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Effect of foliar sprays of NAA, triacontanol and boron on growth and seed quality in bitter gourd (*Momordica charantia* L.) cv. Pusa Visesh

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ABSTRACT

An investigation was undertaken to study the effect of foliar sprays of NAA, triacontanol and boron on vine growth, seed quality and storability in bitter gourd cv. Pusa Visesh. Results revealed that NAA at 50mg/l produced the longest vines (192.33 and 260.67cm), maximum leaf area (1.890 and 2.965cm^2/vine), leaf area index (1.969 and 2.760) and leaf chlorophyll content (39.23 and 38.90 SPAD value) at 85 and 100 days after sowing (DAS), respectively. As for seed quality attributes, treatment with boron at 4mg/l recorded lowest seed moisture content and highest seed germination percentage (9.16% and 85.5%, respectively), followed by NAA at 50mg/l (9.21% and 85.25%, respectively) whereas, Control recorded highest seed moisture and lowest seed germination percentage (9.84% and 74.5%, respectively) recorded at the end of storage.

Key words: Bitter gourd, vine length, boron, seed moisture

INTRODUCTION

Bitter gourd (*Momordica charantia* L.) is one of the most important tropical vegetable crops. It belongs to the family Cucurbitaceae, and is popularly known as balsam pear, *karela*, or bitter melon. In India, it is cultivated in an area of 26,004 hectares, with total production of 1,62,196 tonnes at a productivity level of 6.23 tonnes per ha.

Use of PGRs and micronutrients like boron could be a useful alternative for increasing crop production. GA_3 and NAA are important growth regulators that can modify growth, sex ratio and yield-contributing characters in a plant (Shantappa *et al*, 2007).

Micronutrients and cations are involved in enzyme systems as co-factors, with exception of Zn, Mn, Cu and B. The latter are capable of acting as 'electron carriers' in enzyme systems and are responsible for oxidation-reduction process in the plant system.

Storage and preservation of quality seed stocks until the next season is as important as producing quality seeds. Farmers and scientists opine that safe storage of seeds is advantageous, as, it reduces the burden of seed production every year, besides facilitating timely supply of desired genetic stocks for use in the years following periods of low production. Germination ability and vigour expected from stored seeds is another matter of great importance.

Seed is said to be in storage mode while on the plant itself, right from its physiological maturity, and continues to be so until the next sowing, or further use, or death. Deterioration of seed during storage is inevitable and leads to various changes at different levels, viz., impairment or shift in metabolic activity, compositional changes, decline or change in enzyme activity, phenotypic cytological changes, apart from quantitative losses. Seeds being hygroscopic in nature, this viability and vigour under storage is known to be regulated by variation in physico-chemical factors, initial seed quality, storage structures, packaging materials, etc. (Doijode, 1988).

MATERIAL AND METHODS

A field experiment was conducted at College of Agriculture, Raichur, Karnataka, during *rabi* 2009, with three replications in Randomized Block Design. Healthy and bold seeds were dibbled with spacing of 120cm x 80cm to a depth of 4.0cm. After germination, one seedling was retained per hill. Gross plot size was 10.80 x 8.0 = 86.4m^2, and net plot size was 8.4 x 6.4m = 76.8m^2. Plant protection measures were adopted as and when required. Two growth regulators, viz., NAA (25 and 50mg/l), triacontanol (0.5 and 1.0mg/l) and boron (3.0 and 4.0mg/l) were used as foliar application,

with absolute Control and water spray, at two to four true-leaf stage, and then at 60 days after sowing (DAS), 75 DAS and 90 DAS. Precaution was 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 vine length, leaf area, leaf area index and leaf chlorophyll content.

Vine length was measured from the base of the plant to the tip of fully-opened top leaf at 70, 85 and 100 DAS. Leaves from five selected plants from each treatment were used for estimating leaf area. Leaf area was computed by using a leaf area meter (LAI Ceptometer Model L8-80, Decagon Devices, Inc., USA). LAI was expressed as cm^2 per plant.

Leaf chlorophyll content was measured from the middle leaves at 70, 85 and 100 DAS. In each plot, five plants were selected and the mean leaf chlorophyll content was recorded using a portable Chlorophyll meter SPAD – 502 (Spectrum tech.org.inc, USA) and expressed in SPAD value.

For seed quality analysis, fruits were harvested when they turned orange-red, and seeds were separated manually to estimate seed moisture content and seed germination percentage. Germination test was conducted as per ISTA (International Seed Testing Association) procedure by the rolled towel method. From the germination test, ten normal seedlings were selected randomly from each treatment on the day of the final count. Seedling length was measured from shoot tip to root tip. Ten normal seedlings were held in a butter paper bag and dried for 24 hours in a hot-air oven maintained at 90^0C to measure seedling dry weight. Later, seedlings were removed from the oven and allowed to cool in desiccators for 30 minutes before weighing them in an electronic balance (Anon., 1999).

RESULTS AND DISCUSSION

Plant growth regulators modify plant organs differentially and influence source-to-sink relationship to improve yield potential. Such substances are, therefore, potentially useful in agriculture. Suitable concentrations applied at appropriate time can increase yield either by altering dry matter distribution in the plant or by regulating growth (Watson, 1958). Microenvironment plays a vital role in production of quality seeds besides increasing productivity. Incorporating nutrients in to the seed improves the vigour potential which, in turn, leads to higher yield (Chauhan *et al*, 1984).

In the present investigation, spraying NAA at 50mg/l significantly improved vine length (192.33cm and 260.67cm), followed by NAA at 25mg/l (186.60cm and 252.33cm) at 85 DAS and 100 DAS, respectively. Lowest vine length (168.33cm and 214.10cm, respectively) was noticed in Absolute Control (Table 1). Increase in vine length is thought to be due to increasing plasticity of the cell wall, followed by hydrolysis of starching to sugars (which into lowers water potential of the cell, resulting in entry of water into the cell thereby causing elongation and rapid cell division

Table 1. Effect of plant growth regulators and other chemicals on growth parameters in bitter gourd cv. Pusa Visesh

Treatment	Vine length (cm)			Leaf area (cm^2/vine)			Leaf area index (LAI)			Leaf chlorophyll content (SPAD value)		
	70 DAS	85 DAS	100 DAS	70 DAS	85 DAS	100 DAS	70 DAS	85 DAS	100 DAS	70 DAS	85 DAS	100 DAS
T1 : Absolute Control	144.31	168.33	214.10	1.258	1.592	2.291	1.310	1.658	2.387	30.27	32.17	31.70
T2 : Water spray	145.33	169.33	218.67	1.276	1.645	2.317	1.329	1.714	2.413	33.17	34.40	33.98
T3 : Naphthalene acetic acid @ 25mg/l	150.67	186.60	252.33	1.421	1.796	2.493	1.480	1.871	2.597	36.17	37.47	36.80
T4 : Naphthalene acetic acid @ 50mg/l	152.33	192.33	260.67	1.434	1.890	2.965	1.493	1.969	2.760	37.53	39.23	38.90
T5 : Triacontanol @ 0.5mg/l	150.67	183.40	229.33	1.407	1.719	2.346	1.466	1.791	2.443	35.20	36.00	35.67
T6 : Triacontanol @ 1.0mg/l	152.93	185.87	230.67	1.379	1.784	2.362	1.436	1.859	2.460	34.97	36.07	35.73
T7 : Boron @ 3.0mg/l	153.17	183.67	228.00	1.346	1.794	2.333	1.402	1.869	2.430	35.30	36.40	36.07
T8 : Boron @ 4.0mg/l	154.00	185.87	232.67	1.447	1.856	2.525	1.507	1.933	2.630	35.50	38.57	36.82
S. Em±	4.41	5.33	6.91	0.066	0.051	0.075	0.069	0.054	0.079	2.15	2.17	1.98
P = 0.05	NS	16.16	20.96	NS	0.156	0.228	NS	0.162	0.238	NS	5.77	6.02

DAS – Days after sowing; NS – Non-significant

Table 2. Effect of plant growth regulators and other chemicals on seed moisture content (%) in bitter gourd cv. Pusa Visesh

Treatment	Storage period (months)											
	1	2	3	4	5	6	7	8	9	10	11	12
T_1 : Absolute Control	7.27	7.28	7.29	7.30	7.32	7.55	7.68	7.86	8.00	8.90	8.95	9.84
	(15.65)	(15.65)	(15.65)	(15.68)	(15.67)	(15.95)	(16.09)	(16.28)	(16.64)	(17.35)	(17.40)	(18.28)
T_2 : Water spray	7.18	7.28	7.30	7.43	7.45	7.50	7.64	7.82	8.15	8.71	8.78	9.53
	(15.54)	(15.65)	(15.68)	(15.81)	(15.84)	(15.88)	(15.91)	(15.94)	(16.59)	(17.17)	(17.23)	(17.98)
T_3 : Naphthalene	7.24	7.30	7.30	7.32	7.34	7.45	7.67	7.89	8.18	8.54	8.60	9.31
aceticacid @ 25mg/l	(15.60)	(15.67)	(15.67)	(15.69)	(15.72)	(15.77)	(15.80)	(15.85)	(16.58)	(16.98)	(17.05)	(17.77)
T_4 : Naphthalene	7.15	7.17	7.25	7.26	7.28	7.30	7.33	7.38	7.80	8.25	8.41	9.21
aceticacid @ 50mg/l	(15.51)	(15.53)	(15.62)	(15.63)	(15.65)	(15.67)	(15.70)	(15.76)	(16.22)	(16.69)	(16.86)	(17.67)
T_5 : Triacontanol	7.23	7.25	7.29	7.38	7.40	7.43	7.52	7.60	7.95	8.69	8.69	9.45
@ 0.5mg/l	(15.60)	(15.62)	(15.68)	(15.76)	(15.78)	(15.82)	(16.00)	(15.68)	(16.60)	(17.14)	(17.14)	(17.90)
T_6 : Triacontanol	7.08	7.12	7.17	7.24	7.25	7.36	7.43	7.45	7.73	8.37	8.78	9.46
@ 1.0mg/l	(15.43)	(15.47)	(15.52)	(15.61)	(15.62)	(15.73)	(15.81)	(15.84)	(16.03)	(16.92)	(17.23)	(17.91)
T_7 : Boron @ 3.0mg/l	7.20	7.32	7.33	7.38	7.40	7.54	7.64	7.78	8.22	8.79	8.90	9.42
	(15.57)	(15.69)	(15.71)	(15.76)	(15.79)	(15.94)	(16.05)	(16.20)	(16.62)	(17.24)	(17.35)	(17.87)
T_8 : Boron @4.0mg/l	7.07	7.11	7.19	7.30	7.30	7.44	7.58	7.88	7.90	8.49	8.53	9.16
	(15.42)	(15.47)	(15.56)	(15.67)	(15.68)	(15.83)	(15.98)	(16.30)	(16.32)	(16.94)	(16.98)	(17.62)
S. Em±	0.09	0.10	0.10	0.10	0.10	0.10	0.08	0.11	0.14	0.15	0.19	0.11
P = 0.05	NS	NS	NS	NS	NS	0.28	0.22	0.31	0.39	0.43	0.56	0.32

Figures in parentheses indicate angular transformed value; NS: Non-significant

Table 3. Effect of plant growth regulators and other chemicals on seed germination (%) in bitter gourd cv. Pusa Visesh

Treatment	Storage period (months)											
	1	2	3	4	5	6	7	8	9	10	11	12
T_1 : Absolute Control	81.75	83.25	83.75	82.75	81.25	80.00	79.25	78.50	77.75	76.50	75.75	74.50
	(64.73)	(65.85)	(66.25)	(65.53)	(64.36)	(63.45)	(62.94)	(62.42)	(61.88)	(61.04)	(60.52)	(59.69)
T_2 : Water spray	82.25	84.50	85.50	84.75	83.50	82.25	81.75	81.00	79.75	78.25	77.00	75.75
	(65.09)	(66.87)	(67.69)	(67.09)	(66.11)	(65.15)	(64.75)	(64.26)	(63.47)	(62.23)	(61.40)	(60.54)
T_3 : Naphthalene	86.25	88.00	88.75	88.50	88.00	87.25	86.75	86.25	86.00	85.25	84.50	83.75
aceticacid @ 25mg/l	(68.26)	(69.81)	(70.41)	(70.34)	(69.79)	(69.24)	(68.75)	(68.37)	(68.08)	(67.42)	(67.16)	(66.51)
T_4 : Naphthalene acetic	87.75	89.25	90.25	90.25	90.25	89.00	88.50	88.00	87.25	87.00	86.25	85.25
acid @ 50mg/l	(69.57)	(70.93)	(71.84)	(71.83)	(71.88)	(70.75)	(70.26)	(69.79)	(69.13)	(69.08)	(68.26)	(67.44)
T_5 : Triacontanol	84.00	87.00	87.50	87.25	87.25	86.75	86.50	86.50	86.00	85.50	84.75	83.75
@ 0.5mg/l	(66.45)	(68.90)	(69.33)	(69.10)	(69.10)	(68.79)	(68.59)	(68.55)	(68.03)	(67.69)	(67.03)	(66.24)
T_6 : Triacontanol	85.00	87.25	88.00	87.75	87.50	86.75	86.75	86.50	86.50	86.00	85.50	84.50
@ 1.0mg/l	(67.22)	(69.13)	(69.75)	(69.59)	(69.33)	(68.70)	(68.68)	(68.46)	(68.45)	(68.15)	(67.84)	(67.01)
T_7 : Boron @ 3.0mg/l	86.75	87.25	89.25	89.00	88.75	88.25	88.00	87.75	87.25	86.50	86.00	85.00
	(68.67)	(69.10)	(70.88)	(70.69)	(70.47)	(70.03)	(69.81)	(69.59)	(69.09)	(68.49)	(68.08)	(67.26)
T_8 : Boron @ 4.0mg/l	88.50	90.25	91.00	90.50	90.25	89.25	89.00	88.75	87.50	87.00	86.50	85.50
	(70.22)	(71.84)	(72.61)	(72.18)	(71.94)	(70.93)	(70.78)	(70.59)	(69.37)	(69.01)	(68.48)	(67.65)
S. Em±	0.68	0.88	0.74	1.14	0.98	1.15	1.18	1.29	1.09	1.28	1.39	1.31
P = 0.05	1.99	2.56	2.16	3.32	2.86	3.35	3.46	3.76	3.18	3.74	4.05	3.83

Figures in parentheses indicate angular transformed values

in the growing portion) in bottle gourd (Kore *et al*, 2003) and in ridge gourd (Hilli *et al*, 2010).

NAA at 50mg/l also recorded highest leaf area and LAI (2.965cm^2/vine and 2.760, respectively) at 100 DAS, followed by boron at 4mg/l (2.525 cm^2/vine and 2.630, respectively) and NAA at 25mg/l (2.493cm^2/vine and 2.597, respectively). Lowest leaf area and LAI (2.291cm^2/vine and 2.387, respectively) were noticed in Absolute Control (Table 1). Additional availability of NAA in the seed may have increased the level of amylase in aleurone tissue of the seed for better conversion of the complex starches into simple sugars for providing energy for growth, and, leaf area increased with increase in time to a maximum, coinciding with maximum top growth, and a steady decline at later stages in musk melon (Ram Asrey *et al*, 2001).

Maximum leaf chlorophyll content was observed with NAA 50mg/l (39.23 and 38.90 SPAD value) which was on par with that in boron 4mg/l (38.57 and 36.82 SPAD value),

whereas, Control recorded 32.17 and 31.70 SPAD value at 85 and 100 DAS, respectively (Table 1). This may have been due to growth regulators and agrochemicals causing decreased chlorophyll degradation, and increased chlorophyll synthesis. Growth regulator application delayed leaf senescence which could also be attributed to higher chlorophyll content. Similar results were reported by Shinde and Jadhav (1995) in cowpea and Sai Sankar (2001) in mung bean.

Seed is the nucleus of life and is subjected to continuous ageing once it has reached physiological maturity. This phenomenon results in an irreversible change in seed quality ultimately affecting viability. Quantitative deterioration of seed during storage is mainly attributed to prolonged storage.

After the harvest of crop, the resultant seeds were analyzed for various seed quality parameters (Tables 2 & 3). Growth regulator and nutrient treatments showed beneficial, significant influence on seed quality parameters over Control.

Growth regulator and other treatments did not show any significant effect on moisture content until five months of storage. As the storage period advanced, per cent moisture content increased successively. Boron at 4mg/l recorded lowest seed moisture (9.16%), followed by NAA at 50mg/l (9.21%), whereas, Control recorded highest seed moisture (9.84%) at the end of storage. This variation in moisture content is mainly due to environmental factors and the pervious use of cloth bag. Similar trend was reported by Gavale (1994) in tomato and Marbhal *et al (*2006) in bitter gourd.

Low seed germination percentage recorded in freshly harvested seeds may be due to primary dormancy associated with the embryo of fresh seeds. Subsequently, as storage proceeded, gradual increase in seed germination was seen in all the treatments up to the third month of storage. From the fourth month onwards, a slight decrease in seed germination and seed quality parameters was observed indicating the onset of deterioration (which may be due to combined effects of high temperature, low oxygen and high CO_2 partial pressures) in melon (Edelstein *et al*, 1995). Similar findings were reported by Murugesan and Vanangamudi (2005) in ash gourd, and Nerson (1991) in cucurbits.

Storage studies revealed that germination percentage (Table 3) was significantly high in boron @ 4mg/l (88.50%, 91.00% and 85.50%), followed by NAA @ 50mg/l (87.75%, 89.25% and 85.25%), boron @ 3 mg/l (86.75%, 89.25% and 85.00%) and water spray (82.25%, 85.50% and 75.75%) treatments, whereas, lowest germination percentage was observed in Absolute Control (81.75%, 82.75% and 74.50%, respectively) at the end of first, third and twelfth month of storage period, respectively. Highest germination percentage recorded at the end of the third month of storage period is perhaps due to a natural breakdown of seed dormancy due to external environmental factors. This might be due to an adequate supply of food reserves for resuming embryo growth and synthesis of hydrolytic enzymes secreted which act on the starchy endosperm, in turn, affecting the physiology of seed germination and establishment of the seedling. Effect of boron on seed germination was also earlier reported by Gedam *et al* (1996) in bitter gourd. Differences in storability are probably due to variations in combating seed-borne pathogen.

However, all the treatments resulted in above the Minimum Seed Certification Standards of 60% of seed germination up to twelve months of storage.

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