EFFECT OF PLANT GROWTH REGULATOR (GABA) ON MORPHOLOGICAL CHARACTERS AND YIELD OF BLACK GRAM (*VIGNA MUNGO* L.)

M.R. Islam*, A.K.M.A. Prodhan, M.O. Islam** and M. K. Uddin***

ABSTRACT

A study was carried out in the Department of Crop Botany, Bangladesh Agricultural University, Mymensingh, Bangladesh during 2005 to investigate the effect of GABA (a mixture of GA_3 and ABA) on morphological characters, yield and yield attributes of black gram. Four levels of GABA (0.25, 0.50, 1.0 and 2.0 mg/l) alongwith a control (fresh water) were studied in a randomized complete block design with four replications. The results revealed that GABA @ 1.0 mg/l significantly increased the plant height, number of branches per plant, number of leaves per plant, total chlorophyll content, number of pods per plant, pod length, number of seeds per pod and seed yield. The total chlorophyll content was higher at 1.0 mg GABA concentration. Among different concentrations GABA @ 1.0 mg performed better for yield and yield contributing characters. It gave the highest seed yield (1.50 t/ha) against the lowest (1.3 t/ha) from control.

KEYWORDS: ***Vigna mungo;*** **GA; ABA; agronomic characters; chlorophyll; Bangladesh.**

INTRODUCTION

Black gram (*Vigna mungo* L. Hepper, syn. *Phaseolus mungo* L.) is one of the most important pulse crops grown in Bangladesh. It grows well in north or north-west part of Bangladesh, especially in Rajshahi and Chapai Nowabganj districts. It is mainly grown for human consumption but is also used as fodder for cattle and green manure for improving soil fertility.

Black gram contains approximately 25-28 percent protein, 4.5-5.5 percent ash, 0.5-1.5 percent oil, 3.5-4.5 percent fibre and 62-65 percent

***Scientific Officer, ***Senior Scientific Officer, Regional Agricultural Research Station, BARI, Ishurdi, Pabna, **Professor, Department of Crop Botany, BAU, Mymensingh, Bangladesh.**

carbohydrate on dry weight basis (7). The dried seeds, whole or split, are used to make dal, soups, curries and are added to various spiced or fried dishes. Despite its various uses, its acreage and yield are decreasing day by day (3).

Among pulses black gram ranks fourth in Bangladesh both in terms of acreage and production. It can be grown both in summer and winter seasons. Pulse crops cover about 557508 acres where black gram occupies 58918 acres with average yield of 862 kg per hectare, which is very lower than other pulse crops (7).

Considering the significance of black gram in Bangladesh, it is necessary to improve this crop quantitatively and qualitatively. Among various practices application of plant growth regulators (PGRs) are considered very important in view of convenience, cost and labour efficacy. PGRs are being used as an aid to enhance yield. GABA is a mixture of gibberellic acid (GA_3) and abscisic acid (ABA)). It can manipulate growth and yield in various crops. Foliar application of GABA has been found to increase seed yield in groundnut (12), mungbean (10, 13) and soybean (5, 8). However, information about stimulatory effect of GABA on black gram is not clearly known.

In present investigation effect of different concentrations of GABA was studied on morphological characters, yield and yield attributes of black gram to determine optimum concentration of GABA.

MATERIALS AND METHODS

This study was conducted in the Department of Crop Botany, Bangladesh Agricultural University, Mymensingh, Bangladesh during the year 2005. Geographically, experimental field is located at 24°25´N latitude and 90°50´E longitude at an elevation of 18 m above sea level (2). Soil of experimental plot was silty loam in texture having pH 6 to 6.5. The climate of this place is characterized by heavy rainfall during April to October (4). Maximum and minimum temperature during growing period varied from 27.28 to 33.01°C and 14.74 to 25.39°C, respectively. Crop (cv. BARI Mash-3) was sown during February 2005 in RCBD with four replications. The size of unit plot was 3.5 m x 2.5 m. Plant to plant and row to row distances were maintained at 15 cm and 30 cm, respectively. Four concentrations of GABA (0.25, 0.5, 1.0 and 2.0 mg/l) including control (fresh water) were studied. The formulation of GABA (GA_3+ABA) was water soluble powder. For preparation of GABA working solution 0.25, 0.50, 1.0 and 2.0 mg of original powder were added separately to one litre of water contained in a volumetric flask and spray was

done at 30 DAS (days after sowing) in afternoon with hand sprayer. The crop was fertilized with 30-40-20 kg N-P_2O_5-K_2O per hectare. All fertilizers were applied during final land preparation. In addition cow dung was applied @ 6 tons per hectare during land preparation. One weeding and thinning was done at 15 DAS. The first crop sampling was done on 40 DAS and it was continued at an interval of 10 days till 80 DAS. The selected plants of each plot were uprooted carefully to ensure maximum root extraction. The plant height was recorded by measuring with a graduated scale placed from ground level to tip of last leaf. Data on plant height, number of leaves per plant, number of branches per plant, number of pods per plant, pod length, number of seeds per pod, 1000 seed weight and seed yield were recorded using standard procedures and statistically analyzed. Total leaf area of individual sample was measured by an electronic leaf area meter (LI-3000, USA) and chlorophyll content measured by using spectrophotometer. The differences between means were computed by Duncan's multiple range test (DMRT) (11).

RESULTS AND DISCUSSION

Morphological characters

Plant height: Plant height increased gradually with advancement of age of plants in all treatments (Table 1). GABA effect on plant height was significant during whole growth period. At 40 DAS, maximum plant height (23.70 cm) was found at 1.0 mg GABA which was statistically similar to 2.0 mg GABA (22.70 cm). The lowest plant height was obtained from control (20.50 cm). At 50 DAS, 1.0 mg GABA again topped in plant height (37.86 cm) which differed significantly from other concentrations. The lowest plant height (31.05 cm) was found in control. Similar trend was observed at 60 and 70 DAS. At 80 DAS, same treatment i.e. 1.0 mg GABA gave more plant height (45.42cm) which was statistically similar to 2.0 and 0.50 mg. The lowest plant height (40.30 cm) was obtained from control. Rahim (8) also reported that application of 1.0 mg GABA per litre increased the plant height in soybean. Islam *et al.* (5) observed that 0.664 ml GABA per litre enhanced plant height significantly in lentil.

Number of branches per plant: Number of branches per plant was significantly affected by different concentrations of GABA (Table 1). Application of GABA @ 1.0 mg produced maximum number of branches at all growth stages compared to other concentrations of GABA and control. At 40 DAS, the highest number of branches per plant (2.65) was found at 1.0 mg GABA which was statistically similar to 2.0 mg concentration (2.55)

against the lowest in control (1.45). Nearly similar trend was observed at 50 and 60 DAS. At 70 DAS, the highest number of branches per plant (3.88) was recorded at 1.0 mg of GABA concentration which was statistically similar to that of 2.0 mg (3.75) and 0.50 mg (3.43). At 80 DAS, again 1.0 mg GABA produced higher number of branches (4.40) which was statistically identical to that of 2.0 mg (Table 1). Sultan (13) also reported increased number of branches in mungbean with application of 1.0 mg GABA.

Table 1. Effect of GABA on morphological characters in black gram.

GAB concentrations	40 DAS	50 DAS	60 DAS	70 DAS	80 DAS
			Plant height (cm)		
Control	20.50c	31.05c	35.83c	40.07c	40.30c
0.25 mg/l	21.10bc	31.75bc	35.96c	41.68b	41.82bc
0.50 mg/l	21.35bc	32.85bc	37.01bc	42.06b	43.34ab
1.0 mg/l	23.70a	37.86a	39.51a	44.29a	45.42a
2.0 mg/l	22.70ab	34.40b	37.96b	42.26b	43.76ab
CV%	4.55	5.16	4.41	3.73	4.13
			Number of branches/plant		
Control	1.45c	2.22c	2.65c	2.93b	3.10c
0.25 mg/l	1.70bc	2.45c	2.85c	3.12b	3.20c
0.50 mg/l	1.85b	2.75bc	2.95bc	3.43ab	3.90b
1.0 mg/l	2.65a	3.41a	3.50a	3.88a	4.40a
2.0 mg/l	2.55a	3.15ab	3.24ab	3.75a	4.20ab
CV%	8.56	13.35	7.30	10.55	6.44
			Number of leaves/plant		
Control	8.90c	17.65d	26.30c	34.00b	23.92b
0.25 mg/l	9.85bc	18.80d	26.62bc	34.55b	25.35b
0.50 mg/l	10.05b	20.40c	27.43bc	35.00b	27.60a
1.0 mg/l	11.40a	24.75a	33.18a	39.85a	29.30a
2.0 mg/l	10.65ab	22.10b	28.34b	38.05a	28.85a
CV%	6.35	4.13	3.80	3.52	4.39

In a column, values with different letter(s) differed significantly at 5% level as per DMRT.

Number of leaves per plant

Number of leaves per plant also varied significantly due to GABA concentration at different stages of plant growth (Table 1). Irrespective of concentration, more number of leaves was found at 70 DAS compared to other growth stages. At 40 DAS, maximum number of leaves was recorded at 1.0 mg (11.40) which was identical to 2.0 mg but differed significantly from other concentrations and control. At 70 and 80 DAS, 1.0 mg GABA concentration excelled in number of leaves (39.85 at 70 DAS and 29.30 at 80 DAS) which was statistically similar to 2.0 mg (38.05 at 70 DAS and 28.85 at 80 DAS). The results revealed that 1.0 mg of GABA showed its superiority

during whole growth period. Rahman (9) noted higher number of leaves in mungbean at 30 ppm GABA.

Leaf area per plant

Effect of GABA on leaf area was found significant at all growth stages. It increased gradually with crop growth and declined after 70 DAS due to fall of matured leaves (Table 2). At 40 DAS, maximum leaf area was observed at 1.0 mg GABA concentration (192.04 cm^2) followed by 2.0 mg (159.25 cm^2), 0.50 mg (155.52 cm^2) and 0.25 mg (146.02 cm^2) concentrations against the lowest in control (121.37 cm^2). At 60 DAS, the highest leaf area was recorded at 1.0 mg (605.92 cm^2) which was statistically similar to 2.0 mg (579.03 cm^2) concentration. At 70 DAS also the highest leaf area was observed at 1.0 mg (529.75 cm^2) which was statistically similar to 2.0 mg (519.02 cm^2), 0.50 mg (495.59 cm^2) and 0.25 mg (475.58 cm^2) concentrations. Control produced the lowest (405.84 cm^2). It has been earlier reported that GABA at 0.664 ml significantly increased the leaf area compared to control in lentil (5) and soybean (1).

Total chlorophyll content

Effect of GABA on total chlorophyll content was studied at 40 and 60 DAS (Table 2). At both concentrations, maximum total chlorophyll content was obtained from 1.0 mg level (2.95 mg/g Fw at 40 DAS and 3.23 mg/g Fw at 60 DAS) which differed significantly from other concentrations. However, at 60 DAS, it was identical to 2.0 mg level of GABA. However, control produced the lowest chlorophyll content at both stages. It produced statistically similar to 0.25 mg level at 40 DAS and 0.25 and 0.50 mg level at 60 DAS.

Table 2. Effect of GABA on leaf area and chlorophyll content of black gram.

GABA concentrations	Leaf area (cm/plant)				Chlorophyll content (mg/g Fw)	
	40 DAS	50 DAS	60 DAS	70 DAS	40 DAS	60 DAS
Control	121.37c	333.07d	476.08b	405.84b	2.32d	2.74c
0.25 mg/l	146.02b	355.97cd	480.15b	475.58ab	2.50cd	2.81bc
0.50 mg/l	155.52b	383.61c	306.92b	495.59a	2.60bc	2.84bc
1.0 mg/l	192.04a	603.43a	605.92a	529.75a	2.95a	3.23a
2.0 mg/l	159.25b	466.86b	579.03a	519.02a	2.72b	3.09ab
CV%	7.33	4.87	6.93	9.56	4.74	7.02

In a column, values with different letter(s) differed significantly at 5% level as per DMRT.

Leaf area index (LAI)

The data showed that LAI was significantly affected with different concentrations of GABA compared to control (Table 3). At 40 DAS, maximum LAI was found at 1.0 mg (0.426) which differed significantly from other concentrations. The lowest LAI was obtained from control (0.269). Similar trend was also obtained at 50 DAS. At 60 DAS maximum LAI was recorded at 1.0 mg (1.346) which was statistically similar to 2.0 mg (1.286). At 70 DAS results were similar to that obtained at 60 DAS. Finally, LAI decreased with advancing age due to matured leaf fall. The increased LAI in lentil was also recorded by Islam *et al.* (5) with 0.664 mg/l GABA.

Table 3. Effect of GABA on leaf area index in black gram.

GABA concentrations	Leaf area index			
	40 DAS	50 DAS	60 DAS	70 DAS
Control	0.269d	0.740c	1.057b	0.899d
0.25 mg/l	0.324c	0.791c	1.067b	1.056c
0.50 mg/l	0.345bc	0.852c	1.126b	1.101bc
1.0 mg/l	0.426a	1.340a	1.346a	1.177a
2.0 mg/l	0.353b	1.037b	1.286a	1.153ab
CV%	3.36	11.34	3.91	3.79

In a column, values with different letter(s) differed significantly at 5% level as per DMRT.

Yield and yield attributes

Number of pods per plant: The number of pods per plant varied significantly due to different concentrations of GABA (Table 4). Maximum number of pods per plant was obtained from 1.0 mg (45.65) which differed significantly from other concentrations. Minimum pods per plant were produced in control (35.62). Rahman (10) also reported that 1.0 mg of GABA increased the number of pods per plant in mungbean.

Pod length: Different concentrations of GABA had no significant effect on pod length of black gram. Maximum pod length (4.77cm) was obtained from 1.0 mg against the lowest from control (4.44cm) (Table 4). However, all GABA concentrations were statistically similar.

Number of seeds per pod: No significant effect of GABA concentrations was observed on number of seeds per pod, However, higher number of seeds per pod (6.31) was obtained from 1.0 mg against the lowest (6.01) from control.

Table 4. Effect of GABA on yield and yield attributes in black gram.

GABA concentrations	No. of pods/plant	Pod length (cm)	No. of seeds/pod	1000- seed weight (g)	Seed yield (t/ha)
	80 DAS	80 DAS	80 DAS	80 DAS	80 DAS
Control	35.62 d	4.44a	6.01a	40.00a	1.39c
0.25 mg/l	39.50 c	4.45a	6.03a	40.25a	1.40c
0.50 mg/l	40.55 bc	4.57a	6.27a	40.75a	1.45b
1.0 mg/l	45.65 a	4.77a	6.31a	41.00a	1.50a
2.0 mg/l	41.40 b	4.56a	6.29a	40.50a	1.46b
CV(%)	3.47	7.51	5.07	3.78	3.32

In a column, values with different letter(s) differed significantly at 5% level as per DMRT.

1000-seed weight: Thousand seed weight of black gram also did not vary due to different concentrations of GABA. Here again, more 1000-seed weight (41.00) was recorded in 1.0 mg GABA level against minimum (40.00) from control (Table 4). These results confirmed some earlier findings (5, 8).

Seed yield: Seed yield was significantly affected by different concentrations of GABA (Table 4) with stimulatory effects. GABA also enhanced seed yield (8.22%) over control. The highest seed yield (1.50 t/ha) was obtained from 1.0 mg which differed significantly from other concentrations and control. Control produced the lowest seed yield (1.39 t/ha) which was statistically similar to that of 0.25 mg (1.40 t/ha). The increase in seed yield at 1.0 mg GABA concentration was due to increased number of pods per plant, seeds per pod and 1000 seed weight. The results further revealed that increase in GABA concentrations upto 1.0 mg increased the seed yield but thereafter, it declined. In some earlier studies, 1.0 mg GABA application in soybean (8) and 0.664 mg in lentil (5) increased seed yield. However, in other studies on groundnut (12) 2.0 mg per litre GABA performed better. Kamuro *et al.* (6) observed 86 percent more wheat grain yield over control with combined effect of 2 ppm GABA and 10 ppm GA_3 (GABA).

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