International Journal of Farm Sciences **5(1)** : 51-55, 2015

Effect of soil application of Zn, Mn and Mg on growth and nutrient content of large cardamom, *Amomum subulatum* Roxb at Sikkim

BA GUDADE, KN HARSHA*, AK VIJAYAN, P CHHETRI, TN DEKA, SUBHASH BABU and RAGHAVENDRA SINGH****

ICRI, RRS, Spices Board, Tadong, Gangtok 737102 Sikkim, India
***ICRI, RRS, Spices Board, Sakleshpur 573134 Karnataka, India**
****ICAR, RC, NEH Region, Sikkim Centre, Gangtok 737102 Sikkim, India**
Email for correspondence: bgudade@gmail.com

ABSTRACT

A field experiment was conducted during 2012-14 at research farm of ICRI, RRS, Kabi to find out the effect of soil application of Zn, Mn and Mg on growth and nutrient content of large cardamom. The experiment was laid out in randomized block design comprising of eight treatments viz $ZnSO_4$ (5 kg/ha) ZnSO4 (10 kg/ha), $MnSO_4$ (10 kg/ha), $MnSO_4$ (5 kg/ha), MgSO4 (10 kg/ha), $MgSO_4$ (5 kg/ha), ZnSO4 + $MnSO_4$ + $MgSO_4$ (10 kg/ha) and control. Soil application of ZnSO4 + $MnSO_4$ + $MgSO_4$ (10 kg/ha) resulted in significantly higher number of immature tillers (2.99 and 3.19) and mature tillers (2.86 and 3.11) during both September 2013 and March 2014 and vegetative buds (2.56). Nutrient status in soil with ZnSO4 + $MnSO_4$ + $MgSO_4$ (10 kg/ha) proved its superiority and its effect was statistically non-significant on available Fe and B in soil. Significantly higher Mg (0.45%) and Mn (487.37 ppm) content in leaf was recorded with ZnSO4 + $MnSO_4$ + $MgSO_4$ (10 kg/ha) and significantly higher Zn (54.41 ppm) content in leaf was recorded with $ZnSO_4$ @10 kg/ha.

Keywords: Soil application; Zn; Mn; Mg; large cardamom; growth; nutrient content

INTRODUCTION

Large cardamom belonging to family Zingiberaceae and cultivated in Sikkim Himalayas since time immemorial is believed to be the native of the state. Popularly known as Bada Elaichi in Hindi and Alainchi in Nepali it is one of the world's ancient spices. Sikkim is the largest producer of large cardamom constituting lion share of the Indian and world market (Gupta et al 2013). It is grown in the tracks up to 1000 to 2200 m amsl with well distributed rainfall spread around 200 days with a total of about 3000-3500 mm/year (Gudade et al 2013b and Gudade et al 2014). Large cardamom is a sciophyte ie the plant is grown under shade (Gudade et al 2013c and Gudade et al 2013a). It is essentially a cross-pollinated crop due to the

heterostylic nature of its flowers though they are self-fertile. Bumble bee *(Bombus breviceps)* is the major pollinator in large cardamom due to its high pollination efficiency attributed to its big body size and foraging habit (Kishore et al 2012). In recent years productivity of large cardamom declined in Sikkim. There are several factors responsible for declination of the productivity. Among them the role of plant nutrients especially macro and micronutrients is of paramount importance. All plantation crops respond constructively to the application of macro as well as micronutrients. The main sources of these nutrients are parent material, sewage sludge, town refuse, farm yard manure (FYM) and organic matter. These nutrients are present in small amounts ranging from few mg/kg to several thousand mg/kg in soils (Wajahat et al 2006). Among the nutrients Zn, Mn and Mg are of special importance because of their role in the growth and development process in crops. At the time of fertilization most of the zinc is diverted to seed only (Jenik and Barton 2005, Pandey and Gautam 2009, Reid et al 2011). In most cultivated plants the critical concentration of manganese in leaves is 25 mg/kg dry matter (Mutaftchiev 2003). Soil application with magnesium increases net assimilation rate, seed yield and crude protein content of plants. The soils of Sikkim are acidic in nature having high organic matter content and no information is available on effect of soil application of Zn, Mn and Mg on growth and nutrient content of large cardamom. Keeping it in view the present study was undertaken to find out the effect of soil application of Zn, Mn and Mg on growth and nutrient content of large cardamom in Sikkim.

MATERIAL and METHODS

The field experiment was carried out during 2012-2014 at Indian Cardamom Research Institute, Regional Research Station, Spices Board research farm at Kabi (1800 m amsl), north Sikkim. Soil of experimental field was clay loam and soil pH was 4.6. The experiment was laid out in randomized block design (RBD) with three replications. Experiment comprised of eight treatments viz $ZnSO_4$ (5 kg/ha), ZnSO4 (10 kg/ha), $MnSO_4$ (10 kg/ha), $MnSO_4$ (5 kg/ha), MgSO4 (10 kg/ha), $MgSO_4$ (5 kg/ha), ZnSO4 + $MnSO_4$ + $MgSO_4$ (10 kg/ha) and control.

Large cardamom cultivar Sawney was planted with the spacing of 1.5 m x 1.5 m during July 2012. Treatments of soil application of secondary nutrients (Mg) and micronutrients (Zn and Mn) were imposed as per the technical programme (once in a year) ie April during 2012 to 2013. The growth parameters were observed as per the standard procedures two times in a year in September 2013 and March 2014.

The plant samples collected were ground into fine powder and passed through a 40 mm mesh sieve and used for chemical analysis to find out the nutrient content in plants. Similarly the composite soil samples were collected from 0-15 cm soil profile for analysis of nutrient content. The soil samples were air-dried, ground and passed through 100 mm mesh sieve and analyzed. Standard laboratory methods were followed for analyzing the leaf and soil samples to find out the nutrient content. The soil and leaf samples were analysed at Division of Agronomy and Soil Science, Indian Cardamom Research Institute, Spices Board, Myladumpara, Kerala.

RESULTS and DISCUSSION

Growth parameters of large cardamom: The result revealed that growth parameters of large cardamom significantly influenced due to Zn, Mn and Mg nutrition. Soil application of Zn, Mn and Mg alone or in combination of all these nutrients had significant effect on growth of large cardamom. Among the treatments application of ZnSO4 + $MnSO_4$ + $MgSO_4$ (10 kg/ha) exerted the maximum effect on immature tillers (2.99 and 3.19), mature tillers (2.86 and 3.11) and vegetative buds (2.56) of large cardamom in September and March as compared to all other treatments (Table 1). It might be due to the vital role of Zn, Mn and Mg in photosynthesis, nitrogen and phosphate metabolism which resulted in better crop performance.

Nutrient content in soil and leaf of large cardamom: Soil and leaf samples of the experiment were analyzed to know the impact of applied nutrients on nutrient availability in soil and content in leaf. With respect to nutrient status in soil the treatment of ZnSO4 + $MnSO_4$ + $MgSO_4$ (10 kg/ha) proved its superiority over the others and its effect was statistically non-significant on available Fe and B in soil (Table 2). Different treatments showed different uptake pattern with respect to Mg and other micronutrients content in leaf. Among the treatments significantly higher Mg (0.45%) and Mn (487.37 ppm) content in leaf was recorded with the application of ZnSO4 + $MnSO_4$ + $MgSO_4$ (10 kg/ha) as compared to control (Table 3). This might be due to improved nutrient availability. However application of $ZnSO_4$ (10 kg/ha) had significantly higher Zn (54.41 ppm) content in leaf over the control (Table 3). No significant effect of treatments was observed on Fe and Cu content in large cardamom leaf (Table 3). It may be due to acidic soil condition of experimental site.

ACKNOWLEDGEMENTS

Authors are thankful to the Director (Research), Indian Cardamom Research Institute, Spices Board, Myladumpara,

Table 1. Effect of soil application of Zn, Mn and Mg on growth of large cardamom

Treatment	Immature tillers		Mature tillers		Vegetative buds
	Sep 2013	Mar 2014	Sep 2013	Mar 2014	
$ZnSO_4$ (5 kg/ha)	1.53	1.96	1.58	1.66	1.44
$ZnSO_4$ (10 kg/ha)	1.87	2.22	2.04	1.96	1.86
$MnSO_4$ (10 kg/ha)	1.82	2.40	2.19	2.25	2.02
$MnSO_4$ (5 kg/ha)	1.84	2.42	2.25	2.30	2.07
$MgSO_4$ (10 kg/ha)	2.17	2.70	2.61	2.45	2.04
$MgSO_4$ (5 kg/ha)	2.63	2.79	2.51	2.70	2.08
$ZnSO_4$ + $MnSO_4$ + $MgSO_4$ (10 kg/ha)	2.99	3.19	2.86	3.11	2.56
Control	1.01	1.42	1.11	1.23	1.19
SEm±	0.13	0.17	0.10	0.11	0.08
LSD (P= 0.05)	0.38	0.52	0.32	0.33	0.23

Table 2. Effect of soil application of Zn, Mn and Mg on soil fertility status of large cardamom

Treatment	Available nutrient (ppm)					
	Mg	Zn	Cu	Mn	Fe	B
$ZnSO_4$ (5 kg/ha)	37.87	3.63	2.02	17.03	187.85	0.163
$ZnSO_4$ (10 kg/ha)	37.80	4.05	2.03	18.13	186.59	0.168
$MnSO_4$ (10 kg/ha)	36.33	3.38	2.05	20.26	187.00	0.167
$MnSO_4$ (5 kg/ha)	36.00	3.36	2.07	19.10	188.45	0.153
$MgSO_4$ (10 kg/ha)	47.53	3.33	2.02	17.78	186.48	0.150
$MgSO_4$ (5 kg/ha)	43.00	3.34	2.09	17.32	188.82	0.168
$ZnSO_4$ + $MnSO_4$ + $MgSO_4$ (10 kg/ha)	47.93	4.01	2.13	19.33	189.48	0.167
Control	35.64	2.98	1.78	16.37	180.25	0.162
SEm±	1.63	0.13	0.10	0.87	2.89	0.001
LSD (P= 0.05)	4.95	0.40	0.30	2.64	NS	NS

Table 3. Effect of soil application of Zn, Mn and Mg on nutrients content in leaf of large cardamom

Treatment	Nutrient Content				
	Mg (%)	Zn (ppm)	Cu (ppm)	Mn (ppm)	Fe (ppm)
$ZnSO_4$ (5 kg/ha)	0.36	52.39	5.99	348.48	291.22
$ZnSO_4$ (10 kg/ha)	0.33	54.41	6.01	351.73	325.70
$MnSO_4$ (10 kg/ha)	0.39	47.70	5.91	484.62	296.60
$MnSO_4$ (5 kg/ha)	0.41	46.71	5.89	482.29	301.27
$MgSO_4$ (10 kg/ha)	0.43	45.60	5.40	339.68	320.23
$MgSO_4$ (5 kg/ha)	0.41	44.12	5.36	348.90	347.07
$ZnSO_4$ + $MnSO_4$ + $MgSO_4$ (10 kg/ha)	0.45	48.86	5.94	487.37	347.67
Control	0.28	42.60	5.29	345.49	289.17
SEm±	0.032	0.74	0.31	17.17	19.97
LSD (P= 0.05)	0.098	2.25	NS	52.08	NS

Kerala for providing necessary facilities for analysis of soil and leaf samples.

REFERENCES

Gudade BA, Chhetri P, Deka TN, Gupta U and Vijayan AK 2013a. Large cardamom (*Amomum subulatum* Roxb): a spice crop with multiple uses. Indian Journal of Arecanut, Spices and Medicinal Plants **15(4):** 15-17.

Gudade BA, Chhetri P, Gupta U and Deka TN 2013b. Establishment of large cardamom (*Amomum subulatum* Roxb) sucker nursery at Sikkim. Popular Kheti **1(3):** 1-3.

Gudade BA, Chhetri P, Gupta U and Harsha KN 2013c. More large cardamom under *Alnus*. Indian Horticulture **58(2):** 19-20.

Gudade BA, Chhetri P, Gupta U, Deka TN, Vijayan AK and Bhattarai NK 2014. The study of eco-friendly practices of large cardamom cultivation in Sikkim and Darjeeling. Ecology, Environment and Conservation **20(1):** 119-123.

Gupta U, Gudade BA, Chhetri P and Harsha KN 2012. Large cardamom- the lifeline in Sikkim. Indian Horticulture **57(4):** 7-10.

Jenik PD and Barton MK 2005. Surge and destroy: the role of auxin in plant embryogenesis. Development **132:** 3577-3585.

Kishore K, Kalita H, Rinchen D and Pandey B 2012. Floral biology of large cardamom (*Amomum subulatum*). Indian Journal of Agricultural Sciences **82(7):** 578-582.

Mutaftchiev K 2003. Kinetic spectrophotometric determination of manganese in some medicinal plants and their decoctions. Revue Roumaine de Chimie **48(9):** 697.

Pandey SN and Gautam S 2009. Effects of zinc supply on its uptake, growth and biochemical constituents in lentil. Indian Journal of Plant Physiology **14(1):** 67-70.

Reid DE, Ferguson BJ, Hayashi S, Lin YH and Gresshoff PM 2011. Molecular mechanisms controlling legume auto regulation of nodulation. Annals of Botany **108:** 789-795.

Wajahat N, Perveen S and Saleem I 2006. Status of micronutrients in soils of district Bhimber (Azad Jammu and Kashmir). Journal of Agriculture and Biological Sciences **1(2):** 35-40.

Received: 12.11.2014 ***Accepted: 3.1.2015***