

Effect of starter solution and GA₃ on growth and yield of cabbage

R. Roy, M.A. Rahim and M.S. Alam

Department of Horticulture, Bangladesh Agricultural University, Mymensingh, Bangladesh

Abstract: The Present research work was conducted at the Horticulture Farm of Bangladesh Agricultural University, Mymensingh during the period from October, 2001 to February, 2002 to study the effect of starter solution and GA₃ on growth and yield of cabbage. The two factor experiment consisted of four levels of starter solution, viz., 0, 1.0, 1.5 and 2.0% of urea, and four concentrations of GA₃, viz., 0, 25, 50 and 75ppm. The application of starter solution and different concentrations of GA₃ influenced independently and also in combination on the growth and yield of cabbage. The highest yield (104.93 t/ha) was obtained from 1.5% starter solution which was significantly different from other solutions, and the lowest yield (66.86 t/ha) was recorded from the control. Significantly the highest yield (104.66 t/ha) was found from 50 ppm GA₃, while the lowest yield (66.56 t/ha) was recorded from control. In case of combined effect, the highest yield of cabbage (121.33 t/ha) was obtained from the treatment combination of 1.5% starter solution + 50 ppm GA₃ followed by 1.5% starter solution + 75 ppm GA₃ (115.22 t/ha), while the lowest yield (57.11 t/ha) was produced by the control treatment. Economic analysis revealed that 1.5% starter solution + 50 ppm GA₃ treatment was the best treatment combination in respect of net return (Tk. 173775/ha) with a benefit cost ratio of 3.52.

Key words: Cabbage, GA₃, starter solution, yield.

Introduction

Starters are the mixtures of fertilizers and mostly used as solution. It provides a ready source of nutrition near the absorbing zone of the seedlings just after transplanting. 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 starter solution and plant growth regulators in minimizing the transplanting shock and being encouraged to a quick growth (Chhonkar and Jha, 1963). The use of starter solution influences vegetative growth, and ultimately production. The beneficial effect has been reported by Sayre (1938). Growth regulators are organic compounds other than nutrients; small amount of which are capable of modifying growth (Leopold, 1963). Among the growth regulators, auxin causes enlargement of plant cell, and gibberellins stimulate cell division, cell enlargement or both (Nickell, 1982). Cabbage was found to show a quick growth when treated with plant growth regulators (Islam *et al.*, 1993). Application of GA₃ stimulates morphological characters like plant height, number of leaves, head diameter, thickness of head as well as the weight of the head. The concentrations of these chemicals interacting with the environmental conditions play important role in modifying the growth and yield components of cabbage. Considering the above factors, the present study was undertaken to find out the effect of starter solution, appropriate concentration of GA₃ and Starter solution along with different concentrations of GA₃ for better vegetative growth, maximum yield and economic return of cabbage.

Materials and Methods

The research work was conducted at the Horticulture Farm of Bangladesh Agricultural University, Mymensingh during the period from October, 2001 to February, 2002 to study the effect of starter solution and GA₃ on growth and yield of cabbage. The cultivar of cabbage used in this experiment was Atlas-70, the seeds were F₁ hybrid and produced by Sakata Seed Corporation of Japan. Cabbage seedlings were raised in two seedbeds of 5 m × 1 m size. The two factor experiment consisted of four levels of starter solution (Factor A) and four levels of concentration of GA₃ solution (Factor B). The factors were as follows: Factor A: levels of

starter solution: i. 0% urea - No starter solution (S₀); ii. 1.0% urea - Starter solution (S₁); iii. 1.5% urea - Starter solution (S₂); iv. 2.0% urea - Starter solution (S₃); Factor B: Levels of concentration of GA₃ Solution, i. 0 ppm GA₃ - No GA₃ Solution (G₀); ii. 25 ppm GA₃ - GA₃ solution (G₁); iii. 50 ppm GA₃ - GA₃ solution (G₂); iv. 75 ppm GA₃ - GA₃ solution (G₃). 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 1 and 5 per cent levels of probability (Gomez and Gomez, 1984). Cost and return analysis were done in details according to the procedure of Alam *et al.* (1989).

Results and Discussion

The present experiment was conducted to investigate the effect of starter solution and GA₃ and their possible combined effect on the growth and yield of cabbage. The results are presented in Tables and necessary discussions have been made under the following sub-headings:

Plant height and number of leaves per plant: The plant height and number of leaves per plant of cabbage at different days after transplanting (DAT) were significantly influenced

by the treatments of starter solution. Plant height and number of leaves per plants were increased with increasing period of time. The tallest plant (38.82) and maximum (24.32) number of leaves per plant were observed in 1.5% starter solution (S_2) treatment. The shortest plant (10.39cm) and minimum (6.11) number of leaves per plant were given by the control (S_0) treatment. This might be due to the fact that starter solution i.e. urea solution reduced the transplanting shock and enhanced urea uptake for the plants from the very beginning. The present result of the study is supported by the findings of Chhonkar and Jha (1963).

Plant height and number of leaves per plant at different days after transplanting (DAT) were also significantly influenced by the application of different concentration of GA_3 . The highest (39.20 cm) plant and maximum (21.40) number of leaves per plant were found at 40 days after transplanting, respectively with the concentration of 75 ppm GA_3 (G_3) treatment. The shortest plants of 10.68 cm and minimum (7.16) number of leaves per plant were found at 8 DAT, respectively in control.

Plant height and number of leaves per plant were found to be significantly different due to the combined effect of starter solution and concentration of GA_3 at different days after transplanting (Table 1). It was revealed that the tallest plant (42.37 cm) and maximum (24.05) number of leaves per plant were found in plants treated with 1.5% starter solution + 75 ppm GA_3 (S_2G_3) treatments. The lowest plant height (10.23 cm) and minimum number of leaves per plant (6.10) were observed from the control treatment (S_0G_0). Plant height was significantly different from the beginning to harvest due to the use of starter solution and GA_3 .

Days to head formation, Days to head maturity, Number of loose leaves/plant, Number of folded leaves/plant, Length of stem (cm) and Fresh weight of stem (g): 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) were significantly influenced by the starter solution. The minimum days to head formation (44.45 days), days to head maturity (70.77) and the maximum number of loose leaves/plant (15.93), number of folded leaves/plant (39.43), length of stem (6.59cm) as well as fresh weight of stem (48.29g) were obtained from the treatment of 1.5% starter solution. The days to head formation and days to head maturity where it showed the minimum number of loose leaves/plant, number of folded leaves/plant, length of stem (cm) and fresh weight of stem (g) were found in the control treatments.

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) were significantly varied with the application of GA_3 . The minimum days to head formation (43.54 days), days to head maturity (69.95) and the maximum number of loose leaves/plant (16.47), number of folded leaves/plant (39.95), length of stem (6.52cm) as well as fresh weight of stem (46.30g) were obtained from the treatment of GA_3 solution. The maximum days to head formation and days to head maturity where it showed the minimum number of loose

leaves/plant, number of folded leaves/plant, length of stem (cm) and fresh weight of stem (g) were found in the control.

The treatment combinations of starter solution and GA_3 significantly influenced the days to head formation. The minimum days to head formation (40.73 days), days to head maturity (66.53) and the maximum number of loose leaves/plant (18.45), number of folded leaves/plant (41.03), length of stem (6.73 cm) as well as fresh weight of stem (48.51g) were obtained from the treatment of GA_3 solution and 1.5% starter solution. The maximum days to head formation and days to head maturity where it showed the minimum number of loose leaves/plant, number of folded leaves/plant, length of stem (cm) and fresh weight of stem (g) were found in the control (Table 2).

Diameter of stem, number of lateral roots/plant, length of root (cm), fresh weight of root (g)/plant, thickness of head (cm), diameter of head of cabbage (cm): The diameter of stem, number of lateral roots/plant, length of root (cm), fresh weight of root (g)/plant, thickness of head (cm), diameter of head of cabbage had significant variations among the starter solution treatments. The thickest stem (3.05 cm) and the highest number of lateral roots/plant (35.87 cm), length of root (23.89 cm), fresh weight of root (12.61g)/plant, thickness of head (15.69), diameter of head (23.74) were obtained from the treatment of 1.5% starter solution whereas the lowest values were obtained for all the parameters from the control treatment.

Application of GA_3 significantly influenced for all the mentioned parameters. The thickest stem (2.2.83cm) and the highest number of lateral roots/plant(35.08), length of root (23.23cm), fresh weight of root (11.95g)/plant, thickness of head (14.92), diameter of head (23.81), were obtained from the treatment of 75ppm GA_3 (G_3) while the lowest were obtained from the control (G_0) treatment.

The treatment combination of starter solution and GA_3 significantly influenced the thickness of stem. The thickest stem (3.49 cm) was observed in the treatment combination of 1.5% starter solution + 75 ppm GA_3 (S_2G_3) and it was statistically identical with 1.5% starter solution + 50 ppm GA_3 (S_2G_2) treatment. On the other hand, the lowest (1.40 cm) stem diameter was found from no starter solution + 0 ppm GA_3 (S_0G_0) treatment combination (Table 3).

Biomass per plant (kg), gross weight of head (kg), economic yield/plant (kg), dry weight of head (g), yield/plot (kg) and yield (t/ha): Starter solution had significant influence on the biomass production of cabbage (Table 4). The highest biomass per plant (4.06 kg) gross weight of head (3.56kg), economic yield/plant (2.86kg), dry weight of head (170.65kg), yield/plot (45.33kg), and yield t/ha (99.87) were produced by 1.5% starter solution which was statistically similar to 1.0% starter solution while the lowest values were given by the control (S_0) treatment.

The treatment combination of starter solution and GA_3 influenced the biomass production per plant (Table 6). The highest biomass production (4.51 kg), gross weight of head (4.00kg), economic yield/plant (3.32 kg), dry weight of head (195.275g), yield/ Plot (52.41 kg) and yield t/ha (115.66) were obtained from the treatment combination of 1.5% starter solution + 50 ppm GA_3 (S_2G_2) followed by

the treatment combination of 1.5% starter solution + 75 ppm GA₃ (4.20 kg). The lowest production on all the parameters was observed in the control treatment (S₀G₀).

Economics analysis: The total cost of production per hectare ranged between Tk. 69750 to Tk. 76224. Among treatments, the variation was due to the cost of different

concentration of starter solution and different concentration of GA₃ (Table 7). The highest cost of production of Tk. 76224 was involved in 1.0% starter solution + 75 ppm GA₃ (S₁G₃), 1.5% starter solution + 75 ppm GA₃ (S₂G₃) and 2.0% starter solution + 75 ppm GA₃ (S₃G₃) treatment.

Table 1. Combined effect of starter solution and GA₃ on the plant height of cabbage

Starter solution × Conc. of GA ₃	Plant height (cm) at different days after planting					Number of leaves at different days after planting				
	8	16	24	32	40	8	16	24	32	40
	DAT	DAT	DAT	DAT	DAT	DAT	DAT	DAT	DAT	DAT
S ₀ G ₀	10.23	14.16	17.77	20.41	27.31	6.10	9.47	10.50	12.03	14.10
S ₀ G ₁	10.34	14.15	18.43	21.93	30.75	6.11	9.36	10.51	12.14	16.54
S ₀ G ₂	10.36	14.15	18.67	22.37	34.1	6.11	9.38	10.47	12.28	18.22
S ₀ G ₃	10.27	14.14	18.98	23.18	35.91	6.11	9.28	10.52	12.59	18.30
S ₁ G ₀	10.87	16.71	23.78	27.06	33.92	7.53	10.21	12.03	15.64	18.03
S ₁ G ₁	10.92	16.84	24.52	29.14	37.12	4.53	10.15	12.43	16.07	20.24
S ₁ G ₂	10.98	16.85	26.03	30.58	38.32	7.55	10.31	12.61	16.43	21.17
S ₁ G ₃	10.92	16.84	26.32	32.32	40.33	7.47	10.26	12.52	16.88	22.03
S ₂ G ₀	11.09	17.56	26.29	31.59	36.13	8.08	11.01	13.86	17.06	20.62
S ₂ G ₁	11.05	17.3	26.73	32.94	37.58	8.04	11.14	13.79	17.25	22.01
S ₂ G ₂	11.07	17.62	26.55	32.93	39.2	8.07	11.28	13.84	18.47	23.95
S ₂ G ₃	11.17	17.77	26.88	32.41	42.37	8.04	11.19	13.81	18.92	24.05
S ₃ G ₀	10.55	15.92	23.98	26.23	33.23	6.93	9.75	12.00	14.53	17.77
S ₃ G ₁	10.58	15.9	24.87	28.32	36.25	7.03	9.74	11.42	15.29	20.14
S ₃ G ₂	10.55	15.92	24.49	28.86	37.72	7.02	9.83	11.44	15.78	20.70
S ₃ G ₃	10.6	15.74	24.74	28	38.2	7.03	9.94	11.55	15.93	21.22
LSD (0.01)	--	1.994	3.674	3.347	5.693	1.252	1.197	2.303	1.914	2.145
CV (%)	4.78	5.52	6.91	5.32	7.01	7.78	5.26	8.79	5.52	4.79

S₀: 0% starter solution (Control), S₁ : 1.0% starter solution, S₂ : 1.5% starter solution, S₃ : 2.0% starter solution, G₀ : 0 ppm GA₃ (Control), G₁ : 25 ppm GA₃, G₂ : 50 ppm GA₃, G₃ : 75 ppm GA₃

Table 2. Combined effect of starter solution and GA₃ on the growth of cabbage

Starter solution × Conc. of GA ₃	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)
S ₀ G ₀	51.87	82.49	10.30	25.12	5.01	31.50
S ₀ G ₁	49.15	81.00	12.20	32.51	5.99	33.51
S ₀ G ₂	46.92	73.11	13.43	37.27	6.05	37.00
S ₀ G ₃	48.24	75.07	12.84	36.95	6.15	37.19
S ₁ G ₀	50.56	78.91	12.37	34.08	5.28	33.10
S ₁ G ₁	45.43	73.01	15.40	38.54	6.51	43.50
S ₁ G ₂	43.35	70.03	17.21	41.24	6.50	47.51
S ₁ G ₃	44.41	71.07	17.83	37.92	6.73	48.05
S ₂ G ₀	50.70	78.03	13.09	36.09	6.00	35.51
S ₂ G ₁	43.74	69.56	15.72	39.63	6.50	48.51
S ₂ G ₂	40.73	66.53	18.45	41.03	6.73	53.63
S ₂ G ₃	42.65	68.94	16.46	40.98	7.13	55.50
S ₃ G ₀	52.35	80.12	11.93	34.28	6.35	37.66
S ₃ G ₁	45.23	71.29	14.13	36.73	6.60	42.87
S ₃ G ₂	43.15	70.13	16.78	40.26	6.81	47.08
S ₃ G ₃	44.40	70.51	15.57	37.99	6.50	48.30
LSD (0.01)	5.768	7.501	1.964	5.254	1.309	4.717
CV (%)	5.53	4.53	5.99	6.34	9.25	4.94

S₀: 0% starter solution (Control), S₁ : 1.0% starter solution, S₂ : 1.5% starter solution, S₃ : 2.0% starter solution, G₀ : 0 ppm GA₃ (Control), G₁ : 25 ppm GA₃, G₂ : 50 ppm GA₃, G₃ : 75 ppm GA₃

Table 3. Combined effect of starter solution and GA3 on the growth and yield of cabbage

Starter solution × Conc. Of GA3	Diameter of stem (cm)	Number of lateral roots/plant	Length root (cm)	Fresh weight roots (g)/plant	Thickness of head (cm)	Diameter of head (cm)
S ₀ G ₀	1.40	25.39	16.84	8.02	12.15	14.77
S ₀ G ₁	1.78	27.40	17.11	8.36	13.09	18.10
S ₀ G ₂	1.86	32.62	18.58	9.02	13.26	20.03
S ₀ G ₃	1.91	31.05	17.25	8.72	13.16	19.03
S ₁ G ₀	1.73	33.34	17.33	9.99	12.84	19.01
S ₁ G ₁	2.37	34.17	18.31	10.45	13.74	22.09
S ₁ G ₂	2.88	35.40	24.89	13.17	14.94	24.35
S ₁ G ₃	2.89	35.62	23.66	11.56	14.58	24.09
S ₂ G ₀	2.33	34.09	20.38	11.43	13.08	19.50
S ₂ G ₁	3.06	35.09	24.67	12.57	16.04	22.34
S ₂ G ₂	3.30	37.01	25.43	13.32	16.97	27.25
S ₂ G ₃	3.49	37.30	25.07	13.13	16.66	25.88
S ₃ G ₀	2.00	30.47	20.41	10.78	12.52	18.30
S ₃ G ₁	2.13	34.12	22.29	10.84	13.63	20.85
S ₃ G ₂	2.84	35.29	24.00	12.29	14.50	23.60
S ₃ G ₃	3.03	34.31	22.25	10.79	14.40	22.25
LSD (0.01)	0.369	3.070	4.359	2.593	2.129	2.808
CV (%)	6.68	4.11	9.18	10.59	6.73	5.86

S₀ : 0% starter solution (Control), S₁ : 1.0% starter solution, S₂ : 1.5% starter solution, S₃ : 2.0% starter solution, G₀ : 0 ppm GA₃ (Control), G₁ : 25 ppm GA₃, G₂ : 50 ppm GA₃, G₃ : 75 ppm GA₃

Table 4. Main effect of starter solution on the yield components and yield of cabbage

Starter solution (%)	Biomass/ plant (kg)	Gross weight of head (kg)	Economic yield/plant (kg)	Dry weight of head (g)	Yield /Plot (kg)	Yield (t/ha)
0	3.28	2.35	1.85	114.15	28.88	66.86
1.0	3.85	3.29	2.53	159.37	41.42	88.97
1.5	4.06	3.56	2.86	170.65	45.33	104.93
2.0	3.55	3.25	2.35	142.12	38.72	95.25
LSD (0.01)	0.411	0.251	0.159	10.98	0.722	3.124

The biomass per plant varied significantly due to GA₃ treatments (Table 5). The maximum biomass per plant (3.96 kg), gross weight of head (3.55 kg), economic yield/plant (2.80 kg), dry weight of head (171.95 g), yield/ Plot (45.22 kg) and yield (990.87 t/ha) were produced by 1.5% starter solution while the lowest values were obtained by the control (S₀) treatment.

Table 5. Main effect of GA₃ 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	66.56
25	3.79	2.80	2.27	148.27	37.81	81.23
50	3.96	3.55	2.80	171.95	45.22	104.66
75	3.86	3.43	2.60	150.10	42.57	86.66
LSD (0.01)	0.411	0.251	0.159	10.98	0.722	3.124

The treatment combination of 1.5% starter solution + 50 ppm GA₃ (S₂G₂) gave the highest gross return of Tk. 242660 and net return of Tk. 173775. On the other hand, the lowest gross return of Tk. 114220 and net return of Tk. 44470 were recorded from the control treatment.

The benefit cost ratio (BCR) was found to be the highest (3.52) in treatment combination of 1.5% starter solution + 50 ppm GA₃ (S₂G₂), while the lowest benefit cost ratio (1.64) was recorded from the control treatment.

From the economic point of view, it is apparent from the above results that the application of 1.5% starter solution + 50 ppm GA₃ was much profitable than the rest of the treatments from the soil under the Old Brahmaputra Agro-ecological Zone (AEZ-9).

The results of the experiment revealed that all parameters studied were significantly influenced by starter solution. When 1.5% starter solution was applied, all the characters attained highest values followed by 1.0% and 2.0% starter solutions, respectively. The lowest values in all the parameters were found in the control treatment. Maximum yield/plot (45.33 kg) and yield/ha (104.93 tonnes) were obtained from 1.5% starter solution treatment and the lowest yield/plot (28.88 kg) and yield/ha (66.86 tonnes) were from the control treatment. Application of GA₃ played an important role on the growth and yield of cabbage. Different concentrations of GA₃ significantly influenced all the characters recorded. The maximum, yield/plot (45.22 kg) and yield/ha (104.66 tonnes) were recorded from 50 ppm GA₃. The lowest yield/plot (28.75

kg), yield/ha (66.56 tonnes) were recorded in the control treatment. The combination of starter solution and different concentrations of GA₃ exhibited significant variation for all the parameters studied. Most of the characters expressed maximum values under 1.5% starter solution + 50 ppm GA₃. The maximum yield/plot (52.41 kg) and yield/ha (121.33 tonnes) were noted from the treatment combination of 1.5% starter solution + 50 ppm GA₃. On the other hand, the minimum yield/plot (24.67 kg) and yield/ha (57.11 tonnes) were recorded from on starter solution + 0 ppm GA₃. The maximum cost of

production of Tk. 76224/ha was involved in the treatment combination of 1.0% starter solution + 75 ppm GA₃ (S₁G₃), 1.5% starter solution + 75 ppm GA₃ (S₂G₃) and 2.0% starter solution + 75 ppm GA₃ (S₃G₃) treatment but the highest net return of Tk.173775/ha was obtained from 1.5% starter solution + 50 ppm GA₃ (S₂G₂) treatment. The maximum benefit cost ratio 3.52 was recorded from 1.5% starter solution + 50 ppm GA₃ (S₂G₂) treatment combination.

Table 6. Combined effect of starter solution and GA₃ on the yield components and yield of cabbage

Starter solution × Conc. of GA ₃	Biomass/ plant (kg)	Gross weight of head (kg)	Economic yield/plant (kg)	Dry weight of head (g)	Yield /Plot (kg)
S ₀ G ₀	2.60	2.30	1.61	88.12	24.67
S ₀ G ₁	3.39	2.32	1.67	115.05	26.77
S ₀ G ₂	3.52	2.41	2.10	127.77	33.74
S ₀ G ₃	3.60	2.38	2.00	125.56	30.35
S ₁ G ₀	3.27	2.43	2.00	125.38	30.29
S ₁ G ₁	3.99	2.97	2.30	160.45	39.27
S ₁ G ₂	4.06	3.91	2.91	189.03	48.26
S ₁ G ₃	4.06	3.86	2.90	162.62	47.85
S ₂ G ₀	3.41	3.35	2.11	125.73	31.60
S ₂ G ₁	4.10	2.99	2.90	186.65	46.73
S ₂ G ₂	4.51	4.00	3.32	195.27	52.41
S ₂ G ₃	4.20	3.91	3.11	174.95	49.77
S ₃ G ₀	3.20	2.66	1.90	124.55	28.45
S ₃ G ₁	3.67	2.91	2.21	130.92	37.65
S ₃ G ₂	3.76	3.88	2.89	175.71	46.45
S ₃ G ₃	3.57	3.55	2.40	137.28	42.32
LSD (0.01)	0.829	0.502	0.318	21.96	5.444
CV (%)	9.95	7.15	5.83	6.67	6.28

S₀ : 0% starter solution (Control), S₁ : 1.0% starter solution, S₂ : 1.5% starter solution, S₃ : 2.0% starter solution, G₀ : 0 ppm GA₃ (Control), G₁ : 25 ppm GA₃, G₂ : 50 ppm GA₃, G₃ : 75 ppm GA₃

Table 7. Cost and return of cabbage production due to starter solution and GA₃

Treatment combinations	Total cost of production (Tk.)	Gross return (Tk.)	Net return (Tk.)	Benefit cost ratio (BCR)
S ₀ G ₀	69750	114220	44470	1.64
S ₀ G ₁	61323	123960	62637	2.02
S ₀ G ₂	68661	156180	87519	2.27
S ₀ G ₃	76000	140520	64520	1.85
S ₁ G ₀	53984	140220	86236	2.60
S ₁ G ₁	61547	181800	120253	2.95
S ₁ G ₂	68885	223420	154535	3.24
S ₁ G ₃	76224	221520	145296	2.91
S ₂ G ₀	53984	146280	92296	2.71
S ₂ G ₁	61547	216040	154493	3.51
S ₂ G ₂	68885	242660	173775	3.52
S ₂ G ₃	76224	230440	154216	3.02
S ₃ G ₀	53984	131720	77736	2.44
S ₃ G ₁	61547	174320	112773	2.83
S ₃ G ₂	68885	215040	146155	3.12
S ₃ G ₃	76224	195920	119696	2.57

The findings of the experiment indicated that the yield of cabbage head was greatly improved by starter solution and by different concentrations of GA₃. Head yield was increased due to starter solution and concentration of GA₃ over control. But the highest financial benefit was obtained from 1.5% starter solution along with 50 ppm

GA₃ treated plot. The results obtained from the investigation exhibited a great influence of starter solution and GA₃ on the production of cabbage.

References

- Alam, M. S., T. M. T. Iqbal, M. S. Amin and M. A. Gaffar. 1989. Krishitattik Fasaler Utpadan O Unnayan. T. M. Jabair Bin Iqbal, Vill. Manik Patal, Meghai, Shirajganj. P. 239
- BARC. 1997. Fertilizer Recommendation Guide. Bangladesh Agricultural Research Council, Farmgate, New Airport Road, Dhaka-1215. P. 73.
- Chhonkar, V. S. and R. N. Jha. 1963. The use of starter solutions and plant growth regulators in transplanting of cabbage and their response on growth and yield. *Indian J. Hort.*, 20(2): 122-128.
- Gomez, K. A. and A. A. Gomez. 1984. *Statistical Procedures for Agricultural Research*. Second Edition. A Wiley Inter-Science Production, John Wiley and Sons. New York. P.680
- Islam, M. A., A. Siddiqua and M. A. Kashem. 1993. Effect of growth regulators on the growth, yield and ascorbic acid content of cabbage. *Bangladesh J. Agril. Sci.*, 20(1):21-27.
- Leopold, A. C. 1963. *Auxins and Plant Growth*. Berkeley and Los Angeles. University of California Press. P. 5.
- Nickell, L. G. 1982. *Plant Growth Regulators*. Springer-Verlag Berlin Heidelberg, New York. pp. 1-3.
- Sayre, C. B. 1938. Use of nutrient solution and hormones in the water for transplanting tomatoes and their effect on earliness and total yield. *Proc. Amer. Soc. Hort. Sci.*, 36: 732-736.