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Effect of Foliar Nutrition with Zinc and Boron on the Performance of Black Pepper (*Piper nigrum* L.) under Hill Zone (Zone-9) of Karnataka, India

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A B S T R A C T

Field trial was conducted on effect of foliar nutrition with zinc and boron on the performance of black pepper (*Piper nigrum* L.) varieties under hill zone (Zone-9) of Karnataka from May 2016 to June 2017 at Horticulture Research and Extension Centre, Sirsi (UHS, Bagalkot), Uttara Kannada district. Present trial was laid out in split plot design replicated thrice with three black pepper varieties (IISR-Shakti, IISR-Thevam and Panniyur-1) as main plot and foliar nutrition (zinc-0.5%, boron-0.15%, combination of zinc 0.5% + boron 0.15%, control - no spray) as sub plot. Among growth parameters, canopy compactness (56.67 laterals/m^2), leaf area (585.50 cm^2), leaf area index (2.62) were higher in the variety Panniyur-1 receiving foliar nutrition with zinc (0.5 %). Among yield attributes, number of spikes per vine (627.00) and dry weight of berries (2.61 kg/vine) were higher in the variety Panniyur-1 receiving foliar nutrition with zinc (0.5 %).

Introduction

Black pepper (*Piper nigrum* L.) (Family: Piperaceae) is one of the most important spices of commerce and trade in India since prehistoric period. Among the spices, black pepper occupies a unique position and hence, called as the 'King of spices' and widely used for food flavouring. It is a climbing herbaceous perennial evergreen vine native to humid tropical rain forests of Western Ghats of India. Black pepper is grown in 26

countries including India, Indonesia, Sri Lanka, Thailand, China, Vietnam, Cambodia, Brazil, Mexico and Guatemala.

In Karnataka black pepper is cultivated in an area of 32,000 hectare with production of 19,000 tons and with a productivity of 602 kg per ha, mainly grown in Chikkkamagalur, Shivamogga, Uttar Kannada, Dakshina Kannada and Udupi districts (Anon., 2016). In Uttara Kannada district it is mainly grown as an associated mixed crop under areca based cropping system. Varietal performance of black pepper differs under different agroclimatic conditions (Hussain *et al.*, 2016). Hence there is a need to identify high yielding variety of black pepper with minimum incidence of foot rot disease.

Foliar feeding is a direct method of fertilizing plants. It involves spraying nutrients on the surface of leaves and stem where they are absorbed and used. Quantity of nutrients absorbed by the leaf during foliar application may be small, it is compensated by a higher efficiency of uptake than applying the same quantity of nutrients to the soil. The "law of little bits" always applies to foliar feeding. Black pepper now a days ruling the Indian market as a king fetching a lucrative market price. To realize the higher productivity, foliar nutrition with micro nutrients also play a vital role. Keeping this in view, the present study was conducted to study the effect of foliar nutrition with zinc and boron on performance of black pepper varieties.

Materials and Methods

Field experiment was laid out under hill zone (Zone-9) of Karnataka at Horticulture Research and Extension Station, Sirsi for evaluating the varietal variation, effect of foliar nutrition (zinc and boron) on growth, yield and quality attributes of black pepper during 2016-2017. The trial was laid out in split plot design with main plot (three varieties of black pepper *viz*., IISR-Shakti, IISR-Thevam and Panniyur-1) and sub plot (foliar nutrition with 0.5 % zinc, 0.15% boron, combination of 0.5% zinc and 0.15% boron, control without spray). Foliar sprays were taken as pre-monsoon and post-monsoon spray.

The altitude of Sirsi is at 590 m above mean sea level. It receives both S-W and N-E monsoon. The mean rainfall of the tract is 2200 mm which is distributed over a period of six months (May to October), with a peak during June.

Results and Discussion

Canopy compactness (56.67 laterals/m^2), leaf area (585.80 cm^2) and leaf area index (2.62) were recorded higher by the variety Panniyur-1 with foliar nutrition of zinc at 0.5 per cent (Table 1). It may be attributed due to the varietal characteristic of Panniyur-1 and foliar nutrition with zinc. This result of present study were in-line with the findings of Swietlik (1999), Barman and Pal (1990), Mishra (2001) in chrysanthemum. Increased canopy compactness (number of laterals / m^2) was found in the variety Panniyur-1 (23.98 laterals / m^2) with foliar spray of zinc at 0.5 per cent which may be due to the genetic feature of the variety having tendency to produce higher number of laterals compared to other two varieties in the present investigation. Foliar spray with zinc produced higher number of laterals per square meter which may attributed to enhanced vegetative growth. Result of present findings are found to be in-line with the findings of Arora and Singh (1968) in guava and Supriya and Bhattacharyya (1993) in gladiolus, who recorded number of laterals per shoot which significantly improved due to zinc foliar nutrition. Leaf area and leaf area index (LAI) were higher by the variety Panniyur-1 (585.80 cm^2 and 2.62 respectively) receiving foliar nutrition with zinc at 0.5 per cent.

Table.1 Effect of foliar nutrition with zinc and boron in black pepper varieties on canopy compactness, leaf area and leaf area index at six months after foliar nutrition

Treatment Foliar nutrition Variety	Canopy compactness (laterals / m^2)					Leaf area (cm^2)					Leaf area index				
	F_1	**F_2**	**F_3**	**F_4**	**Mean**	**F_1**	**F_2**	**F_3**	**F_4**	**Mean**	**F_1**	**F_2**	**F_3**	**F_4**	**Mean**
V_1	45.75	28.33	35.58	25.85	33.88	475.33	430.50	437.33	417.17	440.08	1.45	1.06	1.14	1.04	1.17
V_2	35.75	25.64	28.88	22.92	28.30	376.67	375.20	352.16	326.33	357.59	1.39	1.15	1.01	0.98	1.13
V_3	56.67	42.67	52.60	37.66	47.40	585.80	521.53	536.83	499.25	535.85	2.62	1.40	1.65	1.48	1.79
Mean	46.06	32.21	39.02	28.81		479.27	442.41	442.11	414.25		1.82	1.20	1.27	1.17	
For comparison means of															
	S.Em ±		**C.D. at 5 %**		**CV (%)**	**S.Em ±**		**C.D. at 5 %**		**CV (%)**	**S.Em ±**		**C.D. at 5 %**		**CV (%)**
Variety (V)	0.98		3.86		27.97	1.69		6.62		3.94	0.019		0.076		14.77
Foliar nutrition (F)	0.53		1.59		13.16	0.83		2.45		1.67	0.021		0.063		14.04
Interaction of variety and foliar nutrition (V x F)	0.93		2.75			1.43		4.25			0.037		0.109		
V at same level of F	1.97		3.76			3.37		6.18			0.04		0.11		
F at same or different level of V	0.93		2.75			1.43		4.25			0.03		0.11		

Main plot –Variety (V):
V_1 : IISR Shakti
V_2 : IISR Thevam
V_3 : Panniyur-1

Sub plot – Foliar nutrition (F):
F_1 : Foliar nutrition with zinc (0.5 %)
F_2 : Foliar nutrition with boron (0.15 %)
F_3 : Foliar nutrition with zinc + boron (0.5 % +0.15 %)
F_4 : Control (No spray)

Table.2 Effect of foliar nutrition with zinc and boron in black pepper varieties on number of spikes per vine and dry weight of black pepper berries per vine (kg)

Treatment	Number of spikes per vine					Dry weight of black pepper berries per vine (kg)				
Foliar nutrition / Variety	**F_1**	**F_2**	**F_3**	**F_4**	**Mean**	**F_1**	**F_2**	**F_3**	**F_4**	**Mean**
V_1	501.10	417.00	448.50	297.00	415.90	1.48	0.86	1.33	0.78	1.11
V_2	579.00	442.00	510.00	334.00	466.25	2.11	1.54	1.86	1.41	1.73
V_3	627.00	461.00	583.00	415.00	521.50	2.61	1.69	2.29	1.56	2.04
Mean	569.03	440.00	513.83	348.67		2.07	1.36	1.83	1.25	
For comparison means of										
	S.Em ±		**C.D. at 5 %**		**CV (%)**	**S.Em ±**		**C.D. at 5 %**		**CV (%)**
Variety (V)	0.93		3.66		2.07	0.005		0.020		3.19
Foliar nutrition (F)	0.72		2.15		1.39	0.005		0.014		2.69
Interaction of variety and foliar nutrition (V x F)	1.25		3.72			0.008		0.025		
V at same level of F	1.87		4.29			0.010		0.027		
F at same or different level of V	1.25		3.72			0.008		0.025		

Main plot –Variety (V):
V_1 : IISR Shakti
V_2 : IISR Thevam
V_3 : Panniyur-1

Sub plot – Foliar nutrition (F):
F_1 : Foliar nutrition with zinc (0.5 %)
F_2 : Foliar nutrition with boron (0.15 %)
F_3 : Foliar nutrition with zinc + boron (0.5 % +0.15 %)
F_4 : Control (No spray)

Higher leaf area recorded by Panniyur-1 variety is attributed to inherent capacity of the variety. Foliar spray with zinc helped in increasing leaf area due to the higher vegetative growth. These findings are in accordance with the findings of Supriya and Bhattacharyya (1993) in gladiolus, Dawood *et al.,* (2001) in citrus and Eiada and Mustafa (2013) in pomegranate. Eiada and Mustafa (2013) described that use of micronutrients mainly zinc, that play an important role which increase the cell division to increased level of auxin. It is also in conformity with the findings of Hamza and Sadananda (2005) in black pepper.

Yield attributes

Yield attributes are the major factors for increasing the productivity in black pepper. Important yield attributes in black pepper like number of spikes per vine (627.00) and dry weight of berries per vine (2.61 kg) were higher in the variety Panniyur-1 receiving foliar nutrition with zinc at 0.5 per cent (Table 2).

Higher number of spikes per vine found in Panniyur-1 which is attributed to the inherent character to produce higher number of spikes per vine. Foliar spray with zinc also increased number of spikes. Interaction of Panniyur-1 with zinc foliar nutrition helped in getting higher number of spikes per vine (627). Awasthi *et al.,* (1975) reported that zinc sulphate foliar spray, increased the number of fruits in litchi and reduced the fruit drop considerably due to the increased biosynthesis of IAA (Indole acetic acid) in zinc treated plants.

Significantly higher dry weight of berries were recorded by the variety Panniyur-1 followed by the variety IISR-Thevam receiving foliar nutrition with zinc. The fruit weight increased with the increase in concentrations of zinc and found to be the maximum under 0.8 per cent and Rath *et al.,* (1980) also got the similar results in mango. Daulta *et al.,* (1981) sprayed 1.0 per cent zinc sulphate and reported the increased initial fruit set and the fruit weight in grape variety beauty seedless.

In conclusion, Foliar nutrition with zinc helps in improving the growth as well as yield attributes that helped in obtaining higher productivity in black pepper. However, good quality of black pepper can be attributed by foliar nutrition with combination of zinc 0.5 per cent and boron 0.15 per cent. So, foliar nutrition can be used as the cheaper and easy way to obtain better yield from black pepper varieties.

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