be significant. Sadgrove (2006) and stated that, leaching loss of both phosphorous and potassium could be avoided with application of silicon. Mongia *et al*. (2003) reported application of silicon increased the nutrient availability.

The minimum silicon content in soil (62.62 kg/ha) was recorded in treatment with soil application of calcium silicate @ 1000 g/plant + foliar application of potassium silicate @ 4 ml L^{-1}/plant at 30 days interval. The application of SiO_2 increased soluble Si in the soil and helped in more uptake of silicon (Barbosa *et al*., 2001). The similar trends were noticed by Kamenidou *et al*. (2008). The application of silicon resulted in more nutrient availability to the plants, resulted in cell multiplication and differentiation and thus helps in formation of tissues (Prakash *et al*., 2011).

Nutrient content leaf lamina

The highest nitrogen content in the leaf (3.68%) was observed in treatment with soil application of calcium silicate @ 1000 g/plant + foliar application of potassium silicate @ 4 ml L^{-1}/plant at 30 days interval and the lowest recorded in $\mathbf{T_1}$ (control). Silicon application avoided leaching of nitrogen and helped in more uptake. The similar results were observed by Kamenidou *et al.* (2008).

The uptake of phosphorus was significantly influenced by soil and foliar application of silicon compared to control. The maximum phosphorus content (0.32%) in the leaf lamina was found in soil application of calcium silicate @ 1000 g/plant + foliar application of potassium silicate @ 4 ml L^{-1}/plant at 30 days interval ($\mathbf{T_8}$) and minimum in $\mathbf{T_1}$ (control). Silicon in solution rendered more P available to plants reversing its fixation as silicon itself competed for P fixation and thus, slowly released P and helped in more uptake. The above results are in conformity with the findings of Nesreen *et al.* (2011) and Kamenidou *et al.* (2008).

The soil and foliar application of silicon on potassium uptake was significantly increased as compared to control. The maximum potassium content in the leaf lamina (2.81%) was found in the treatment $\mathbf{T_8}$ (soil application of calcium silicate @ 1000 g/plant + foliar application of potassium silicate @ 4 ml L^{-1}/plant at 30 days interval. The minimum potassium content (2.30%) was recorded in the control ($\mathbf{T_1}$). Silicon helped in more uptake of potassium. The K content in the treatment with potassium silicate recorded more per cent of potassium compared to calcium silicate as it contain potassium along with silicon. Nesreen *et al*. (2011) recorded that, the application of potassium silicate increased per cent K in leaf and the similar results were observed by Kamenidou *et al*. (2009) and Kamenidou *et al*. (2008).

The uptake and accumulation of silicon in leaf was found to be more with foliar application of potassium silicate @ 4 ml L^{-1} at 15 days interval (2.63%) and which was on par with other treatments. The results are in conformity with findings of Kamenidou *et al*. (2009) in gerbera and zinnia.

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