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Efficacy of various vitamins and nutrients in enhancing quality and production of Capsicum (*Capsicum annuum* L.)

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Abstract

The experiment was undertaken to examine the response of foliar application of Ascorbic acid, Boric acid, and riboflavin on the growth and yield of Capsicum (*Capsicum annuum* L.). In this experiment, the treatments considered were boric acid (100 ppm), ascorbic acid (10ppm), riboflavin (10 ppm), ascorbic acid (10 ppm)+ boric acid (100ppm), and riboflavin (10ppm)+Boric acid (100ppm). The experiment was laid out in randomized block design (RBD) with four replication. Among all the treatments, ascorbic acid (10ppm)+Boric acid (100ppm) treated plants give the highest plant growth and fruit yield, followed by riboflavin (10ppm) +boric acid (100ppm). The results showed that foliar application of these vitamins and boric acid significantly increased the growth parameters and photosynthetic pigments compared with the control plants. All treatments induced the plants to flower and produce fruits earlier than the control plants. The treated plants improve the quality of the fruit produced by increasing self life, protein, sugar, and ascorbic acid content.

Key words : *Capsicum,* vitamins, boric acid, fruit yield and quality.

Capsicum, commonly known as bell pepper, is a popular vegetable crop that is cultivated worldwide for its nutritional and economic benefits. Bell pepper, is an important agricultural crop for its commercial value and nutritional benefit of fruits. The fruit is rich source of natural colors and antioxidant. The use of vitamins and nutrients can play a crucial role in improving the quality and yield of *Capsicum*. Ascorbic acid (vitamin C) has a regulatory role in promoting productivity in many plants such as pepper[20], pea plants[10] and potato[8]. Micronutrients such as boron had great influence on plant growth and development. The

essential physiological activities of boron linked to strength of cell wall and development, RNA metabolism, sugar transport, hormones development, respiration, cell division, Indole acetic acid (IAA) metabolism and as part of the cell membranes[14]. Boron deficiency causes delay in pollen germination and pollen tube development and ultimately it halts flowering and fruit setting[17]. A foliar spray of micronutrients is a common practice to overcome deficiencies to improve fruit quality. Nutrients are generally more quickly available to the plants by the foliar application than by soil application. Earlier experiments on foliar spray of micronutrients and vitamins in different vegetable crops shown significant responses in improving the yield and quality[13]. Therefore, the present study has been carried out to evaluate the effects of foliar application of ascorbic acid, riboflavin, and boron on capsicum yield, quality, and shelf-life.

The study was carried out during the period Jan- March 2022 and 2023 on a clay loam soil at the Crop Farm of University of Science and technology Meghalaya. The test crop was capsicum of variety 'california wonder'. The experiment was carried out in Randomized Complete Block Design (RCBD) with six treatment and each treatment was replicated five times. The treatments were T1Boron (100 ppm), T2 Ascorbic acid (5ppm)+ Boron (50 ppm), T3 Riboflavin (5ppm) +Boron (50 ppm), T4 Ascorbic (10 ppm) and T5 Riboflavin (10 ppm) and T6 is the control. The treatments were applied 30 days after transplanting as foliar spray for two times at 15 days interval. The record on growth, yield and quality parameters were taken and statistical analysis were done. Chlorophyll estimation were done by following the method of Arnon[4]. Total soluble protein was determined following the method of Lowrey *et al.*[12]. Ascorbate content in fruits was determined by 2, 4 dinitrophenyl hydrazine method (DNPH) given by Riemschneider *et al.*,[19]. Total carbohydrates content in fruit was determined by Anthrone method[21].

In this experiment different concentration of different vitamins and nutrients which was applied as foliar spray showed significantt effect on plant height and branch number of Capsicum (Table-1). Improvement in growth characters is considered to be prerequisite to increase yield. The highest Plant height (53.59 cm) and branch number (9) was observed from the T2 (0.5pm Ascorbic acid +boric acid) treatment followed by T4 (10ppm Ascorbic acid) treatment. Boron have a critical role in carbohydrate transport and amino acid production emphasizes the profound effect of its deficiency on the yield and crop quality[22]. Ascorbic acid (vitamin C) is an essential compound for plant tissues as it has antioxidant function, acts as an enzymatic cofactor and a plant growth regulator[9]. Ascorbic acid plays an important role in different processes like, photosynthesis, photo protection and cell expansion resistance to environmental stress[18]. Early flowering leads to early fruit formation, first picking and consequently helps in timing of harvesting. Ascorbic acid (5ppm)+ Boron (50 ppm) *i.e.* T2 treated plants showed minimum number of days to 50% flowering (48 days) and days to first picking (80.1 days) followed by T1 Boron (100 ppm) treatment of the crop. The earliness in flowering and picking might be due to accelerated photosynthesis and rapid translocation of photosynthesis

Table 1.Effect of some vitamins and nutrient on growth and yield of Capsicum (*Capsicum annuum* L.)

Treatments	Plant height (cm)	Branch number	Days taken to50% flowe-ring (DAT)	Days to first picking	Number of fruitper plants	Fruit dia-meter (cm)	Fruit yield per plant (g)	Ave-rage Fruit weight (g)	Self life (Days)
T1 Boron (100 ppm)	46.41	7.75	51.9	82.13	8.75	5.38	678.12	77.5	8
T2 Ascorbic acid (5ppm)+ Boron (50 ppm)	53.50	9.00	48.6	80.1	9.50	6.38	799.8	84.20	10
T3 Riboflavin (5ppm) +Boron (50 ppm)	45.56	7.50	52.06	83.75	8.85	5.25	650.65	73.52	9
T4 Ascorbic acid (10 ppm)	49.75	8.00	51.8	84.25	9.00	5.83	723.23	80.34	8.5
T5 Riboflavin (10 ppm)	43.81	7.25	53.4	83.88	8.25	5.25	648.53	78.61	8
Control	42.63	6.75	56.0	89.75	7.50	4.50	542.62	72.35	7
SED	0.82	0.32	0.26	2.05	045	0.31	4.23	2.65	0.56
CD at 5%	1.44	0.56	0.48	3.10	0.80	0.55	6.15	3.76	1.65

towards initiating flower buds in early flowering[1]. In Integrated application of vitamins and nutrients increased yield and yield attributing characters of capsicum (Table-1). Application of Ascorbic acid (5ppm)+ Boron (50 ppm) recorded maximum values of all yield attributing characters like average fruit weight (84.2 g), fruit diameter (6.38cm) and number of fruits per plant (9.0) followed by ascorbic acid treatment. Similar findings were also reported by Alaa *et al*.,[2] in Bean. Higher vegetative growth might have helped in the synthesis of greater amount of fruit material which was later translocat into developing fruits resulting in increased fruit length and diameter[7].

The maximum fruit yield per plant was recorded in treatment T2 Ascorbic acid (5ppm)+ Boron (50 ppm) (763.23 g per plant) compared to other treatments.. The combination of mineral boron and ascorbic acid had an interactive effect on flowering and fruit production. This may be due to the increased availability of nutrient to the plants. The maximum self life was recorded 10 days with by T2 Ascorbic acid (5ppm)+ Boron (50 ppm) followed by 9 days in T3 Riboflavin (5ppm) +Boron (50 ppm treatment. These results are in consonance with findings of Kumar *et al*.,[11]. Boron plays important role in pollen tube growth which effect seed and fruit set and increase shelf

life[5]. Boron promotes the absorption of calcium and increases the content of vitamin C in the fruit by improving membrane integrity, slowing biosynthesis and reducing respiration in cherry tomato[15].

Chlorophyll and carotenoid content showed significant difference among the applied treatment (Fig. 1). The highest leaf chlorophyll content was recorded with T2 Ascorbic acid (5ppm)+ Boron (50 ppm) treatment *i.e*. Chlorophyll a, 2.90 mg.g^{-1} fresh w t , Chlorophyll b, 1.49 mg.g^{-1} fresh wt and carotinoid 0.31 mg.g^{-1} fresh wt. Photosynthesis is one of the most important indices of plant growth and development, and chlorophyll content is a measure of photosynthetic efficiency. Application of appropriate boron can stable leaf structure, which can effectively promote the synthesis of photosynthetic pigments that affect directly the photosynthetic capacity in tomato plants[23]. Vitamins could be regarded as compounds of bioregulators or hormone precursors that, in tiny amounts, employ a valuable impact on plant growth and development. All essential physiological processes, such as photosynthesis, biosynthesis enzymes and secondary metabolites, nutrient and water absorption, and cell division more or less depend on vitamin availability. Ascorbic acid (AsA) function as an antioxidant, an enzyme cofactor, and as a pre-cursor for oxalate and tartrate synthesis. AsA is affiliated with chloroplasts in which the effect of oxidative stress on photosynthesis is mitigated[2].

Quality of capsicum was evaluated by estimating protein, sugar and ascorbic acid content of the fruit. It is evident from Fig. 2 that maximum value of protein and sugar content of fruits were recorded in treatment T2 Ascorbic acid (5ppm)+ Boron (50 ppm) followed by T3 Riboflavin (5ppm) +Boron (50 ppm). Ascorbic acid performs a crucial function in maintaining several metabolic processes[3]. The possible cause depicted in the increase in total soluble sugar may be due to difference in mineralization, continuous availability of more nutrients in higher amount and better utilization by plants[6]. Minz *et al*.,[16] reported that the improvement in TSS content of broccoli head with the application of micronutrients might be attributed to increased metabolic activities associated with production of total soluble solids, such as carbohydrates, organic acid, amino acid and other inorganic elements.

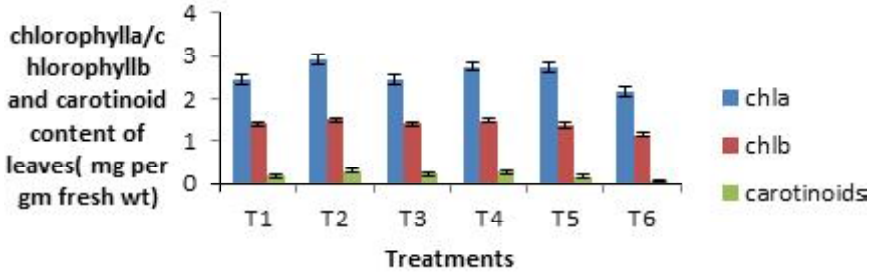

Fig. 1. Effect of some vitamins and nutrient on chlorophyll and carotenoid content of leaves of Capsicum (*Capsicum annuum* L.)

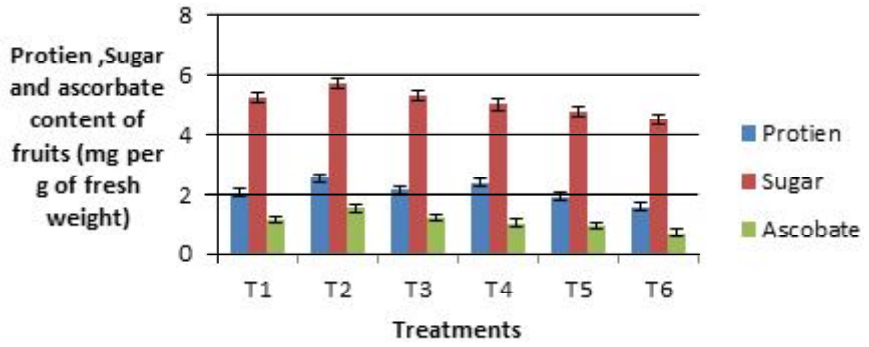

Fig. 2. Effect of some vitamins and and nutrient on protein, sugar and ascorbate content of leafs of Capsicum (*Capsicum annuum* L.)

Based on the experiments results, it can be concluded that the foliar application of ascorbic acid, boric acid, and riboflavin can significantly improve the growth and yield of *Capsicum* plants. Among the treatments, ascorbic acid (10ppm) + boric acid (100ppm) treatment showed the best results in terms of plant growth and fruit yield, followed by riboflavin (10ppm) + boric acid (100ppm) treatment. The application of these vitamins and boric acid also enhanced the quality of the fruits produced by increasing their self-life, protein, sugar, and ascorbic acid content. These findings suggest that foliar application of ascorbic acid, boric acid, and riboflavin can be used as an effective strategy to improve the growth and yield of Capsicum plants and enhance the quality of the fruits produced.

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