J. Environ. Sci. & Natural Resources, **4(2): 79-82 , 2011** ISSN 1999-7361

Effect of Different Level of GA_3 on Growth and Yield of Cabbage

R. Roy[1] and K. M. Nasiruddin[2]

[1]Department of Horticulture, Bangladesh Agricultural University, Mymensingh

[2]Department of Biotechnology, Bangladesh Agricultural University, Mymensingh

Abstract

The research work was conducted to study the effect of GA_3 on growth and yield of cabbage. Single factor experiment consisted of four concentrations of GA_3, viz., 0, 25, 50 and 75 ppm. Significantly the minimum number of days to head formation (43.54 days) and maturity (69.95 days) was recorded with 50 ppm GA_3 and 50 ppm GA_3 gave the highest diameter (23.81 cm) of cabbage head while the lowest diameter (17.89 cm) of cabbage head was found in control (0 ppm GA_3) treatment. The application of different concentrations of GA_3 as influenced independently on the growth and yield of cabbage. Significantly the highest yield (45.22 kg/plot and 104.66 t/ha) was found from 50 ppm GA_3.

Key Words: Cabbage, GA_3, yield

Introduction

Cabbage (*Brassica oleracea* var. *capitata* L.), a member of the family Cruciferae, is one of the five leading vegetables in Bangladesh. It was originated in the sea coast of England, Denmark and north-western part of France (Thompson and Kelly, 1975). It occupies 11.33 thousand hectares of land with the total production of 112 thousand metric tones in Bangladesh (BBS, 2000). Growth regulators are organic compounds other than nutrients; small amount of which are capable of modifying growth (Leopold, 1963). Ammong the growth regulators, auxin causes enlargement of plant cell and gibberellins stimulate cell division, cell enlargement or both (Nickell, 1982). Due to the diversified use of productive land, it is necessary to increase the food production, and gibberellic acid (GA_3) may be a contributor in achieving the desired goal. The production of cabbage can be increased by using GA_3. Cabbage was found to show a quick growth when treated with plant growth regulators (Islam *et al*., 1993). Application of GA_3 stimulates morpho-physiological, and yield and yield contributing characters of cabbage. Application of GA_3 with the environmental conditions play important role in modifying the growth and yield of cabbage. Cabbage seedlings are transplanted from seedbed to the main field. The time between uprooting and establishment of young and tender seedlings in the field is very critical. Vegetables, like, cabbage, cauliflower and tomato respond well to plant growth regulators in minimizing the transplanting shock and being encouraged to a quick growth (Chhonkar and Jha, 1963). Growth regulators are organic compounds other than nutrients; small amount of which are capable of modifying growth (Leopold, 1963). Considering the above factors, the present study was undertaken to find out the effect of appropriate concentration of GA_3 for better vegetative growth, maximum yield and economic return of cabbage.

Materials and Methods

The research work was conducted to study the effect of GA_3 on growth and yield of cabbage. The cultivar of cabbage was Atlas-70, the seeds were F_1 hybrid and produced by Sakata Seed Corporation of Japan. Cabbage seedlings were raised in two seedbeds of 5 m × 1 m size. The single factor experiment consisted of four levels of GA_3 (0 ppm: control/G_0; 25 ppm: G_1; 50 ppm: G_2 and 75 ppm: G_3. The experiment was laid out in the Randomized Complete Block Design (RCBD) with three replications. Well decomposed cowdung was applied @ 10 t/ha and was incorporated to the soil of the plot during final land preparation. Urea, triple super phosphate (TSP) and muriate of potash (MP) were applied to the experimental plots @ 325, 150 and 200 kg/ha, respectively (BARC, 1997). Thirty days old healthy and uniform sized seedlings were transplanted in the experimental plots on 28 November, 2001. The seedlings were uprooted carefully from the seedbed to avoid damage to the root system. Intercultural operations were done as and when necessary. Data were collected on Plant height, Number of leaves per plant, Days to head formation, Days to head maturity, Number of outer loose leaves per plant, Number of folder leaves, Length of stem, Fresh weight of stem, Diameter of stem, Number of roots per plant, Length of root, Fresh weight of roots, Thickness of head, Diameter of head, Biomass or biological yield of individual plant, Gross weight of head, Economic yield per plant, Dry weight of head, Yield per plot and Yield per hectare. The collected data on various parameters under study were statistically analyzed using MSTAT statistical programme. The significance of difference between pairs of treatment means was evaluated by the least significance difference (LSD) test at 5 per cent levels of probability (Gomez and Gomez, 1984).

Results and Discussion

GA_3 effect on morpho-physiological character

Application of GA_3 on morpho-physiological characters showed significant variation in all the parameters where they increased with the increasing level of GA_3 from control up to 75 ppm GA_3. The plant height of cabbage at 8, 16, 24, 32 and 40 days after transplanting (DAT) were significantly influenced by different concentrations of GA_3. It was observed that the plant height increased with the increasing period of time and also increasing level of GA_3.The tallest plants (10.68, 16.12, 24.23, 28.98 and 39.20 cm) were observed at 8, 16, 24, 32 and 40 days after transplanting, respectively whereas the shortest plant (10.47, 16.09, 22.96, 26.32 and 32.65 cm) were recorded at similar DAT, respectively (Fig. 1). Number of leaves per plant at different days after transplanting was also significantly different due to the application of GA_3. Significantly the highest (7.17, 10.17, 12.10, 16.08 and 21.40) number of leaves was found in 75 ppm GA_3 and the minimum (7.13, 10.11, 11.10, 14.81 and 17.83) was noted in the control treatment at 8, 16, 24, 32 and 40 DAT, respectively (Fig. 2).

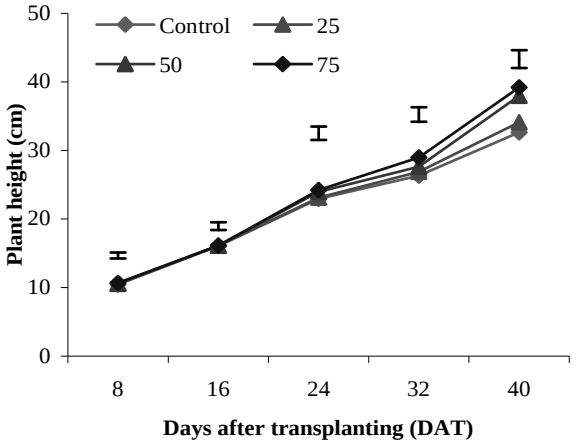

Fig. 1: Effect of different concentrations of GA_3 on plant height at different days after transplanting. Vertical bars represent LSD at 5% level of significant

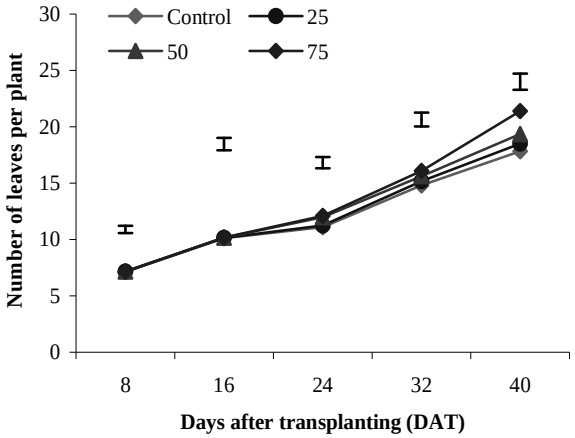

Fig. 2: Effect of different concentrations of GA_3 on number of leaves per plant at different days after transplanting. Vertical bars represent LSD at 5% level of significant

Days to head formation and maturity was significantly varied with the application of GA_3 at final stage of data recording. The minimum days to head formation (43.54 days) and maturity (69.95 days) were recorded from the plants which were sprayed with 50 ppm GA_3 followed by 75 pm GA_3 (44.93 and 71.40 days, respectively). The maximum days to head formation (51.37 days) and maturity (79.89 days) were obtained from control treatment. Numbers of loose and folded leases were also varied significantly with the application of GA_3 where the highest numbers of loose and folded leaves (16.47 and 39.95, respectively) per plant were taken from the plants grown in 50 ppm GA_3 followed by 75 ppm GA_3 (15.67 and 38.46, respectively) which was statistically more or less similar. The lowest loose and folded leaves (11.92 and 32.39, respectively) were observed in control treatment from the observation of table 1. The longest stem (6.59 cm) was given by the GA_3 application doses of 75 ppm and the shortest (5.66 cm) was found in without GA_3. Weight of stem showed significant variation due to the effect of GA_3 where the significantly highest fresh weight of stem (47.26 g) and the significantly lowest (34.44 g) was also found in control treatment (Table 1).

Table 1: Effect of GA_3 on the growth of cabbage

Conc. of GA_3 (ppm)	Days to head formation	Days to head maturity	Number of loose leaves/plant	Number of folded leaves/plant	Length of stem (cm)	Fresh weight of stem (g)
0	51.37	79.89	11.92	32.39	5.66	34.44
25	45.89	73.72	14.36	36.85	6.40	42.10
50	43.54	69.95	16.47	39.95	6.52	46.30
75	44.93	71.40	15.67	38.46	6.63	47.26
$LSD_{(0.05)}$	**2.142**	**2.785**	**0.729**	**1.951**	**0.486**	**1.752**
CV (%)	**5.53**	**4.53**	**5.99**	**6.34**	**9.25**	**4.94**

G_1: 25 ppm GA_3, G_2: 50 ppm GA_3 , G_3: 75 ppm GA_3

Application of GA_3 significantly influenced the diameter of stem of cabbage. The thickest stem (2.83 cm) was found from the 75 ppm GA_3 (G_3) followed by (2.72 cm) 50 ppm GA_3 (G_2) treatment, while the lowest diameter (1.87 cm) was obtained from the control (G_0) treatment. Number of roots per plant was significantly varied with the application of GA_3. The highest number of roots (35.08) per plant was recorded from the plants grown with 50 ppm GA_3 followed by 75 ppm GA_3 (34.57) and 25 ppm GA_3 (32.70), respectively. But 50 ppm GA_3 and 75 ppm GA_3 showed identical effect in this respect. While the lowest number of roots (30.82) per plant was obtained from 0 ppm GA_3 treatment. Length of root was significantly the highest (23.23 cm) and the shortest root (18.74 cm) was found in 50 ppm and control treatment, respectively. Weight of roots per plant was significantly varied with the application of GA_3. The maximum weight of roots (11.95 g) was recorded from 50 ppm GA_3 followed by 75 ppm GA_3 (11.05 g) and 25 ppm GA_3 (10.55 g), respectively. While the lowest weight of roots (10.06 g) was recorded from 0 ppm GA_3 treatment. The effect of GA_3 treatments was significant in respect of thickness of head. Fifty ppm GA_3 (G_2) gave the maximum thickness of head (14.92 cm) of cabbage head and it was statistically identical with 75 ppm GA_3 (14.70 cm). The lowest thickness of head (12.15 cm) of cabbage head was found in 0 ppm GA_3 treatment. The effect of GA_3 treatment was significant in respect of head diameter. Fifty ppm GA_3 (G_2) gave the maximum diameter (23.81 cm) of cabbage head followed by 75 ppm GA_3 (22.81 cm) and 25 ppm GA_3 (20.84 cm), respectively. The lowest diameter (17.89 cm) of cabbage head was found in 0 ppm GA_3 treatment (Table 2).

Table 2: Effect of GA_3 on the growth and yield of cabbage

Conc. of GA_3 (ppm)	Diameter of stem (cm)	Number of lateral roots/plant	Length of root (cm)	Fresh weight of roots/plant (g)	Thickness of head (cm)	Diameter of head (cm)
0	1.87	30.82	18.74	10.06	12.65	17.89
25	2.33	32.70	20.60	10.55	14.13	20.84
50	2.72	35.08	23.23	11.95	14.92	23.81
75	2.83	34.57	22.06	11.05	14.70	22.81
LSD(0.05)	**0.137**	**1.140**	**1.618**	**0.963**	**0.791**	**1.043**
CV (%)	**6.68**	**4.11**	**9.18**	**10.59**	**6.73**	**5.86**

G_1: 25 ppm GA_3, G_2: 50 ppm GA_3, G_3: 75 ppm GA_3

The biomass per plant varied significantly due to GA_3 treatments. The maximum biomass per plant (3.96 kg) was found with 50 ppm GA_3 (G_2) and it was statistically similar to 75 ppm GA_3 (3.86 kg) while the lowest biomass per plant (3.12 kg) was produced by the control (G_0) treatment. The effect of GA_3 treatments was significant in respect of head weight. The highest head weight (3.55 kg) was obtained from the 50 ppm GA_3 (G_2) followed by 75 ppm GA_3 (3.43 kg). While the lowest head weight (2.69 kg) was given by the control (G_0) treatment. Economic yield per plant was significantly varied with the application of GA_3. The maximum economic yield (2.80 kg) was recorded from 50 ppm GA_3 which was statistically similar with 75 ppm GA_3 (2.60 kg). While the lowest yield (1.91 kg) was recorded from 0 ppm GA_3. Application of GA_3 significantly influenced the dry weight of head of cabbage. The maximum dry weight of cabbage head (171.95 g) was found in 50 ppm GA_3 and the lowest dry weight of head (115.97 g) was found in the control treatment (G_0). Application of GA_3 significantly influenced the head yield per plot. The highest yield per plot (45.22 kg) was produced by the plants grown with the 50 ppm GA_3 (G_2), which was followed by 75 ppm GA_3 (42.57 kg) treatment. While the lowest yield per plot (28.75 kg) was found from control (G_0) treatment. Application of GA_3 treatments significantly influenced cabbage yield. The highest yields (104.66 t/ha) was found with 50 ppm GA_3 (G_2), followed by 75 ppm GA_3 (98.55 t/ha). The lowest yield (66.56 t/ha) was recorded from the control treatment (G_0) (Table 3).

Table 3. Main effect of GA_3 on the yield components and yield of cabbage

Concentration of GA_3 (ppm)	Biomass/ plant (kg)	Gross weight of head (kg)	Economic yield/plant (kg)	Dry weight of head (g)	Yield/plot (kg)	Yield (t/ha)
0	3.12	2.69	1.91	115.97	28.75	28.75
25	3.79	2.80	2.27	148.27	37.81	37.81
50	3.96	3.55	2.80	171.95	45.22	45.22
75	3.86	3.43	2.60	150.10	42.57	42.57
LSD (0.05)	**0.305**	**0.186**	**0.008**	**8.156**	**2.022**	**2.022**
LSD (0.01)	**0.411**	**0.251**	**0.159**	**10.98**	**0.722**	**0.722**

The findings of the experiment indicated that the yield of cabbage head was greatly improved by different concentrations of GA_3. Head yield was increased due to the effect of GA_3 with over control. The results obtained from the investigation exhibited a great influence of GA on the production of cabbage. The findings of the present study will also help decide the justification of using GA_3 in cabbage production.

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