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Influence of Foliar Applied GABA on Growth and Yield Contributing Characters of White Gourd (*Benincasa hispida*)

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ABSTRACT

An experiment was conducted to investigate the effect of GABA on growth, yield and yield attributes of white gourd. The concentrations of GABA were 0.5 mg L^{-1}, 1.0 mg L^{-1}, 1.5 mg L^{-1} and 2.0 mg L^{-1} along with the control (no hormone). GABA was applied as foliar spray at 60 days after planting. Result showed that GABA had positive regulatory effect on growth, yield and yield contributing characters of white gourd. GABA @ 1.0 mg L^{-1} was the best for vine length, leaf length, leaf breadth, number of internodes, number of nodes at which first male and female flower appeared, number of male and female flowers per plant, number of seeds per fruit, weight of 100 seeds, seed length, number of fruits per plant, weight of fruits per plant and total yield of fruits. It was concluded that GABA @ 1.0 mg L^{-1} as foliar spray could be the suitable concentration for enhancing growth and yield of white gourd. © 2010 Friends Science Publishers

Key Words: GABA; Growth regulator; White gourd; Yield

INTRODUCTION

White gourd (*Benincasa hispida* Thunb; syn ash gourd, wax gourd, white pumpkin) is an important vegetable mainly valued for its long storage life and having a good scope for value addition. Green immature fruit, young branches and sometimes mature fruit of white gourd are used as vegetables. The fruits are consumed a baked, fried, boiled, prickled or candied preserved (Robinson & Decker-Walters, 1999). Among cucurbits and other vine vegetables, white gourd production is profitable for small scale producers (Chowdhury, 1993). In Bangladesh, the production of vegetables is higher during winter (60 to 70%) and most districts produce marketable surplus during that season. White gourd can be good addition in the summer when production of other vegetables is low. Total production of white gourd is about 25,245 metric tons from about 3,822 ha with an average yield was about 6.7 t/ha, which is very low (Hamid *et al.*, 1989; BBS, 2004; BARI, 2006).

Plant growth regulators (PGRs) are used to enhance yield (Nickell, 1982). GABA (GA3 1% & SBA *Brassicasteroids* as STC 0.3%) is a plant growth regulator, which can manipulate a variety of growth and yield in various crops. Foliar application of plant growth regulators increased plant height, number of leaves per plant, fruit size and seed yield in ground nut (Lee, 1990), cotton (Kapagate *et al.*, 1989), cowpea (Khalil & Mandurah, 1989) and rice (Kaur & Singh, 1987). GABA enhances endogenous hormones levels of plants that affect growth, physiological attributes and yield. GABA (0.33 mL L^{-1}) enhanced growth and yield attributes of wheat (Dakua, 2002), rice (Hoque, 2002) and onion (Islam *et al.*, 2007).

Effects of GABA on growth and yield of white gourd in Bangladesh is not conclusive. The study was undertaken to determine how GABA affects growth and yield of white gourd in Bangladesh and to determine the best concentration and frequency of application of GABA to maximize yield.

MATERIALS AND METHODS

The study was conducted at the Field Laboratory of the Department of Crop Botany, Bangladesh Agricultural University, Mymensingh, from February to June 2006. The field was located at 24°45'N and 90°24'E at 18 m above sea level. The soil was a silty-loam Sonatola Soil Series of Grey Flood Plain Soil type under the agro-ecology zone (AEZ-9) termed Old Brahmaputra Flood Plain (FAO, 1999; UNDP, 1988). The climate was sub-tropical and characterized by high temperature and had a rainy season from April to September and a dry season with moderately low temperature during the rest of the year.

The local white gourd (*Benincasa hispida* Thunb) cv. Jali super was used. The growth regulator was applied at the

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concentrations of 0.5, 1, 1.5 and 2 mg L^{-1}. There was a 0 mg L^{-1} control and treatments were replicated four times. Beds were 10 cm in height and 4 × 2 m in size. The soil was cultivated after planting by hand. Weeds, dead roots and stubble were removed. Drainage channels were prepared around beds. Plots were prepared with spade. Cow dung (1,500 kg ha^{-1}) and triple super phosphate (125 kg ha^{-1}) were applied at planting. Urea was applied at planting (75 kg ha^{-1}) and at 30 and 50 days after emergence (37.5 kg ha^{-1} at each pplication). Muriate of Potash was applied at planting (50 kg ha^{-1}) and at 30 and 50 days after mergence (25 kg ha^{-1} at each application). The experiment was arranged in a randomized complete block design.

Seeds were soaked in tap water for 24 h and sown on 1 March 2006 in the pit of raised beds. Pit to pit distance was 2 m and row to row distance was 4 m, respectively. Plants were thinned to two healthy plants per pit at 30 days after planting (DAP). GABA was diluted to get treatment solutions. GABA was applied with a hand sprayer at 60 DAP at late hours of evening to avoid dehydration at midday.

Trellises made from bamboo facilitated climbing, protected fruit from soil pathogens and facilitated harvest. Irrigation was provided as and when needed. Weeding and mulching was done. Insects were controlled with Malathion 50 EC @ 2.0 mL L^{-1} of water was applied at 15 days intervals and Cupravit @ 0.2% was applied to control powdery mildew at 15 days intervals. Green fruit harvesting was from 19 May 2005 to June.

Fresh tissue (100 g) was weighed and dried in an oven in an aluminum boat at 62°C. Numbers of seeds from mature fruit were counted. Seed length was measured. One hundred seed were collected from mature fruits, sun dried and weighed. Numbers of fruit per plant was recorded. Weight of ten randomly selected mature fruit was determined. Numbers of fruit per plant and total fruit yield were recorded. The data were analyzed using the MSTAT-C statistical package. Data were subjected to analyses of variance. Means were separated with Duncan's Multiple Range Test (Gomez & Gomez, 1984).

RESULTS AND DISCUSSION

Main vine length: Treatment affected vine length over time (Fig. 1). Vines continued to grow from 70 to DAP (final harvest) regardless of treatment. One mg L^{-1} concentration produced the longest vines at all measurement times. GABA promoted seedling growth and increase plant height in rice, which was due to cell expansion, cell elongation and cell division. Application of GABA might have activated the hormonal activities (Sekh, 2002).

Affect on leaves: GABA treatment affected most leaf characteristics (Table I). Treatment did not affect petiole length; average 16.2 cm. Leaf lengths and width were greatest for the 1 mg L^{-1} concentration. Islam *et al.* (2007) observed that all concentration of GABA increased leaf length in onion compared to controls.

Table I: Effect of GABA concentration on white gourd leaf length and width, petiole length and number of internodes on the main vine

GABA Concentration	Petiole Length (cm)	Leaf length (cm)	Leaf breadth (cm)	Number of Internodes In main vine
Control	14.90a	14.98c	18.20c	18.88b
0.5 mgL^{-1}	15.69a	17.13b	22.30b	19.63ab
1.0 mgL^{-1}	17.00a	20.44a	14.80a	21.66a
1.5 mgL^{-1}	16.58a	16.32bc	22.45bc	19.88ab
2.0 mgL^{-1}	16.58a	15.58c	22.35c	18.82b
$LSD_{0.05}$	2.47	1.38	1.38	2.29
SE±	1.13	0.63	1.05	1.05
CV %	10.12	5.31	5.31	7.51

Values in a column followed by the same letter are not significantly different, $P \leq 0.05$, DMRT

Table II: Effect of concentration of GABA on flowering behavior of white gourd

GABA Concentration	Node at which first male flower appears	Node at which first female flower appears	Number of male flowers per plant	Number of female Flowers per plant
Control (0)	13.50c	18.50d	55.19d	10.13c
0.5 mgL^{-1}	16.32abc	22.30c	69.44c	13.19ab
1.0 mgL^{-1}	18.44a	24.35a	93.13a	14.26a
1.5 mgL^{-1}	17.94ab	23.65b	84.38b	12.69b
2.0 mgL^{-1}	15.26bc	20.50c	74.38c	12.25b
$LSD_{0.05}$	2.83	1.65	7.46	1.25
SE±	1.30	1.13	3.42	0.57
CV %	11.29	6.43	6.43	6.49

Values in a column followed by the same letter are not significantly different, $P \leq 0.05$, DMRT

Table III: Effect of different concentrations of GABA on fruit dimensions of white gourd

GABA Concentration	Fruit length at edible stage (cm)	Fruit length at mature stage (cm)	Fruit diameter at edible stage (cm)	Fruit diameter at mature stage (cm)
Control	20.50a	24.69a	29.82a	61.12a
0.5 mgL^{-1}	24.01a	29.13a	34.51a	65.26a
1.0 mgL^{-1}	26.51a	32.60a	36.76a	67.73a
1.5 mgL^{-1}	24.27a	27.44a	32.76a	64.38a
2.0 mgL^{-1}	22.21a	25.64a	31.51a	62.76a
$LSD_{0.05}$	6.06	8.63	5.27	8.70
SE±	2.78	3.96	2.42	3.99
CV %	16.73	20.07	10.35	8.79

In a column, figures with common letter (s) do not differ significantly at 5% level of significance as per DMRT

Affect on vines: Treatment affected number of internodes/plant on the main vine (Table I). One mg L^{-1} concentration produced more internodes than did the 0.0 and 2 mg L^{-1} GABA concentrations. Other levels of treatment were intermediate between the high and low values.

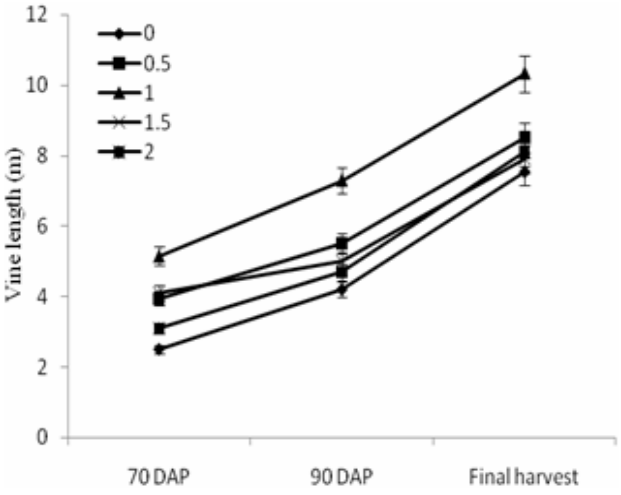
Treatment affected numbers of nodes on which the first male and female flowers per plant appeared and numbers of male and female flowers per plant (Table II). Again 1 mg L^{-1} concentration produced greatest numbers of nodes with first male flowers per plant than for the control

Table IV: Effect of concentrations of GABA on seed characteristics and yield of white gourd

GABA Concentration	Seed length (cm)	No. of seed/fruit	Weight of 100 seed (g)	No. of fruit/ plant	Total yield of fruit (t/ha)
Control	1.17b	860.4b	4.94c	6.10c	6.96c
0.5 mg L^{-1}	1.22ab	1053.0b	5.90ab	7.80ab	9.84ab
1.0 mg L^{-1}	1.29a	1270.0a	6.46a	8.41a	10.79a
1.5 mg L^{-1}	1.21b	1059.0b	6.18ab	7.71b	9.48ab
2.0 mg L^{-1}	1.23ab	981.6b	6.18ab	7.68b	8.44b
$LSD_{0.05}$	0.07	201.10	0.6026	1.251	1.45
SE±	0.03	92.31	0.28	0.30	0.66
CV %	3.22	12.50	6.71	6.49	10.35

Values in a column followed by the same letter are not significantly different, $P \leq 0.05$, DMRT

Fig. 1: Effect of GABA concentrations from 0 to 2 mg L^{-1} on white gourd vine length over time



followed by rest of the treatments. One mg L^{-1} concentration produced numbers of female flowers per plant that were greater than those for the control and other concentrations except the 0.5 mg L^{-1}, for which it was similar. Application of GABA at 0.5, 1 and 2 mg L^{-1} also enhanced numbers of flowers in peanut (Samsuzzaman, 2004) and in mungbean (Rahman, 2004). The present results are in accordance with the findings of them.

Affect on fruit seed and yield: The data regarding to fruit length and diameter both at the edible and mature stage showed that the differences are significant (Table III). Treatment did not affect fruit length or diameter at the edible stage, avg. 23.5 and 33.07 cm, respectively and fruit length or diameter at the mature stage, avg. 27.9 and 64.25 cm, respectively. Treatment affected seed length, number of seed/fruit and weight of 100 seed (Table IV), but not the seed dry matter, which averaged 3.48%. One mg L^{-1} GABA produced seed that were longer than those from control plants. The other treatments had seed that were the same length of those from plants treated with 1 mg L^{-1} or those from control plants. Treatment with 0.5 and 1 mg L^{-1} produced the highest number of seed per fruit. The weight of 100 seed from plants treated with the various GABA concentrations was similar, and higher, than that of seed from controls. Application of GABA at 0.332 or 0.664 mg L^{-1} increased the weight of 100 seed in soybean (Abdullah, 2002). The weight of fruit per plant and fruit weight were not affected by treatment, 7.16 and 0.99 kg per plant, respectively. Treatment affected number of fruit per plant and total yield (Table IV), but not per plant yield (avg. 7.16 kg per plant) or fruit weight (avg. 0.99 kg). Treatment with 0.5 and 1 mg·L^{-1} produced the numbers of fruit per plant that were similar and higher than for the control. The other treatments produced numbers of fruit per plant that were similar to the 0.5 mg L^{-1} concentration. Treatment with 0.5, 1 and 2.0 mg L^{-1} of GABA increased numbers of pods and seed in peanut (Samsuzzaman, 2004). All treatments with GABA produced yields that were greater than for the control.

CONCLUSION

The results of this study showed that foliar application of GABA at a concentration of 1 mg L^{-1} can be used to increase vegetative growth, yield components and yield of white gourd. However more research needs to be undertaken in order to determine the economic usefulness of this concentration of in a large-scale production in the summer season.

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