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Seed Quality as Influence by Plant Growth Regulators in Bitter Gourd (*Momordica charantia* L.)

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An experiment was conducted to find out the effect of growth regulators and stages of spray on seed yield and quality in bitter gourd variety phule green gold during summer-2013. Application of GA_3 50 ppm exerted significantly the highest seed yield per plant (10.38g), which was at par with GA_3 25 ppm (S_1) (10.24), ethrel 250 ppm (S_3) (10.04) and ethrel 500 ppm (S_4) (10.15). The maximum germination percentage (95.93 %), root length (14.55 cm) shoot length (13.96 cm) vigour index-I (1234)and vigour index-II (5856) were recorded with GA3 50 ppm.

Key words: Bitter gourd, Gibberrelic Acid, Ethrel, Naphthalic Acetic Acid (NAA), Cycocel (CCC), Germination, Vigour index

Bitter gourd is one of the most importance cucurbitaceous vegetable crop widely cultivated in Gujarat. Bitter gourd is a different nature's bountiful gifts to mankind which not only have fabulous digestional properties, it is a store house of remedies for many common ailment. Fruits, leaves and even the roots of this vegetable have been used in ayurveda for number of diseases. It has immense medicinal properties due to the presence of beneficial phytochemicals, which are known to have antibiotic, antimutagenic, antioxidant, antiviral, antidiabetic and immune enhancing properties. A compound known as 'charantin', present in the bittergourd is used in the treatment of diabetes in reducing blood sugar level.

Cucurbits share about 5.6 per cent of the total vegetable production of India and were cultivated on about 9,205 thousand hectares with production of 1,62,187 million tones (Anonymous, 2013). In Gujarat area under cucurbits is 0.44 lakh hectares with production of 5.25 million tonnes (Anonymous, 2013).

Growth regulators enhance the number of female flowers and fruits that lead to increase the seed yield and quality in bitter gourd. Though a number of improved varieties are available in India, an efficient seed production package is lacking aimed at manipulating the sex ratio for enhance seed yield and quality. Considering all these, the present investigation were under taken to increase the seed yield and quality in phule green gold during summer-2013.

MATERIALS AND METHODS

A field trial was conducted at college of agricultural, J.A.U., Junagadh, Gujarat, India during summer-2013 with three replication in split plot design. The seed were sown in field with 2m x 1m.

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The plant protection measures were adopted as and when required. Five plants from each treatment were select randomly for recording observation. Four growth regulators each with two concentrations *viz.*, Gibberrelic Acid, Ethrel Naphthalic Acetic Acid (NAA) and Cycocel (CCC) were used for foliar application with water spray and control (no spray) makes total 10 treatment viz., GA_3 25 ppm (S_1), GA_3 50 ppm (S_2), Ethrel 250 ppm (S_3), Ethrel 500 ppm (S_4), NAA 50 ppm (S_5), NAA 100 ppm (S_6), CCC 100 ppm (S_7), CCC 200 ppm (S_8), water spray (S_9), control (no spray) (S_{10}).

Three sprays were given at Two to four leaf stage (M_1), flower initiation stage (M_2), fifteen days after flower initiation stage (M_3). Precaution was taken to prevent drifting of spray solutions from one treatment plot to other. Fruits were harvested as and when they turn orange red colour and seeds were extracted manually. The observations on the seed yield per plant, germination percentage, root length, shoot length, seedling dry weight and vigour index were recorded the germination test was conducted as per ISTA procedure by adopting rolled towel method. Seedling dry weight was calculated based upon the five normal seedlings which were selected at random and dried in hot air oven at 75^0C for 24 hours. The vigour index was calculated by adopting the methods suggested by Abdul-Baki and Anderson and expressed in whole numbers for each treatment by using the following formula:

Vigour index I = Germination (%) × Seedling length (cm)
Vigour index II=Germination (%)×Seedling dry weight (mg)

RESULTS AND DISCUSSION

Effect of growth regulators

Growth regulators exhibited significant influence on seed yield per plant (Table 1). The highest seed yield per plant (10:38 g) was obtained in GA_3 50 ppm, which was at par with GA_3 25 ppm (S_1) (10.24), ethrel 250 ppm (S_3) (10.04) and ethrel 500 ppm (S_4) (10.15), while control recorded the lowest seed yield (8.70 g). Increase in seed yield may be due to the maximum number of female flower and fruits per vine and growth regulators brings certain changes in metabolism during fruit and seed development due to which there would be a greater accumulation of food reserves which resulted in higher seed yield. The beneficial effect of growth regulators were also reported by Gedam *et al.* (1998) and Arvindkumar *et al.* (2012) in bitter gourd who reported that boron at 4 ppm produced maximum seed yield. Marbhal *et al.* (2005) and Shantappa *et al.* (2007) were also observed similar effects of NAA at 50 ppm in bitter gourd; Rasmi (2003) with NAA 100 ppm in bottle gourd; Hilli *et al.* (2010) with NAA 100 ppm in ridge gourd; Adirai *et al.* (2001) with etheral 250 ppm and Shirzad *et al.* (2012) with GA_3 @ 25 ppm in pumpkin.

Growth regulators showed significant influence on germination percentage, root length, shoot length, seedling dry weight and vigour index (Table 1). Application of NAA 100 ppm recorded the higher germination percentage (95.93 %), root length (14.55 cm), shoot length (13.96 cm), vigour index – I (1234) and vigour index – II (5856) compared to all other growth regulator treatments. The control recorded the lowest germination percentage (82.39 %), shoot length (9.07 cm), root fresh weight (0.079 g), vigour index – I (1234) and vigour index – II (5856). Increasing in germination percentage may be due to adequate supplied the food reserves in adequate quantity to resume embryo growth and release enzymes responsible for degradation of macromolecules into micro-molecules to be utilized in growth promoting processes. Increase in seed quality attributes in NAA treatment may be due certain changes in metabolism, which helps in better seed development, greater accumulation of food reserves. Similar result were recorded by Shantappa *et al.* (2007), Gedam *et al.* (1996) and Arvindkumar *et al.* (2012) who reported higher germination percentage with NAA at 50 or 100 ppm in bitter gourd; Hilli *et al.* (2008) and Hilli *et al.* (2010) with NAA at 100 ppm in ridge gourd; Rashmi (2003) in bottle gourd and Prasad *et al.* (2008) in pumpkin.

Effect of stages of spray

Stages of spray showed non significant influence on seed yield. Among the stages of spray, the growth regulators sprayed at fifteen days after flower initiation stage (M_3) recorded higher seed yield (9.83 g) compare to flower initiation stage (M_2) (9.81 g) and Two to four leaf stage (M_1) (9.64 g). The highest seed yield as well as the highest seed yield per vine associated with M_3 stage. These beneficial effects of exogenous application of growth regulators at fifteen days after flower initiation stages was also reported in Rashmi (2003)

Table 1. Effect of plant growth regulators and stages of spray on seed yield and quality character in bitter gourd.

Plant Growth Regulators		Seed yield/plant (g)				Germination Percentage				Root length (cm)			
		(M_1)	(M_2)	(M_3)	Mean	(M_1)	(M_2)	(M_3)	Mean	(M_1)	(M_2)	(M_3)	Mean
GA_3 25 ppm	(S_1)	11.56	9.58	9.57	10.24	99.00	89.02	88.73	92.25	14.95	14.24	14.22	14.47
GA_3 50 ppm	(S_2)	11.83	9.78	9.52	10.38	99.67	91.03	88.39	93.03	15.02	14.43	14.19	14.55
Ethrel 250 ppm	(S_3)	8.87	11.11	10.15	10.04	84.40	99.13	94.06	92.53	13.17	14.94	14.44	14.18
Ethrel 500 ppm	(S_4)	10.88	9.21	10.38	10.15	97.67	84.46	96.06	92.73	14.50	13.47	14.64	14.20
NAA 50 ppm	(S_5)	10.45	9.44	9.74	9.88	96.87	91.99	94.93	94.60	14.30	14.10	14.40	14.27
NAA 100 ppm	(S_6)	8.56	10.92	9.90	9.79	91.53	99.46	96.80	95.93	13.34	14.98	14.70	14.34
CCC 100 ppm	(S_7)	9.94	9.08	9.85	9.63	94.46	83.72	91.39	89.86	13.38	12.60	13.37	13.12
CCC 200 ppm	(S_8)	8.47	10.31	10.67	9.82	80.06	95.13	95.60	90.26	11.94	13.77	12.47	12.72
Water spray	(S_9)	8.01	9.78	9.07	8.95	77.40	92.06	85.06	84.84	8.56	10.33	9.63	9.50
Control (No spray)	(S_{10})	7.79	8.90	9.40	8.70	75.39	83.39	88.40	82.39	8.36	9.46	10.08	9.30
Mean		9.64	9.81	9.83		89.64	90.94	91.94		12.75	13.23	13.21	
		Stages (M)	Spray (S)	M x S		Stages (M)	Spray (S)	M x S		Stages (M)	Spray (S)	M x S	
S.Em.±		0.14	0.19	0.33		0.73	1.12	1.95		0.14	0.18	0.32	
C.D. at 5%		NS	0.54	0.94		NS	3.19	5.52		NS	0.52	0.90	
C.V.%		7.81	5.87	4.41		3.71	5.70	4.23					

Plant Growth Regulators		Shoot length (cm)				Vigour index - I				Vigour index - II			
		(M_1)	(M_2)	(M_3)	Mean	(M_1)	(M_2)	(M_3)	Mean	(M_1)	(M_2)	(M_3)	Mean
GA_3 25 ppm	(S_1)	14.35	13.66	13.64	13.88	1901	1831	1831	1855	10932	9730	9932	10198
GA_3 50 ppm	(S_2)	14.44	13.84	13.61	13.96	1928	1871	1818	1872	11100	10033	9700	10278
Ethrel 250 ppm	(S_3)	12.59	14.36	13.86	13.60	1628	1798	1755	1727	8800	9998	9767	9522
Ethrel 500 ppm	(S_4)	13.92	12.89	14.06	13.62	1785	1685	1775	1748	10367	8865	9967	9733
NAA 50 ppm	(S_5)	13.72	13.52	13.82	13.69	1756	1739	1772	1756	10268	9599	10134	10000
NAA 100 ppm	(S_6)	12.76	14.38	14.12	13.75	1676	1866	1812	1785	9267	10665	10333	10088
CCC 100 ppm	(S_7)	12.80	12.02	12.79	12.54	1645	1571	1648	1621	8967	7731	8700	8466
CCC 200 ppm	(S_8)	11.34	13.19	11.89	12.14	1505	1688	1551	1581	7365	8696	8933	8331
Water spray	(S_9)	8.33	10.10	9.40	9.27	1158	1335	1265	1252	5300	6767	6067	6044
Control (No spray)	(S_{10})	8.13	9.23	9.85	9.07	1138	1248	1315	1234	5100	5900	6567	5856
				12.24	12.72	12.70		1612	1663	1654			8746
8798		9010		Stages (M)	Spray (S)	M x S	Stages (M)	Spray (S)	M x S	Stages (M)	Spray (S)		M x S
S.Em.±		0.13	0.18	0.32	14	18	31.65	107	160	276.73			
C.D. at 5%		NS	0.52	0.90	NS	52	89.80	NS	453	785.06			
C.V.%		5.70	4.40	4.50	3.34	6.65	5.41						

in bottle gourd.

Stages of spray showed non significant influence on germination percentage, root length, shoot length, and vigour index-I and vigour index-II. The maximum germination per cent (91.94 %) was noticed in growth regulators sprayed at fifteen days after flower initiation stage (M_3) compare to M_2 and M_1 stage. The growth regulators sprayed at two to four leaf stage recorded minimum germination percent (89.64 %). The increase in germination at M^3 stage may be due to greater accumulation of food reserves in seed because of additional supply of growth regulators especially at fruit development stage. The better seed quality in M_3 stage may be due to certain change in metabolism, which helps in better seed development and greater accumulation of food reserves. similar result was also reported in bitter gourd by Gedam *et al.* (1996). While the maximum root length (13.23), shoot length (12.72), vigour index-I (16.63), and vigour index-II (9010) were noticed in growth regulators sprayed at flowering stage M_2 compared to M_1 and M_3 stage.

Interaction effect of growth regulators and stages of spray

Interaction effect of growth regulators and stages of spray showed a significant influence on seed yield. The highest seed yield (11.83 g) was recorded with GA_3 50 ppm at two to four leaf stage. Similar result was reported in bottle gourd by Arora *et al.* (1985).

CONCLUSION

From the present study, it is concluded that GA_3 50 ppm sprayed at two to four leaf stages were effective for increasing seed yield. The GA_3 50 ppm was effective in improving the seed quality parameters of bitter gourd Cv. Phule green gold.

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