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Effect of Application of Micronutrients on Yield and Economics of Ginger under Eastern Ghat High Land Zone of Odisha

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Abstract: A study was conducted in Eastern Ghat High Land Zone of Odisha to explore the effect of foliar application of micronutrients on ginger during 2017-18 to 2019-20.The treatments consisted of three cultivars viz. V1 (Supranha), V2 (Suravi) and V3 (Varada) and foliar application of IISR ginger micronutrients @ 5 g/litre of water at 60 and 90 days after planting. Ginger variety Suravi was superior over other varieties in terms of yield and economics. Application of micronutrient showed significant variation for all characters studied. Higher fresh rhizome yield of 4.11-8.39% was obtained with foliar application of IISR ginger micronutrients (5 g/litre of water at 60 and 90 days after planting). Higher economic benefit (5.67-11.78% more net return) was also obtained with application of micronutrient. The present experimental findings signify the importance of foliar application of micronutrient along with recommended dose of fertilizers in improving yield and economics of ginger.

Keywords: Economics, Ginger, Micronutrients, Rhizome yield

Ginger (*Zingiber officinale* Rosc.) is an herbaceous perennial and cultivated in many regions of the world as well as in India. In the world, India has largest ginger growing areas (37.18%) with highest production (38.15%) during 2019 (FAOSTAT 2021). The total cultivated area of ginger in India is 160 thousand ha with production of 1118 thousand tons (HSG 2018). Odisha occupies 16.6 thousand ha of ginger land with production of 32 thousand tons. Per unit production of ginger in Odisha is very less (1.93 t/ha) as compared to national average i.e. 6.98 t/ha (HSG 2018). There is a huge scope to intervene different ways to increase productivity of ginger. Different cultivars, sowing time, climatic condition, nutrient management and maturity time are the major dependable factors for variability in productivity of ginger (Behera et al 2020). Different nutrients are essential for growth and development of crop plants. Micronutrients are the essential elements required in smaller amount but importance of these in growth and development of a crop is very much necessary as of major nutrients. Application of micronutrients showed positive impact on different crops (Barbosa et al 2016, Sarker et al 2018, Alkarawi and Hasan 2021). In ginger, different treatments of micronutrients showed extra yield starting of 29.40 to 125.10% (Singh and Dwivedi 2007). Halder et al (2007) reported the beneficial impact of zinc and boron on ginger yield. Although a number of researchers have evaluated the positive effect of micronutrient application in different crops, but very few work has been done on ginger. Study was conducted to evaluating the effect of foliar application of micronutrients on ginger interms of production and economics in Eastern Ghat High Land Zone of Odisha.

MATERIAL AND METHODS

Field experimentation was carried out at High Altitude Research Station, Pottangi (latitude 18.564151, longitude 82.968756-'E and 943 m above msl) under Odisha University of Agriculture and Technology during 2017-18 to 2019-20. The initial soil of the experimental site was sandy loam in texture with pH and nutrients status as in Table 1. A total rainfall of 1435.7, 983.7 and 1717.4 mm with 76, 77 and 99 number of rainy days were observed in first, second and third year of experiment, respectively (Fig. 1). The monthly mean maximum and minimum temperature is presented in Table 2. The experiment consisted of three cultivars viz. V1 (Supranha), V2 (Suravi) and V3 (Varada) and application of micronutrients viz. M1 [Foliar application of IISR (Indian Institute of Spices Research) ginger micronutrients @ 5 g/litre of water at 60 and 90 days after planting] and M2 (control). Experiment was conducted in a factorial RBD design with four replications. Different ginger varieties were sown at 30 cm x 25 cm spacing in a net plot of 3 m X 1 m on 1st week of April and the crop was harvested during first week of February to last week of March. FYM @ 15 t/ha was applied before sowing of ginger. A basal dose of 35 kg N, 100 kg P_2O_5

and 40 kg K_2O/ha were applied uniformly to each subplot during the final land preparation. Two top dressing of 45 kg N and 30 kg K_2O/ha were applied at 45 and 90 DAS. Data on number of leaves/plant and number of tillers/plant were collected from randomly selected five plants at 135 DAS. Observations on clump weight/plant, plot yield and fresh rhizome yield were recorded at harvest. Data were statistically analyzed using analysis of variance (ANOVA) as split-plot design in MS Excel 2010.

RESULTS AND DISCUSSION

Pooled data of three years showed significant variation in number of tillers/plant among different ginger cultivars (Fig. 2). However, a non significant variation was observed among the cultivars for number of leaves/plant (Fig. 2). Highest tiller numbers (13.3/plant) were obtained with ginger variety Suravi (V2) followed by Varada (V3). Differences in growth attributes among the varieties were perhaps due to the variation in genetic make-up within different varieties. Growth attributing characters like number of tillers and leaves per plant were significantly superior with application of IISR ginger micronutrients @ 5 g/litre of water at 60 and 90 days after plantingas compared to non-application of IISR ginger micronutrients mixture (Fig. 2). Recommended fertilizer application with supplementation of foliar nutrition enhances growth characters. Similar improvement reported by application of micronutrients in ginger (Sudha et al2020) and turmeric (Datta et al 2017).

Clump weight of ginger was significantly influenced by different cultivars during all years (Table 2). The maximum clump weight was recorded with Suravi (V2) followed by Varada (V3) and Suprabha (V1). In terms of clump weight, there was no significant difference between V2 and V3. Among the micronutrient, foliar application of IISR ginger micronutrients @ 5 g/litre of water at 60 and 90 days after planting (M1) recorded statistically highest clump weight as compared to control during all three years of experimentation.

During third year of experiment yield performance of ginger crop was better as compared to first and second year (Table 2) may due to be total of 1717.4 mm rainfall received in 99 rainy days in third year as against 1435.7 mm and 983.7 mm in first and second year, respectively during entire growing cycle (Fig. 1). Too much less rainfall in second year resulted in poor performance in terms of production of ginger during this year. Significant variation in plot yield and fresh rhizome yield among the different cultivars was found in all years (Table 2). Ginger cultivar Suravi (V2) recorded higher fresh rhizome yield of 22.03, 20.80 and 21.93 t/ha in first, second and third year of experimentation. In terms of yield, ginger variety Varada (V3) positioned second for all years. It was also observed that there was no significant variation

Table 1. Initial pH and nutrients status of studied soil

pH	Org. C (%)	Av. N (kg ha^{-1})	Av. P (kg ha^{-1})	Av. K (kg ha^{-1})	Av. Fe (mg kg^{-1})	Av. Mn (mg kg^{-1})	Av. Cu (mg kg^{-1})	Av. Zn (mg kg^{-1})	Av. B (mg kg^{-1})
5.96	0.88	300	20.16	180.0	16.0	15.12	1.10	0.45	0.35

Table 2. Monthly mean maximum and minimum temperature during experimentation

Months	2017-18		2018-19		2019-20	
	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
April	40.8	19.0	36.0	22.2	36.8	22.0
May	42.0	22.0	35.8	26.3	38.8	24.5
June	38.2	22.3	32.6	23.3	34.8	24.1
July	33.0	22.0	28.2	22.8	29.0	22.1
August	29.0	22.0	36.0	22.2	29.7	21.8
September	31.0	23.0	29.7	21.8	30.0	21.0
October	30.8	21.4	29.3	18.8	30.4	21.2
November	29.5	15.4	27.3	14.8	29.8	16.0
December	29.1	10.2	26.0	11.2	25.6	12.0
January	29.3	10.7	27.9	10.7	28.5	10.8
February	32.1	14.5	31.7	14.4	31.8	14.3
March	33.4	18.6	35.0	20.2	34.9	19.2

within V2 and V3.The fresh rhizome yield is the inherent capacity of the ginger variety and dependent on vigour of the plant and other plant characters (Kallappa et al 2015). Earlier studies also revealed significant variations for yield of ginger (Rani et al2019, Kallappa et al 2015). Application of micronutrient showed significant variation in both plot yield and fresh rhizome yield. Highest rhizome yield was found when the plant was sprayed with IISR ginger micronutrients @ 5 g/litre of water at 60 and 90 days after planting (M1) over control plot (M2). A higher fresh rhizome yield of 4.11-8.39% obtained when crop was cultivated with foliar application IISR ginger micronutrients as compared to control condition. This

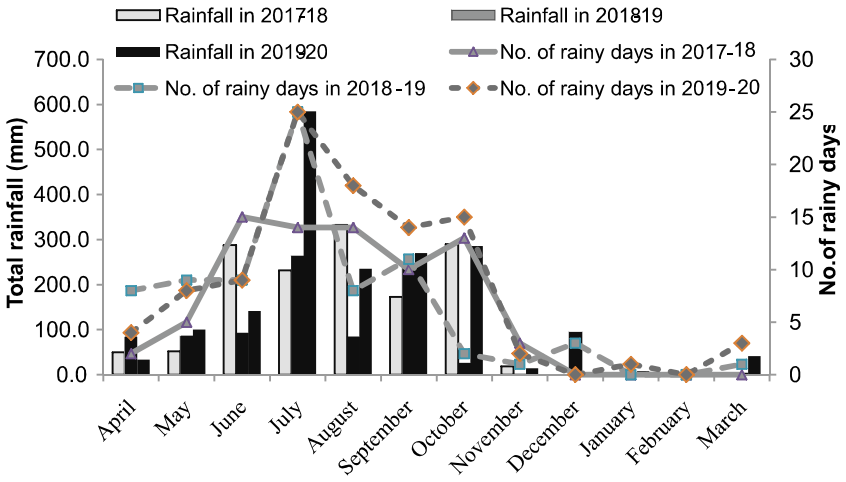

Fig. 1. Total rainfall and number of rainy days during experimentation

Table 3. Effect of cultivars and micronutrients on clump weight, plot yield and fresh rhizome yield of ginger

Treatments	Clump weight (g plant^{-1})			Plot yield (kg^{-3} m^{2})			Fresh rhizome yield (t ha^{-1})		
	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20
Cultivars									
V1	226.07	229.11	237.49	9.04	9.08	9.58	20.08	20.15	21.28
V2	248.03	234.81	243.28	9.92	9.37	9.88	22.03	20.80	21.93
V3	239.58	232.28	243.24	9.58	9.35	9.64	21.28	20.76	21.40
CD (p=0.05)	10.35	3.55	5.06	0.41	0.23	0.23	0.92	0.51	0.51
Micronutrients									
M1	245.12	241.65	246.52	9.80	9.64	9.89	21.77	21.40	21.97
M2	230.67	222.49	236.16	9.23	8.89	9.50	20.48	19.74	21.10
CD (p=0.05)	8.45	2.90	4.13	0.34	0.19	0.19	0.75	0.42	0.42

Table 4. Effect of cultivars and micronutrients on economics of ginger production

Treatments	Gross return (Lakh ha^{-1})			Net return (Lakh ha^{-1})			B;C ratio		
	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20	2017-18	2018-19	2019-20
Cultivars									
V1	16.06	16.12	17.02	11.75	11.62	12.32	3.73	3.58	3.62
V2	17.62	16.64	17.54	13.31	12.14	12.84	4.09	3.70	3.73
V3	17.02	16.61	17.12	12.71	12.11	12.42	3.95	3.69	3.64
Micronutrients									
M1	17.41	17.12	17.57	13.10	12.62	12.87	4.04	3.80	3.74
M2	16.39	15.79	16.88	12.08	11.29	12.18	3.80	3.51	3.59

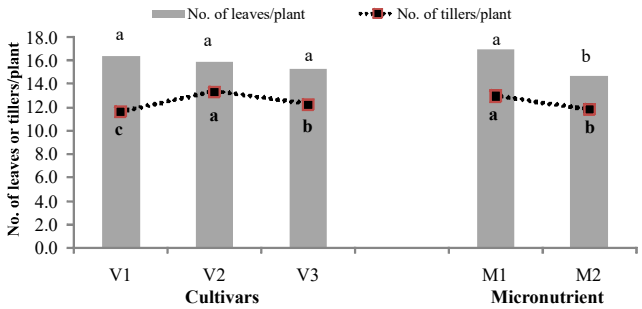

Fig. 2. Number of leaves and tillers per plant of ginger as influenced by cultivars and micronutrient application (pooled data of three years). [Means above the column bar followed by same letter do not differ significantly]

result suggests that recommended crop nutrition along with such foliar feeds could result in improved yield. Foliar sprays of IISR ginger micronutrient attributed to well balanced nutrition resulted in higher yield with this treatment. Improved production of ginger with application of micronutrients was also reported in other studies (Halder et al 2007, Sudha et al 2020).

Highest gross return, net return and B:C ratio was manifested by the cultivation of Suravi (V2) variety during all years because of the highest rhizome yield, the only economic part of the crop. B: C ratio of 3.73-4.09, 3.58-3.70 and 3.62-3.73 were obtained in first, second and third year, respectively by different cultivars with highest value with Suravi. In case of micronutrient application, gross return and net return was recorded higher with the application of micronutrients as compared to control. Higher B: C ratio was also recorded with application of micronutrients (M1). Application of micronutrients enhanced rhizome yield of ginger and ultimately reflected on highest economic return.

CONCLUSION

Ginger cultivar Suravi proved superior over other varieties in experimental region in terms of studied characters like yield and economics. Foliar application IISR ginger micronutrient (5 g/litre of water at 60 and 90 days after planting) with recommended dose of fertilizers helps in increasing ginger production and gave higher economic return.

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