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ORIGINAL RESEARCH ARTICLE



Growth and yield of Bangi (*Cucumis melo* L.) in charland agriculture affected by micronutrients

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ABSTRACT

Bangi (*Cucumis melo* L.) is an important short duration summer fruit crop, it is rich in vitamins and minerals, facilitated to protect from hidden hunger. To expedite the growth attributes and fruit yield of Bangi through micronutrient application for the Charland Agriculture, an experiment was conducted at the farmer's (Charland) field in two locations viz., Sadar and Belkuchi upazilas of Sirajgong district, Bangladesh. The crop was cultivated following farmer's management practices in mada(s)/pits (spacing 3.5 m × 3.5 m) in RCBD design with 3 replications. Two fertilizer doses as control (farmers practice; cow dung + NPK) and improved practice (farmers practice + micronutrients), were used as experimental treatments. The application of micronutrients enhanced plant length and other growth descriptors and fruit yield as well; however, locations did not affect the studied descriptors except the number of secondary branches plant⁻¹ and leaf characters. The plant length varied from 148.6 cm to 321.7 cm, the fruit yield (number plant⁻¹) almost quadrupled and size more than double due to improved practice (with micronutrients) resulting in 4–5 times increase the farmer's profit compared to conventional (farmers) practices. Further research on the effect of micronutrients on nutritional quality enhancement (Biofortification) and self-life is suggested for better understanding and nutritional quality improvement processes of Bangi through nutrient management.

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INTRODUCTION

Charlands, the riverine sand and silt landmasses, appear as a result of the dynamics of erosion and deposition in the rivers. With an estimated to be 0.72 m ha in Bangladesh, which is about 5% of the country area and about 6.5 m people (5% of the country's population) live there (CEGIS, 2000). The chars are one of the most vulnerable agroecosystems in Bangladesh and home to the poorest and marginal people. These areas are particularly prone to frequent climate hazards (viz., floods, drought and cyclones) which increases the precariousness of poor people's lives by wiping out their assets and pushing them deeper into poverty. However, they have developed many coping strategies of their own to offset these natural disasters (Haque, 2020). The char dwellers mainly depend on agriculture

and agriculture-related activities, as opportunities for off-farm activities are very minimum (and/or absent) there. Although ca. 64 to 97% of the char areas are cultivable, the charland farmers generally cultivate different local crop cultivars following traditional production practices which consequential to lower crop yield and farm income. More than 35 cropping patterns are followed by the farmers of these areas (Islam *et al.*, 2016). Mixed cropping of Bangi along with Eggplant, Ladies finger and *Amaranthus* spp., is one of the popular cropping patterns during winter.

Bangi (*Cucumis melo* L.) belongs to the gourd family Cucurbitaceae, one of the most important vegetables and fruit yielding family distributed mostly in the tropics, and a few species are also found in the warm temperate regions. *Cucumis melo* is the most diversified species of the genus *Cucumis*, it encompasses

netted muskmelon, salmon-flesh cantaloupe, smooth-skinned and green-fleshed Honey Dew, wrinkle-skinned Cassaba, long shelf-life Hami melon, small and thin-pericarp makuwa, and several non-sweet pickling and cooking oriental melons (Liu et al., 2004). Melon plants are herbaceous, procumbent, hispid, tendril bearing climbing or creeping annuals having fibrous roots, angular, scabrous stem, simple soft hairy orbicular-reniform leaves and thriving in fertile, well-drained soils in warm, sunny locations (Paris et al., 2012). Fruits are rich in vitamins and minerals and help to fight against hidden hunger (micronutrient deficiency) and to treat many other diseases e.g., kidney disorders, cough, bilious diseases, hot inflammation of the liver, liver and bile obstruction, eczema, etc. (Fahamiya et al., 2016). Although the success stories of *Bangi* farmers/production in Bangladesh have been published in some popular dailies (Anonymous, 2016; 2018); hitherto, scientific information on cultivation technology, for example, high yielding cultivar(s) development, fertilizer recommendation, management practices, etc., is not available for improved *Bangi* production in Bangladesh. The present research was, therefore, conducted to enhance the growth attributes and fruit yield of *Bangi* through micronutrients application for the Charland Agriculture, to increase the household income for achieving the food and nutritional security.

MATERIALS AND METHODS

The experiment was conducted at the Farmer's (Charland) field in two locations viz. Sadar and Belkuchi Upazilas of Sirajgong district. *Bangi* seeds were collected from a progressive farmer. *Bangi* was cultivated following farmer's management practices in mada/pit(s) (with the spacing 3.5 m × 3.5 m) in RCBD design with 3 replications. Two fertilizer doses were used as experimental treatments, as follows - i. Farmers practice (Cow dung + NPK in form of Urea-DAP-MoP @ 75-112-62 kg ha⁻¹; Control) and ii. Improved practice (Farmers practice + micronutrients (Gypsum + Zinc + Boron @ 25-10-2.5 kg ha⁻¹). Half of the cow dung was added to the soil during land preparation, the rest amount of the cow dung and the total amount of DAP, Gypsum, Zinc and Boron were added to the pit before seed placement. Urea and MoP were mixed-up with the pit's soil after the thinning operation of additional *Bangi* seedlings, grown-up a few centimeters. Five to six seeds were sown in the pit on 12 February 2020 after winter vegetable crops harvest or in mixed cropping. After germination, 4(-5) healthy seedlings per pit were maintained by uprooting the others. Intercultural operations e.g., weeding, irrigation, hand pollination, pheromone trap installation, etc., were done whenever necessary. Growth, yield and yield contributing descriptors were studied. Although we had started two separate experiments with the same (two) treatments viz. control and improved practice, the crop of the control plots in Sadar upazila was destroyed completely due to excessive rainfall and early flood. Farmers paid their attention to harvest fruit from the improved practice plots as these had bigger fruit and higher yield. Therefore, we had compared

improved practice data between the locations without control data of Sadar upazila.

The collected data were analyzed following the ANOVA using the statistical computer package program MSTAT-C. The mean differences of different parameters among the cultivars were adjudged with Duncan's New Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Bangi is a climbing annual monoecious plant, soft stems can sprawl along the ground or into other plants where they attach themselves by means of tendrils (Figure 1A). Micronutrients enhanced plant length and other growth descriptors and yield as well; however, locations viz. Sadar and Belkuchi Upazilla did not affect the studied descriptors except the number of secondary branches plant⁻¹ and leaf characters (Tables 1 - 6). A wide variation in plant length was observed. The longest plant was 321.7 cm and the lowest was 148.6 cm in length (Tables 1, 2). All other growth descriptors viz. the number of primary and secondary branches plant⁻¹, length of secondary branches, number and length of internodes plant⁻¹ and leaf features - petiole length, length and width of leaf lamina, were also varied significantly (Table 1). Leaves were green in colour, lamina surface rough in both, abaxial and adaxial, side, petiole hollow and hairy (Figure 1B). Moreover, the growth descriptors viz. number and length of secondary branches, length of internode and leaf features - petiole length, length and width of leaf lamina, were also showed significant differences due to location (Table 2).

The number of flowers and the size of floral parts were also enlarged due to micronutrient treatment; however, the female flowers, size-related descriptors, were relatively less affected compared to male flowers (Table 3). Flowering pattern continuous (2-) 3 (-4) times within a growing season, the blooming of male flowers started at 35-40 days after sowing (DAS) and female flowers at 40-45 DAS; around 60% of (total) female flowers became fertilized. Among these fertilized female flowers (/ovary), 50 to 80% developed to matured fruits depending upon the flowering period and the rest were failed to become matured and/or rotten. *Bangi* fruit become matured within 30 days after fruit formation. The total number of harvested fruits plant⁻¹ varied from 10-15 (by improved practice) and 4-5 (by farmers practice) (Table 5). Fruit size varied from 19.2 to 34.3 cm in length, circumference 26.6-52.8 cm (Figure 1E-F), weight 0.99-3.35 kg fruit⁻¹ and the average market price Tk. 10.00-20.00 (US\$ 0.12 - 0.24) fruit⁻¹.

The application of micronutrients viz. Gypsum, Zinc and Boron as the source of S-Zn-B, respectively, commenced longer plant with larger leaves and flowers, and ultimately higher fruit yield in *Bangi* (Tables 1 - 6). These micronutrients, individually and/or combined, stimulate plant growth and development in different ways. For example, Sulphur plays an important role in chlorophyll formation, nitrogen metabolism, as a constituent of amino acids, and synthesis of oils (Kopriva et al., 2019). Zinc is a constituent of metalloenzyme or a cofactor for several enzymes such as



Figure 1. Different parts of a Bangi plant. A. Vegetative parts, B. Leaf, C. Male flower, D. Female flower, E. Fruit with micronutrients, and F. Fruit with farmer's practice.

anhydrases, dehydrogenases, oxidases and peroxidases, and plays an important role in regulating the nitrogen metabolism, cell multiplication, photosynthesis and auxin synthesis in plants (Rout and Das, 2003). It also plays an important role in the synthesis of nucleic acid and proteins and helps in the utilization of phosphorous and nitrogen during seed formation. Boron, an essential trace element required for the physiological functioning of higher plants, is involved in the structural and functional integrity of the cell wall and membranes, ion fluxes across the membranes, cell division and elongation, nitrogen and carbohydrate metabolism, sugar transport, cytoskeletal proteins, and plasmalemma-bound enzymes, nucleic acid, indoleacetic acid, polyamines, ascorbic acid, and phenol metabolism and transport (Shireen et al., 2018). All of these functions accelerate plant growth and development. Thus, along with other growth descriptors, the number of secondary branches plant⁻¹ and the number of nodes plant⁻¹ increased more than double (Table 1), which may directly influence the number of fruits plant⁻¹. The size of fruits was also bigger due to advantageous and balanced nutritional condition (Tables 5, 6; Figure 1E). Therefore, the average market price was increased from Tk. 10.00 (US\$ 0.12) fruit⁻¹ (farmers practice) to Tk. 20.00 (US\$ 0.24) fruit⁻¹ (improved practice). The higher price and greater number of fruits plant⁻¹ combined increased the farmer's profit 4-5 times higher compared to conventional practices. Although we did not calculate a formal cost-benefit analysis, farmers had reported a net income/profit of Tk. 150,000.00 (US\$ 1770) ha⁻¹ of land due

to the application of micronutrients.

Conclusion

The application of micronutrients (S-Zn-B) has a tremendous effect on the growth and yield of *Bangi* in both locations. The fruits yield plant⁻¹, both in number and weight, increased three folds compared to farmer's practice. The fertilizer dose NPK (in form of Urea-DAP-MoP) + Gypsum + Zinc + Boron @ 75-112-62-25-10-2.5 kg ha⁻¹ may be recommended to the farmers of Charland's of Sirajgong district for (more) profitable *Bangi* production. Multi-location experiments with different fertilizer doses will find to be effective to make a recommended fertilizer dose for *Bangi* production in Charland Agriculture. Further research on the effect of micronutrients on nutritional quality enhancement (Biofortification) and self-life is suggested for better understanding and nutritional quality improvement processes of *Bangi* through nutrient management.

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Table 1. Morphological descriptors affected by micronutrients.

Treatment	Plant length (cm)	Primary branch plant ⁻¹ (no.)	Secondary branch plant ⁻¹ (no.)	Secondary branch length (cm)	Inter-node plant ⁻¹ (no.)	Inter-node length (cm)	Leaf stalk length (cm)	Leaf blade	
								Length (cm)	Width (cm)
Control	148.6 b	2.93 b	6.33 b	22.4 b	25.5 b	6.42	10.7	7.71 b	9.21 b
Micronutrients	294.5 a	3.87 a	9.67 a	49.1 a	51.2 a	6.41	12.3	9.65 a	11.25 a
LSD _{0.05}	9.36	0.64	1.58	7.67	7.38	0.07	2.00	0.73	0.94
CV (%)	16.25	24.19	25.15	27.42	24.58	1.31	22.23	10.71	11.68

Table 2. Morphological descriptors affected by locations.

Location	Plant length (cm)	Primary branch plant ⁻¹ (no.)	Secondary branch plant ⁻¹ (no.)	Secondary branch length (cm)	Inter-node plant ⁻¹ (no.)	Inter-node length (cm)	Leaf stalk length (cm)	Leaf blade	
								Length (cm)	Width (cm)
Belkuchi	294.5	3.87	9.67 b	49.1 a	51.2	6.41 b	12.3 b	9.65 b	11.25 b
Sadar	321.7	3.73	12.47 a	14.7 b	53.6	10.66 a	18.3 a	13.21 a	16.19 a
LSD _{0.05}	49.83	0.75	1.66	7.39	8.74	0.94	1.65	1.04	1.39
CV (%)	20.65	25.23	19.19	29.61	21.29	14.10	13.75	11.59	12.94

Table 3. Floral descriptors affected by micronutrients.

Treatment	Male flower					Female flower				
	Stalk length (cm)	Calyx length (cm)	Petal length (cm)	Petal width (cm)	Androecium length (cm)	Stalk length (cm)	Calyx length (cm)	Petal length (cm)	Petal width (cm)	Gynoecium length (cm)
Control	0.85 b	1.07 b	1.83 b	0.97 b	0.26 b	1.15	0.96	1.75	1.29 a	1.74
Micronutrients	1.45 a	1.33 a	2.74 a	1.49 a	0.82 a	1.39	0.91	1.75	1.09 b	1.95
LSD _{0.05}	0.12	0.08	0.22	0.12	0.08	0.34	0.17	0.28	0.11	0.32
CV (%)	13.11	8.53	12.12	12.55	8.53	34.43	23.94	20.53	11.77	22.09

Table 4. Floral descriptors affected by locations.

Treatment	Male flower					Female flower				
	Stalk length (cm)	Calyx length (cm)	Petal length (cm)	Petal width (cm)	Androecium length (cm)	Stalk length (cm)	Calyx length (cm)	Petal length (cm)	Petal width (cm)	Gynoecium length (cm)
Belkuchi	1.45	1.33	2.74	1.49	0.82	1.39	0.91	1.75	1.09	1.95
Sadar	1.43	1.23	2.51	1.52	0.79	1.37	1.01	1.81	1.13	1.89
LSD _{0.05}	0.17	0.17	0.24	0.18	0.17	0.43	0.13	0.42	0.07	0.41
CV (%)	15.06	17.29	11.91	15.77	17.29	39.58	17.92	29.90	7.86	27.26

Table 5. Fruit descriptors affected by micronutrients.

Treatment	Fruit yield (no. plant ⁻¹)	Fruit length (cm)	Circumference (cm)	Weight (kg fruit ⁻¹)
Control	4-5	19.2 b	26.6 b	0.99 b
Micronutrients	10-15	34.0 a	53.3 a	2.27 a
LSD _{0.05}		3.85	5.46	0.34
CV (%)		18.48	17.47	26.45

Table 6. Fruit descriptors affected by locations.

Treatment	Fruit yield (no. plant ⁻¹)	Fruit length (cm)	Circumference (cm)	Weight (kg fruit ⁻¹)
Belkuchi	10-15	34.0	53.3	2.27
Sadar	10-15	34.3	52.8	2.35
LSD _{0.05}		4.75	7.28	0.51
CV (%)		17.76	17.54	28.02

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