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Effect of Boron and Plant Growth Regulators on Hybrid Seed Yield and Quality of Sponge Gourd (*Luffa cylindrica* L.) Hyb. Haritha under Protected Condition

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Abstract

A field experiment was conducted to know the influence of boron and plant growth regulators on hybrid seed yield in sponge gourd hybrid (Haritha) under protected cultivation.The experiment consisted of six treatments *viz.,* Boron (1g/l), Boron (1 g/l) + GA_3(50 ppm), Boron (1 g/l) + NAA (0.3 ml/l), Boron (1 g/l) + Triacontanol (1.5 ml/l), Boron (1g/l) + Homobrassinolide (0.5 ml/l), Boron (1 g/l) + Humic acid (2 ml/l). The treatments were imposed thrice at 2-3 leaf, peak flowering and fruit initiation stages. The results revealed that, spraying of Boron (1 g/l) + NAA (0.3 ml/l) significantly recorded higher vine length (376.6 cm), fruit length (36.2 cm), fruit diameter (17.9 cm), fruit weight (29.8 g), number of fruits per plant (6.83), number of seeds per fruit (148), 100 seed weight (8.91 g), seed weight per fruit (13.1 g), hybrid seed yield per plant (90 g), hybrid seed yield per ha (844.3 kg), seed germination (97.0 %), shoot length (17.6 cm), root length (21.7 cm), total seedling length (39.3 cm), seedling dry weight (904.5 mg), seedling vigour index I (3812), seedling vigour index II (87737) and dehydrogenase enzyme activity (1.319 OD value) compared to control (354.3 cm, 32.3 cm, 16.1 cm, 27.0 g, 5.91,133, 8.41 g, 11.1 g, 66.1 g, 619.7 kg, 84.0 %, 14.2 cm,20.3 cm, 34.5 cm, 826.3 mg, 2898, 69409 and 0.960 OD value, respectively). The results of the experiment clearly indicated that, among the treatments, Boron (1 g/l) + NAA (0.3 ml/l) was the best treatment for getting higher seed yield and quality in spongegourd.

Keywords: Sponge gourd, Plant growth regulators and Fruits & Seed quality parameter

Sponge gourd (*Luffa cylindrica* L.) is also known as "Luffa, Bath sponge, Towel gourd, Dishrag gourd, Vegetable sponge, Rag gourd, Smooth luffa, Scrubber gourd and Wild vegetable sponge". Luffa is widely cultivated vegetable in the family Cucurbitaceae, which is easy to grow hence it is grown throughout Asia and the United States for the food and scrubbers although it is inherent to Tropical Africa and Asia. Sponge gourd is highly cross pollinated and monoecious crop with chromosome number 2n = 26. Flowers are deep yellow in color, unisexual and situated at different internodes. Sponge gourd contains high fibre which is used as cleansing agent and making table mats, shoes soles etc. In India, it is cultivated extensively in the states of Madhya Pradesh, Tamil Nadu, Uttar Pradesh, Andra Pradesh, Kerala and Maharashtra. In India, it occupies an area of 41 m ha with the production of 641 mt and productivity of 15.63 t/ha (Handbook of Horticulture Statistics, 2014). Most of the cucurbitaceous vegetables are usually cultivated in relatively small areas for local consumption and hence the statistical data on area and production are lacking (Anon., 2016). Plant growth regulators are the chemical substances, when applied in small amounts modify the plant growth usually by stimulating part of the natural growth regulatory system. Growth regulators are known to have an effect on the production of earliest flower, yield ratio of male/ female flower, number of fruits and weight of fruit. Initiation of flower bud, development of flowers and fruits are controlled by physiological process. In many agricultural plants, these processes can often be used to alter by proper application of plant growth substances.

Use of plant growth regulators and micro nutrient like boron might be a useful alternative to increase crop production. Foliar spray of micronutrients usually penetrates through the cuticle of leaves or the stomata and enters the cells and results in higher fruit and seed yield. Boron also plays an important role in the pollination process of plant and that reproductive

organs are particularly rich in boron. Adequate boron supply is essential for proper nucleic acid metabolism and influences the incorporation of phosphorus into RNA and DNA.

Material and Methods

A field experiment was conducted to study the influence of boron and plant growth regulators on hybrid seed yield and quality of sponge gourd (*Luffa cylindrical* L.) hybrid (Haritha) under protected cultivation during *Rabi* 2017-18 and the laboratory studies were carried out at the Dept. of Seed Science and technology, College of Agriculture, University of Agriculture Sciences, Raichur. Experiment consisting of seven treatments with three replications were tested using Randomized Block design. The healthy and bold seeds of sponge gourd were dibbled with a spacing of 4 feet × 4 feet a depth of 4 cm. After germination one seedling per hill was maintained. The plant protection measures were adopted as and when required. Five plant growth regulators *viz*., GA_3, NAA, traicontanol, homobrassinolide and humic acid were sprayed along with boron to female parent at three different stages *viz.,* two to three leaf stage, peak flowering and fruit initiation stage. All the precautions were taken to prevent drifting of spray solution from one treatment plot to other. In each treatment, five plants were randomly selected and tagged for recording various biometric observations. Fruits were harvested as and when they turn brown colour and seeds were harvested manually and observations on number of fruits per plant, fruit diameter, fruit length, fruit weight, number of seeds per fruit, seed weight per fruit, 100 seed weight, hybrid seed yield per plant, hybrid seed yield per ha, seed germination, shoot length, root length, total seedling length, seedling dry weight, seedling vigourindex-I, seedling vigourindex-II and dehydrogenase enzyme activity were recorded. Dehydrogenase enzyme activity (Kittock and Law, 1968) and germination test was conducted as per International Seed Testing Association (ISTA 2013) procedure by rolled towel (Between paper) method. From the germination test, ten normal seedlings were selected randomly from each treatment on the day of final count. The seedling length was measured from tip of shoot to root tip. Ten normal seedlings used for measuring seedling length were taken in butter paper and dried in a hot air oven maintained at 90^0C for 24 hours. Ten seedlings were then removed and allowed to cool in a desiccator for 30 minutes before weighing in an electronic balance. The seedling vigour index-I and II was computed using the formula as suggested by Abdul-Baki and Anderson (1973) and expressed as whole number.

Seedling vigour index-1 = Germination (%) × Mean seedling length (cm)

The seedling vigour index-II was computed multiplying germination percentage with the ten seedlings dry weight and expressed as whole number.

Seedling vigour index = Germination (%) × Dryweight of seedlings (mg)

Results and Discussion

Spraying of boron (1 g/l) + (NAA 0.3 ml/l) significantly recorded higher vine length (376.6 cm) *i.e.,* T_4 compared to all other treatments and control (345.3 cm) (Table 1). This increase in vine length due to spraying of chemical and growth regularly might be due increase in plasticity of the cell wall followed by hydrolysis of strach to sugars which in turn lowers the water potential of cell leading to elongation and rapid cell division in the growing portion (Lambat *et al.,* 2015).

Significantly maximum number of fruits per plant (6.83) was recorded in T_4 (boron 1 g/l + NAA 0.3 ml/l) while, minimum was noticed in control (6.30). These findings are in agreement with the results reported by Janak and Sharma (2014) in brinjal @ NAA 20 ppm. Exogenous supply of growth regulators at critical stages of flowering and fertilization, ovary formation, fruit and seed development period etc., may enhance source to sink relationship, accumulation of photosynthates and efficient utilization of food reserves for the development of fruit. These results are supported by the findings of Geeta *et al.* (2010) in bitter gourd @ NAA 50 ppm. Significantly maximum fruit length (36.2 cm) and fruit diameter (17.9 cm)

TABLE 1

Influence of boron and plant growth regulators on hybrid seed yield of sponge gourd hybrid (Haritha)

Treatment	Vine length (cm)	Number of fruits per plant	Fruit diameter (cm)	Fruit length (cm)	Fruit weight (g)	Number of seeds per fruit	Seed weight per fruit (g)	100 seed weight (g)	Hybrid seed yield per plant (g)	Hybrid seed yield per ha (kg)
T_1: Control	345.3	6.30	16.1	32.3	27.0	133.0	11.1	8.41	70.4	660.5
T_2: Boron (1 g/l)	355.3	6.31	16.3	32.5	27.4	135.0	11.4	8.46	72.0	675.6
T_3: Boron (1 g/l) + GA_3 (50 ppm)	371.1	6.72	17.8	36.0	29.4	147.2	12.9	8.82	87.2	817.9
T_4: Boron (1 g/l) + NAA (0.3 ml/l)	376.6	6.83	17.9	36.2	29.8	148.0	13.1	8.91	89.4	843.3
T_5: Boron (1 g/l) + Triacontanol (1.5 ml/l)	370	6.46	17.0	33.1	28.0	146.2	12.6	8.63	81.5	764.1
T_6: Boron (1 g/l) + Homobrassinolide (0.5 ml/l)	370.3	6.54	17.3	35.6	29.0	146.5	12.7	8.73	83.6	784.1
T_7: Boron (1 g/l) + Humic acid (2 ml/l)	364.0	6.44	16.5	33.0	27.8	145.0	12.3	8.52	79.5	745.8
Mean	364.7	6.4	17.0	34.1	28.9	142.9	12.3	8.64	80.0	750.2
S. Em±	4.36	0.05	0.32	1.26	1.70	0.26	0.09	0.06	4.34	40.75
C.D @ 5%	12.9	0.16	1.005	3.95	5.32	0.81	0.28	0.194	13.8	126.9

were recorded in T_4 (boron @ 1 g/l+ NAA 0.3 ml/l) while, minimum was noticed in control (32.3 cm and 16.1cm, respectively). Similar results were also reported by Nagamani *et al.* (2015) in bitter gourd. The plants sprayed with boron (1 g/l) + NAA (0.3 ml/l) combination recorded the highest fruit weight (29.8 g), number of seed (148.0), seed weight per fruit (13.1 g) and 100 seed weight (8.91 g) compared to control (27.0 , 133.0, 11.1 and 8.41 g, respectively). The growth promoters like NAA enhances the source-sink relationship and hormone modified translocation of photosynthates, which will help in better retention of flowers, fruits and seed filling at later stages of crop growth. The results are in agreement with the findings of Lambat *et al.* (2015) in ridge gourd (NAA @ 50 ppm). Plants sprayed with boron (1 g/l) + NAA (0.3 ml/l) combination also recorded the highest seed yield per plant (89.4 g) and per ha (843.3 kg) compared to control (70.4 g and 660.5 g respectively). This increase in seed yield might be due to the fact that, growth regulators and micronutrient bring certain changes in metabolism during fruit and seed development. Consequently, there would be greater accumulation of food reserves that resulted in highest seed yield. The highest seed yield was also due to higher fruit number per plant and higher seeds per fruit. Similar results were also reported by Sajjan and Manjunath (2009) in pumpkin (NAA @ 100 ppm). The seeds harvested from the plants which received boron (1 g/l) + NAA (0.3 ml/l) combination showed higher germination (97.0 %) and dehydrogenase enzyme activity (1.319 OD value) compared to control

TABLE 2

Influence of boron and plant growth regulators on seed quality of sponge gourd hybrid (Haritha)

Treatment	Seed germination (%)	Shoot length (cm)	Root length (cm)	Total seedling length (cm)	Seedling dry weight (mg)	Seedling vigour index I	Seedling vigour index-II	Dehydrogenase enzyme activity (OD value)
T_1: Control	84.0	14.2	20.3	34.5	826.3	2898	69409	0.960
T_2: Boron (1 g/l)	85.0	14.3	20.8	35.1	841.4	2984	71519	0.970
T_3: Boron (1 g/l) + GA_3 (50 ppm)	93.0	16.5	21.6	38.1	878.9	3543	81738	1.189
T_4: Boron (1 g/l) + NAA (0.3 ml/l)	97.0	17.6	21.7	39.3	904.5	3812	87737	1.319
T_5: Boron (1 g/l) + Triacontanol (1.5 ml/l)	92.0	16.2	21.4	37.7	856.4	3468	78789	1.101
T_6: Boron (1 g/l) + Homobrassinolide (0.5 ml/l)	93.0	16.3	21.5	37.7	876.7	3506	81533	1.129
T_7: Boron (1 g/l) + Humic acid (2 ml/l)	86.0	15.9	20.9	36.8	845.4	3165	72704	1.007
Mean	90.0	15.8	21.1	37.0	861.3	3339	77633	1.096
S. Em ±	2.24	0.64	0.19	0.01	0.483	125.3	2949.9	0.07
C.D @ 1 %	7.62	1.93	0.40	0.03	1.506	390.4	9190.2	0.20

(84.0 % and 0.960 OD value, respectively) (Table 2). This increase in seed quality due to spray of boron and plant growth regulators might be due to adequate supply of food reserves to resume embryo growth and synthesis of hydrolytic enzymes which are responsible for degradation of macromolecules into micromolecules to be utilized in growth promoting processes that in turn affects physiology of seed germination. The seeds harvested from the plants sprayed with boron @1g/l + NAA @0.3 ml/l combination also recorded higher shoot length (17.6 cm), root length (21.7 cm) and seedling length (39.3 cm) compared to control (14.2 cm, 20.3 cm and 34.5 cm respectively). NAA had beneficial effect on seed germination by increasing the amylase activity, photosynthesis, translocation, and membrane stability. The seeds harvested from the plants which received boron (1 g/l) + NAA (0.3 ml/l) combination showed higher seedling dry weight (904.5 mg), seedling vigour index I (3812) and seedling vigour index II (87737) compared to control (826.3mg, 2898 and 69409 respectively). PGRs enhances shoot & root growth, cell elongation, vascular differentiation, xylem formation in epicotyls and also in the regulation of expression of several genes involved in xylem development. This might be due to enhancement of the embryo growth by adequate supply of food reserves and activating the hydrolytic enzyme responsible for breakdown of food reserves which can be utilized for embryo growth.

In sponge gourd seed production, Boron (1 g/l) + NAA (0.3 ml/l) was the best treatment for getting higher seed yield and quality.

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