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Effect of PGR and boron on seed quality during storage in bitter gourd (*Momordica charantia*) cv. PUSA VISESH

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ABSTRACT : An experiment was conducted to investigate at the effect of PGRs and boron on seed longevity at the Department of Seed Science and Technology, College of Agriculture, Raichur. The field experiment obtained seeds were subjected to ambient storage condition. Results revealed that the moisture content increases gradually as storage period increased in all the treatments. Boron at 4 ppm maintained lower moisture content of seed (7.07 %, 7.19 % and 9.16 %), seed germination (88.50 %, 91.00 % and 85.50 %), root length (13.31 cm, 13.99 cm and 13.43 cm), shoot length (7.96 cm, 8.50 cm and 8.17 cm) and speed of germination (19.17, 19.49 and 18.23) at the end of first, third and twelve months after storage, respectively.

KEY WORDS : Bitter gourd, Seed quality, Boron, Storage

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Bitter gourd (*Momordica charantia* L.) is one of the most important and a popular vegetable grown in Karnataka. Among the vegetable its considered as prized vegetable because of its nutritive values especially the ascorbic acid and iron (Behera, 2004). Use of PGRs might be a usefull alternative to increase seed production. The growth promoter like NAA and GA_3 stimulates vegetative growth and are involved in the initiation of cell division in the cambium. These plant growth regulators causes osmotic uptake of water which maintain a swelling force against the softening of cell wall (Arora *et al.*, 1985). The Use of PGR's like GA_3 and NAA have an ability to modify the plant growth, sex ratios and yield contributing characters, while micro nutrient like boron will be a useful alternative to increase crop production (Shantappa *et al.*, 2007). The boron and cations are involved in enzyme systems as cofactors with the exception of Zn, Mn, Cu and B. These are capable of acting as 'electron carriers' in the enzyme systems and are responsible for the oxidative-reduction process in the plant system these attributes invariably helpful to increase the longevity of seed.

Storage and preservation of quality seed stocks till the next season is as important as producing quality seeds. Farmers and scientists opined that safe storage of seeds is advantages as it reduces the burden of seed production every year, besides timely supplying of desired genetic stocks for the use in years following periods of low production. The germination and vigour which can be expected from stored seeds is another matter of great importance. Seed is said to be in storage on plant itself right from its physiological maturity and it continues to be in storage until next sowing or further use or death. Deterioration of seed during storage is inevitable and leads to different changes at different levels *viz*., impairment or shift in metabolic activity, compositional changes, decline or change in enzyme activities, phenotypic, cytological changes apart from quantitative losses. Being hygroscopic in nature the viability and vigour of seeds under storage are known to be regulated by variations in the physico-chemical factors, initial seed quality, storage structures, packaging materials etc. (Doijode, 2000). A knowledge of proper storage of seeds under ambient conditions at relatively low cost with minimum deterioration in quality for a period of at least one or more seasons will be of immense use to seed industry and farming community. The available information on effect of PGR and boron on seed quality during storage is not conclusive, considering the above fact the present study was undertaken to observe the performance of PGRs and boron sprays (60, 75 and 90 days after sowing) on seed longevity.

RESEARCH METHODS

A field experiment was conducted at College of Agriculture, Raichur, Karnataka during *Rabi* 2009 with three replications in randomized block design. The healthy and bold seeds were dibbled with a spacing of 120 cm x 80 cm to a depth of 4.0 cm. After germination one seedling per hill was maintained. The gross plot size of the plot was 10.80 x 8.0 = 86.4 m^2 and net plot size: 8.4 x 6.4 m = 76.8 m^2. The plant protection measures were adopted as and when required. Two growth regulators *viz.*, NAA (25 and 50 ppm), triacontanol (0.5 and 1.0 ppm) and boron (3.0 and 4.0 ppm) were used for foliar application at two concentrations 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 fruits were harvested as when they turn orange red colour and seeds were harvested manually. Seed moisture content, seed germination percentage, root length, shoot length and speed of gtermination at monthly intervals (Feb., 10 – January 2011) during storage period seed stored in cloth bag under ambient condition.

For estimation of seed moisture content two replicates of five grams of seed material were taken by using low constant method estimated and expressed in percentage. The powdered seed material was placed in a weighed metal cup. And after removing the lid, moisture cups were placed in hot air oven maintained at 103 $\pm$ 2^0C for 16 $\pm$ 1 hr and the contents were allowed to dry. Then, the contents were weighed in an electronic balance along with metal cup and lid. The moisture content was worked out using the following formula and expressed as percentage (ISTA, 1999).

$$\text{Moisture content (\%)} = \frac{M_2 - M_3}{M_2 - M_1} \times 100$$

where,

M_1 : Weight of the metal cup alone

M_2 : Weight of the metal cup + sample before drying

M_3 : Weight of the metal cup + sample after drying.

The germination test, conducted as per ISTA (1999) (International Seed Testing Association) procedure by rolled towel method. From the germination test, ten normal seedlings were selected randomly in each treatment from all the replication on 14th day. The root length was measured from the tip of the primary root to base of hypocotyls and mean root and the shoot length was measured from the base of the primary leaf to the base of the hypocotyls and mean shoot length was expressed in centimeters.

Seeds were germinated in paper medium with four replications of 100 seed each. The number of seeds germinated was recorded daily up to the day of final count. Cotyledon slipping out of the seed coat was taken as criteria for emergence of seedling and the speed of germination was calculated by using the formula suggested by Agrawal (1995).

$$\text{Speed of germination} = \frac{X_1}{Y_1} + \frac{X_2 - X_1}{Y_2} + \text{-----------} + \frac{X_n\,(Xn - 1)}{Y_n}$$

where,

X_n : % germination on n^{th} day

Y_n : Number of days from seed sowing.

RESEARCH FINDINGS AND DISCUSSION

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. The quantitative deterioration during storage is mainly attributed to period of storage (Delouche and Baskin, 1973).

Effect of plant growth regulators and boron on moisture content (%) of bitter gourd cv. PUSA VISESH :

With the advancement of storage period, moisture content of seed differed significantly due to the influence of plant growth regulators and chemical (Table 1). A linear increase in the moisture content was observed with increase in the storage period up to 12 months in all the treatments. The absolute control recorded highest moisture content (7.27%) and significantly lowest moisture content (7.07 %) was recorded with boron at 4 ppm during the first month of storage. At the end of storage period highest moisture content (9.84 %) recorded with absolute control and lowest in boron 4 ppm (9.16 %).

Effect of plant growth regulators and boron on seed germination percentage (%), root length, (cm), shoot length (cm) and speed of germination (No.) of bitter gourd cv. Pusa Visesh during storage:

In the present study the growth regulators and chemical had a significant effect on seed germination (Table 2). Boron treatment showed significantly higher germination throughout the storage period followed by NAA and triacontanol which were at par with each other. After the harvest of the crop, the resultant seeds were analyzed for various seed quality parameters. Growth regulators and nutrient sprayed treatments showed beneficial significant influence on seed quality parameters over control.

The seeds harvested from the plant received boron @ 4 ppm recorded highest seed germination percentage (88.50 %, 91.00 % and 85.50 %) followed by NAA @ 50 ppm (87.75 %, 90.25 % and 85.25 %), boron @ 3 ppm (86.75 %, 89.25 % and 85.00 %) and water spray (82.25 %, 85.50 % and 75.75 %) whereas, lowest germination percentage was observed in

Table 1 : Effect of plant growth regulators and boron on moisture content (%) of bitter gourd cv. PUSA VISESH

Treatments	Storage period (month)											
	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)	(1659)	(17.17)	(17.23)	(17.98)
T_3 : Naphthalene acetic acid @25 ppm	7.24	7.30	7.30	7.32	7.34	7.45	7.67	7.89	8.18	8.54	8.60	9.31
	(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 acetic acid @ 50 ppm	7.15	7.17	7.25	7.26	7.28	7.30	7.33	7.38	7.80	8.25	8.41	9.21
	(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 @ 0.5 ppm	7.23	7.25	7.29	7.38	7.40	7.43	7.52	7.60	7.95	8.69	8.69	9.45
	(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 @ 1.0 ppm	7.08	7.12	7.17	7.24	7.25	7.36	7.43	7.45	7.73	8.37	8.78	9.46
	(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 @ 3.0 ppm	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 @4.0 ppm	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.E.±	0.09	0.10	0.10	0.10	0.10	0.10	0.08	0.11	0.14	0.15	0.19	0.11
C.D. (P=0.05)	NS	NS	NS	NS	NS	0.28	0.22	0.31	0.39	0.43	0.56	0.32

NS=Non-significant Figures in the parenthesis indicate angular transformed value

Table 2 : Effect of plant growth regulators and boron on seed germination (%) of bitter gourd cv. PUSA VISESH

Treatments	Storage period (month)											
	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 acetic acid @25 ppm	86.25	88.00	88.75	88.50	88.00	87.25	86.75	86.25	86.00	85.25	84.50	83.75
	(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 acid @ 50 ppm	87.75	89.25	90.25	90.25	90.25	89.00	88.50	88.00	87.25	87.00	86.25	85.25
	(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 @ 0.5 ppm	84.00	87.00	87.50	87.25	87.25	86.75	86.50	86.50	86.00	85.50	84.75	83.75
	(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 @ 1.0 ppm	85.00	87.25	88.00	87.75	87.50	86.75	86.75	86.50	86.50	86.00	85.50	84.50
	(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 @ 3.0 ppm	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 @4.0 ppm	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. E.±	0.68	0.88	0.74	1.14	0.98	1.15	1.18	1.29	1.09	1.28	1.39	1.31
C.D. (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 the parenthesis indicate angular transformed values

Table 3 : Effect of plant growth regulators and chemical on root length (cm) of bitter gourd cv. PUSA VISESH during storage

Treatments	Storage period (month)											
	1	2	3	4	5	6	7	8	9	10	11	12
T_1 : Absolute control	12.17	12.21	12.35	12.33	12.19	12.07	11.99	11.96	11.93	11.76	11.59	11.39
T_2 : Water spray	12.36	12.42	12.55	12.54	12.40	12.33	12.26	12.25	12.18	12.01	11.88	11.81
T_3 : Naphthalene acetic acid @25 ppm	12.37	12.58	12.79	12.78	12.75	12.71	12.64	12.63	12.60	12.66	12.59	12.49
T_4 : Naphthalene acetic acid @ 50 ppm	13.20	13.60	14.03	14.01	13.98	13.95	13.87	13.81	13.79	13.67	13.50	13.37
T_5 : Triacontanol @ 0.5 ppm	12.30	12.50	12.76	12.76	12.72	12.69	12.60	12.59	12.41	12.34	12.23	12.11
T_6 : Triacontanol @ 1.0 ppm	12.39	12.69	13.04	13.00	12.90	12.85	12.78	12.77	12.74	12.73	12.49	12.38
T_7 : Boron @ 3.0 ppm	12.54	12.73	12.96	12.94	12.90	12.88	12.77	12.76	12.71	12.60	12.45	12.42
T_8 : Boron @4.0 ppm	13.31	13.60	13.99	13.98	13.95	13.93	13.87	13.71	13.67	13.65	13.50	13.43
S. E.±	0.23	0.21	0.21	0.27	0.14	0.13	0.18	0.22	0.22	0.23	0.29	0.26
C.D. (P=0.05)	0.66	0.62	0.60	0.78	0.41	0.38	0.53	0.63	0.63	0.69	0.86	0.75

Table 4 : Effect of plant growth regulators and chemical on shoot length (cm) of bitter gourd cv PUSA VISESH during storage

Treatments	Storage period (month)											
	1	2	3	4	5	6	7	8	9	10	11	12
T_1 : Absolute control	5.23	5.48	5.72	5.71	5.68	5.64	5.57	5.53	5.51	5.34	4.96	4.84
T_2 : Water spray	5.90	5.96	6.30	6.28	6.23	6.20	6.17	6.08	6.03	5.91	5.30	5.13
T_3 : Naphthalene acetic acid @25 ppm	7.60	7.74	8.12	8.10	8.04	7.98	7.99	7.99	7.98	7.93	7.83	7.70
T_4 : Naphthalene acetic acid @ 50 ppm	7.95	8.17	8.55	8.54	8.45	8.37	8.24	8.21	8.21	8.14	8.10	7.94
T_5 : Triacontanol @ 0.5 ppm	7.25	7.43	8.00	7.97	7.91	7.86	7.86	7.81	7.80	7.77	7.68	7.65
T_6 : Triacontanol @ 1.0 ppm	7.31	7.43	8.00	7.99	7.93	7.88	7.89	7.88	7.83	7.74	7.69	7.69
T_7 : Boron @ 3.0 ppm	7.40	7.76	8.16	8.15	8.06	8.06	8.07	8.05	7.97	7.91	7.91	7.88
T_8 : Boron @4.0 ppm	7.96	8.04	8.50	8.49	8.46	8.45	8.41	8.38	8.36	8.29	8.22	8.17
S.E.+	0.30	0.23	0.29	0.29	0.32	0.27	0.27	0.31	0.31	0.24	0.26	0.24
C.D. (P=0.05)	0.87	0.66	0.86	0.86	0.94	0.80	0.79	0.90	0.90	0.69	0.76	0.70

Table 5 : Effect of plant growth regulators and boron on speed of germination (%) of bitter gourd cv. PUSA VISESH

Treatments	Storage period (month)											
	1	2	3	4	5	6	7	8	9	10	11	12
T_1 : Absolute control	15.94	15.89	16.04	15.93	15.90	15.86	15.69	15.67	15.47	15.35	15.31	14.71
T_2 : Water spray	16.73	16.84	16.73	16.57	16.52	16.48	16.31	16.25	15.99	15.82	15.76	15.55
T_3 : Naphthalene acetic acid @25 ppm	17.36	17.59	17.73	17.51	17.46	17.41	17.31	17.15	16.77	16.67	16.50	16.43
T_4 : Naphthalene acetic acid @ 50 ppm	18.91	18.95	19.11	18.93	18.85	18.64	18.63	18.46	18.40	18.33	18.27	18.17
T_5 : Triacontanol @ 0.5 ppm	16.49	16.59	16.60	16.56	16.38	16.28	16.23	16.17	16.01	15.87	15.83	15.73
T_6 : Triacontanol @ 1.0 ppm	17.70	17.79	17.97	17.91	17.91	17.78	17.68	17.61	17.41	17.20	17.13	17.03
T_7 : Boron @ 3.0 ppm	18.84	18.70	19.10	18.82	18.82	18.72	18.63	18.50	18.43	18.37	18.33	18.20
T_8 : Boron @ 4.0 ppm	19.17	19.08	19.49	19.17	19.17	18.96	18.76	18.68	18.56	18.43	18.36	18.23
S.E.±	0.34	0.29	0.36	0.37	0.55	0.55	0.57	0.52	0.59	0.55	0.56	0.61
C.D. (P=0.05)	0.98	0.83	1.07	1.12	1.64	1.66	1.71	1.55	1.75	1.66	1.68	1.83

absolute control (81.75 %, 83.75 % and 74.50 %, respectively) at the end of first, third and twelve month of storage period, respectively. This increase in seed quality due to spray of growth regulators might be due to adequate supply of food reserves to resume embryo growth and synthesis of hydrolytic enzymes which are secreted and act on starchy endosperm in turn affecting physiology of seed germination and establishment of seedling. Similar effect of NAA on seed germination was also earlier reported by Shantappa *et al.* (2007) in bitter gourd. Effect of boron on seed germination was also earlier reported by Gedam *et al*. (1996) in bitter gourd, these differences in storability might be due to variations in their effectiveness in combating the seed borne pathogen. Similar findings were also reported by Murugesan and Vanangamudi (2005) in ash gourd and Nerson (1991) in cucurbits.

The low seed germination percentage recorded after one month of storage latter on increased because seeds might be possess the primary dormancy associated with embryo of fresh seeds. Later on as storage proceeds there was gradual increase in seed germination in all the treatments up to third month after storage. From fourth month onwards there was a slightly decrease in seed germination and seed quality parameters indicating the on-set of deterioration which might be due to the combined effects of high temperature, low oxygen, and high CO_2 partial pressures (Edelstein *et al*., 1995 in melon).

The root length (13.31 cm, 13.99 cm and 13.43 cm), shoot length (7.96 cm, 8.50 cm and 8.17 cm) and speed of germination (19.17, 19.49 and 18.23) were significantly higher in boron at 4 ppm and was at par with NAA at 50 ppm (13.20 cm, 14.03 cm and 13.37 cm), (7.95 cm, 8.55 cm and 7.94 cm) and (18.91, 19.11 and 18.17) whereas, lowest was recorded in absolute control (12.17 cm, 12.35 cm and 11.39 cm), (5.23 cm, 5.72 and 4.84 cm) and (15.94, 16.04 and 14.71) at the end of first, third and at the end of storage period, respectively (Table 3 ,4 and 5). Similar findings were earlier reported by Balakumar and Balasubramanian (1988) differences in storability might be due to variations in their effectiveness in combating the seed borne pathogen and also might be due to effective action of these growth regulators and chemical on various physiological and biochemical processes in seeds during storage.

However, all the treatments maintained above the minimum seed certification standards of 60 per cent of seed germination up to twelve months of storage.

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