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Assessing Effectiveness of 'Arka Mango Special' for Improving Yield and Quality of Mango Variety 'Banganpalli' in Lateritic Soils of Odisha, India

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A B S T R A C T

A field experiment was conducted at Central Horticultural Experiment Station (ICAR-IIHR), Bhubaneswar, India during 2013-16 to study the response of mango variety 'Banganpalli' to 'Arka Mango Special', a foliar micronutrient formulation developed by IIHR, Bengaluru for higher and quality yields in mango. The experiment was laid out in a randomized block design with four treatments, viz., T_1: control (sprayed with distilled water), T_2: Arka Mango Special @ 0.5%, T_3: IIHR micronutrient formulation-2 @ 0.5% and T_4: recommended dose of Zn and B for the region, i.e., Zn (60ppm) + B (250ppm), and 6 replications. Treatments were foliar sprayed thrice at flower bud differentiation, flower initiation and marble stage of fruit growth. All the three micronutrient treatments significantly improved fruit retention, yield and two important fruit quality parameters, viz., TSS and TSS/acid ratio over the control. Among micronutrient treatments, the treatment Arka Mango Special recorded the maximum values for no. of fruits/panicle at pea stage (26.14), no. of fruits/tree (64.26) and fruit yield (23.65kg/plant) whereas, fruit quality was found to be relatively better in T_3 and T_4 in terms of TSS/acid ratio (57.72) and TSS (19.93°B), respectively.

Introduction

Mango (*Mangifera indica* L.) is one of the most important tropical fruits of the world by virtue of its wide range of adaptability, richness in variety, scale of production, high nutritive value, unique flavour and attractive aroma. It is the 'National Fruit' of India where, it is cultivated in both tropical and sub-tropical regions. With an annual production of 18.53 million tonnes from 2.16 million ha area, India is the leading mango producing country. Andhra Pradesh, Uttar Pradesh, Odisha, Telangana, Karnataka and Gujarat are major mango growing states. In Odisha, it is cultivated on 1.98 lakh ha area with 7.7 lakh tonnes of annual production. In spite of having 3rd largest area under mango cultivation, the state lags behind in mango production by securing 9th position. The productivity of mango obtained in Odisha (3.9 t/ha) is one of the lowest in the country, reason being prevalence of acidic soils. 80% soils of the state are acidic and deficient in micronutrient. Acidic soil environment (pH<6.5) affects the plant growth, biomass and productivity of

crop by influencing the availability of plant nutrients particularly micronutrients, viz., B and Zn. Boron plays important role in cell division, cell development, calcium metabolism, ovule development, pollen tube growth, fruit set and translocation of sugar in plant whereas, zinc is involved in many enzymatic reactions, protein and carbohydrate metabolism and synthesis of growth promoter hormone called auxin. Thus, deficiency of Zn and B in mango crop may result in low fruit set, excessive fruit drop at various stages of fruit development and reduction in yield and fruit quality.

ICAR-Indian Institute of Horticultural Research has developed and released a crop specific foliar nutrition formulation known as 'Arka Mango Special' to correct micronutrient deficiency in mango. It contains various micro and secondary nutrients, viz., Zn, B, Fe, Cu, Mo, Mg and S. It has been found effective in enhancing yield and fruit quality of mango in Zn and B deficient alfisols of peninsular India. Hence, the present investigation was carried out to evaluate effectiveness of 'Arka Mango Special' for enhancing yield of mango in lateritic soils of Odisha.

Materials and Methods

The experiment was conducted at Central Horticultural Experiment Station, Bhubaneswar, Odisha during 2013 – 2016 on a high density orchard (5m x 5m) of mango variety 'Banganpalli' planted in the year of 2005. The experimental site lies at 20°15' N latitude, 85°15' E longitude and 25.5m above mean sea level. The climate of the experimental farm is hot humid tropical with average relative humidity of 85%. The average rainfall varies from 1600 to 1700mm distributed between June to October. The soil of experimental site is sandy loam (80.7% sand, 10.65% silt and 8.65% clay) and strongly acidic (4.8 pH) with low organic carbon (0.20%) and available N, P and K (190.8, 23.9 and 116.9 kg/ha, respectively). The experiment was laid out in randomized block design with four treatments comprised of T_1: control, i.e., no application of micronutrients, T_2: Arka Mango Special @ 0.5%, T_3: IIHR micronutrient formulation-2 @ 0.5% and T_4: recommended dose of Zn and B for the region, i.e., Zn (60ppm) + B (250ppm), and 6 replications. Each replication consisted of eight plants. Arka Mango Special and IIHR micronutrient formulation-2 were procured from IIHR, Bengaluru whereas, Zeta (12%) and Borovin (20%) of Nagarjuna Fertilizers and Chemical Ltd. were used as a source of for Zn and B. Micronutrients were foliar sprayed thrice at flower bud differentiation, flower initiation and marble stage of fruit maturity. In case of T_1, plants were sprayed with distilled water. Observations were recorded on characteristics of flowering and fruiting, viz., flowering shoot %, dimension of panicle (cm), hermaphrodite flower %, no. of fruits per panicle at pea stage of fruit growth and number of fruits retained per panicle at the time of harvesting, yield (kg/tree) and yield contributing parameters, viz., average fruit weight (g) and no. of fruits per plant, and on fruit quality parameters, viz., pulp, peel and stone contents (%), TSS (°B), acidity (% equivalent of citric acid), TSS/acid ratio and dry matter content (%).

The number of flowered shoots per m^2 of canopy were counted and expressed in percentage. At full bloom 20 panicles/tree distributed at the four directions were chosen at random and tagged to record various characteristics of flowering and fruiting. Panicle length and width was measured using measuring tape. Hermaphrodite flower % was determined by using following formula:

$$\text{Hermaphrodite flower \%} = \frac{\text{no. of hermaphrodite flowers/panicle}}{\text{Total number of flowers/panicle}} \times 100$$

Fruits were harvested at full maturity weighed with physical balance and yield is expressed in kg/tree. Average fruit weight was computed

by dividing the fruit yield by the number of fruits. For determination of various fruit quality attributes, four mature and healthy fruits from all the four directions of a tree were selected randomly. Fruit and its fraction, namely, peel and stone were weighed and their contents were calculated as percentage. Dry matter content was determined by gravimetric method where, 2 cm wide longitudinal slice of mango was convective air dried at 135°C for 2 hour. Following formula was used to calculate the dry matter content-

$$\text{Dry matter content (\%)} = \frac{\text{Dry slice weight (g)}}{\text{Fresh slice weight (g)}} \times 100$$

For determination of TSS and acidity, fruit juice was extracted from uniformly ripened fruits. TSS was determined using hand held digital refractometer (Hanna make) whereas, acidity was estimated by titrating the fresh fruit juice with 0.1N NaOH using phenolphthalein as indicator. The data generated on various parameters were tabulated and statistically analyzed using OPSTAT package of Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana for interpretation of results and drawing conclusion.

Results and Discussion

Effect of foliar nutrition of micronutrients on characteristics of flowering and fruiting

From the perusal of pooled data presented in Table 1, it is clear that three sprays of micronutrients (T_2, T_3, and T_4) during flower bud differentiation, flower initiation and marble stage of fruit growth influenced the number of fruits/panicle at pea and harvesting stages of fruit growth significantly however, the effect on flowering shoot, dimension of panicle and hermaphrodite flower % was non-significant. At pea stage, the highest number of fruits/panicle was found in T_2 whereas, T_4 retained the highest number of fruits/panicle at harvest. For the same parameters the differences among the three micronutrient treatments, could not reach the level of significance. Improvement in number of fruits/panicle at pea and harvesting stage could be attributed to the B and Zn present in micronutrient treatments. Boron helps in fruit setting by enhancing the pollen grain germination and pollen tube elongation whereas, Zn reduces the fruit drop at various stages of fruit growth by promoting auxin synthesis which in turn delays the formation of abscission layer. Similar effects of Zn and B on initial fruit set and fruit retention have also been reported by Stino *et al.,* (2011) and Yadav *et al.,* (2014) in mango and guava, respectively.

Effect of foliar nutrition of micronutrients on yield

Data pertaining to fruit yield (Table 2) revealed that, it was maximum in T_2 (23.65kg/tree) and minimum in control (17.21kg/tree). The yield obtained in T_3 and T_4 was statistically at par with the T_2. Though micronutrient treatments did not show significant improvement in flowering shoot % (Table 1) over the control yet, recorded more yields and fruits/tree. This indicates that retention of more number of fruits/panicle (Table 1) might have resulted into harvesting of more number of fruits/tree. The highest and lowest values for fruit weight were recorded in micronutrient treatment T_3 (371.62g/tree) and T_1 (366.75g/fruit), respectively. However, differences for average fruit weight were found to be statistically equal in all the treatments. Thus, higher fruit yield in micronutrient treatments could mainly be due to more number of fruits/tree not due to increase in average fruit weight. Yield enhancement due to application of Zn and B have also been reported by Samant *et al.,* (2008), Gaur *et al.,* (2014) and Lakshmipathi *et al.,* (2015) in ber, guava and cashew, respectively.

Table.1 Effect of foliar nutrition of micronutrients on flowering of mango var. Banganpalli

Treatment	Flowering shoot %	Panicle dimension (cm)		Hermaphrodite flowers/panicle (%)	No. of fruits/panicle at pea stage	No. of retained fruits/panicle
		Length	Width			
T_1	42.55	18.85	16.40	14.72	23.17	1.09
T_2	40.25	19.67	17.22	12.85	26.14	1.59
T_3	41.39	19.30	16.52	15.51	25.46	1.51
T_4	37.69	19.91	17.40	13.75	25.41	1.63
SE(m)±	1.92	0.57	0.54	0.67	0.66	0.07
CD *(P=0.05)*	NS	NS	NS	NS	2.01	0.22

Table.2 Effect of foliar nutrition of micronutrients on fruit yield of mango var. Banganpalli

Treatment	Fruit yield		No. of fruits/tree	Average fruit weight (g/fruit)
	(kg/tree)	(t/ha)		
T_1	17.21	6.88	46.78	366.75
T_2	23.65	9.39	64.26	368.24
T_3	23.04	9.03	62.01	371.62
T_4	22.57	8.63	61.39	368.17
SE(m)±	0.87	0.35	1.81	7.65
CD *(P=0.05)*	2.65	1.06	5.52	NS

Table.3 Effect of foliar nutrition of micronutrients on fruit quality of mango var. Banganpalli

Treatment	Pulp (%)	Peel (%)	Stone (%)	Dry matter content	TSS (°B)	Acidity (%)	TSS/acidity ratio
T_1	70.48	16.17	13.35	17.48	18.21	0.44	43.40
T_2	71.46	15.82	12.72	18.85	19.47	0.37	53.97
T_3	71.40	15.39	13.21	18.39	19.59	0.35	57.72
T_4	72.10	15.49	12.41	18.51	19.93	0.40	51.64
SE(m)±	0.56	0.37	0.30	0.63	0.18	0.03	9.59
CD *(P=0.05)*	NS	NS	NS	NS	0.54	NS	3.15

Effect of foliar nutrition of micronutrients on fruit quality

It is evident from the pooled data presented in Table 3 that the fruits obtained under micronutrient treatments exhibited significant difference for two important attributes of fruit quality, namely, TSS and TSS/acid ratio over the control. The other fruit quality parameters, viz., pulp, peel and stone contents, dry matter and acidity were at par in all the treatments. Among different micronutrient treatments, the treatment T_4 recorded the highest TSS (19.93°B) whereas, T_3 recorded the highest TSS/acid ratio (57.72).

Improvement in fruit quality parameters due to application of B have also been reported by Lal and Ahmed (2012) and Jat and Kacha (2014) in pomegranate and guava, respectively. Anees *et al.,* (2011), Nehete *et al.,* (2011) and Bhowmick *et al.,* (2012) reported increase in TSS due to application of Zn in mango.

On the basis of experimental findings, it may be concluded that, the technology of foliar nutrition of micronutrients, developed by IIHR, Bengaluru for mango (Arka Mango Special) could be adopted in the state of Odisha for improving mango productivity and quality of produce.

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