



Effect of Planting Date and Gibberellic Acid on the Growth and Yield of Garlic

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Abstract

An experiment was conducted with a local cultivar of garlic to study the effects of planting date and gibberellic acid on the growth and yield of garlic at the field laboratory of the Department of Crop Botany, Bangladesh Agricultural University, Mymensingh during November 2001 to April 2002. Early planting influenced the plant height, leaf number, bulb diameter and total dry matter. With the delay in planting time starting from November 7, the yield was chronologically reduced in later plantings. Significantly the highest bulb yield (2.67 t/ha) was recorded when planting was done on November 7 and lowest yield (0.92 t/ha) was obtained from December 22 planted crop. Bulb yield was higher in control plants than those of GA₃ treated plants. The interaction effects of planting date and different concentrations of GA₃ differed significantly in respect of plant height, number of leaves, bulb diameter and dry weight of roots, leaves and bulbs and yield of garlic.

Keywords: Planting time, gibberellic acid, bulb yield, garlic.

1. Introduction

Garlic (*Allium sativum* L.) is one of the most important spice crops of Bangladesh. The crop is widely cultivated in Bangladesh during the winter season. Its per acre production in Bangladesh is 1187.5 kg which is much lower than that of world average (BBS, 1999). So, Bangladesh has to import garlic every year to meet her domestic demand. This crop is cultivated 32000 acres of land with the production of 38000 metric tons during the year 1998-99 (BBS, 1999). Bulbing of garlic is controlled by the day length and temperature to which the dormant cloves and growing plants are exposed before bulbing begins. Delay of a few weeks in the normal planting date (Mid October) lead to severe losses in yield (Rashim, 1988), Siddique and Rabbani (1985) also reported that growth, bulb size and yield reduce due to delayed planting.

Plant growth regulator like gibberellic acid has been known to play a vital role in bulbing of garlic (Rahim, 1988 and Rahim and Forhad, 1988). It has also been reported that foliar spray of gibberellic acid stimulate to form lateral bud and increases the number of cloves per bulb. Rahim (1988) reported that lower concentrations of gibberellic acid significantly increased both leaf and root dry weight and total yield and higher concentrations of GA₃ showed deleterious effects and reduction in final bulb weight. Therefore, an attempt was made to study the effects of different planting times and concentrations of gibberellic acid (GA₃) on the growth and yield of garlic. Maximum garlic yield (2.87 t/ha) obtained from control plants which planted on November 7 and yield gradually decreased with delaying the planting and GA₃ application.

2. Materials and Methods

The experiment was conducted at the field laboratory of the department of Crop Botany, BAU, Mymensingh during November 2001 to April 2002. The soil of the experimental land was sandy loam in texture and belonged to Old Brahmaputra alluvial type (Sonatala). The experimental plots were fertilized with cowdung, urea, triple super phosphate (TSP) and muriate of potash (MP) at the rate of 14 t, 90 kg, 120 kg and 180 kg/ha respectively (Rahim *et al.*, 1984). The experiment was laid out in the factorial randomized complete block design with three replications. The unit plot size was 2m × 2m. The cloves were planted in rows with 20 cm spacing and 15 cm apart. Four planting dates were November 7, November 22, December 7, December 22, 2001 and concentrations of growth regulator (GA₃) were 0 ppm, 100 ppm and 200 ppm. The cloves of uniform size were selected for planting. Gibberellic acid applied as foliar spray at 30 days after planting as per treatment. Weeding and mulching were done as and when required. Irrigation was provided after each fertilization by a water cane. Five plants randomly collected from each plot at 30 days interval up to 120 DAP for growth parameter. At the final harvest, data were recorded on individual bulb weight, number of cloves per bulb, number of leaves per plant, yield/ha. The collected data were statistically analyzed. The significance of the difference between means were expressed as Least Significant Difference (LSD) at 5% level as the minimum unit of significance.

3. Results and Discussion

3.1. Effects of planting date on the growth and yield of garlic

Effects of planting date on the growth of garlic are presented in table 1. Plant height increased gradually with the advancement of plant age. The cloves which were planted on November 7 had the highest plant height (41.74 cm) at 120 days after planting (DAP). These plants were taller than the other plants those planted on later dates at most of the growth stages, such as 30,

60, 90 and 120 DAP. Plant height was gradually decreased with the delay in planting date and the lowest plant height (33.08 cm) at 120 DAP was obtained from planting in December 22. At all the growth stages early planting produced higher number of leaves per plant and decreased gradually with delay in planting. The plants which were planted on November 7 showed the highest number of leaves per plant (6.62) at 120 DAP. This result is similar to the findings of (Rahim *et al.*, 1984). The diameter of bulb differed significantly by the different planting dates. Plants which were planted on November 7 produced the largest bulb diameter (2.15 cm) at 120 DAP. The lowest diameter of bulb was 1.62 cm obtained from the plants which were planted on December 22. Park and Lee (1989) also reported the similar results. The plants that produced smaller bulb may be explained by the fact that the plants did not receive a long cool growing period, which was essential for proper development of bulbs (Rahim and Forhad, 1988). Early planted plants produced significantly higher dry weight of leaves, bulb and root but they were lower on December 22 planted crop. Higher dry weight of leaf and bulb in early planted crop was possibly due to that led to accumulate more photosynthates during the vegetative growth of plants. Garlic yield differed significantly due to different planting dates. The highest yield was obtained from November 7 planting (Fig. 1). The yield decreased gradually with the delay of planting. This result is similar to the findings of (Chowdhury, 1999 and Rahman, 1998). Highest yield (2.67 t/ha) was obtained from the plants planted on November 7 and lowest yield (0.92 t/ha) was obtained from which planted on December 22. This result is consistent with that of Rahman and Talukder (1986). The largest bulb size from the early planting contributed the highest yield. Smaller bulbs and lower yield was obtained from late planting which did not receive a long cool growing period which was essential for proper development of vegetative growth for garlic (Rahim, 1988).

Table 1. Effect of planting date on growth of garlic plant at different days after planting (DAP)

Treatment	Plant height (cm)				No. of leaves/plant				Bulb diameter (cm)			
	30 DAP	60 DAP	90 DAP	120 DAP	30 DAP	60 DAP	90 DAP	120 DAP	30 DAP	60 DAP	90 DAP	120 DAP
Nov. 07	26.65a	33.9a	41.44a	41.74a	4.486a	5.519a	6.22a	6.62a	0.35a	0.4489a	1.77a	2.15a
Nov. 22	26.4ab	28.36b	34.72b	35.12b	4.206b	4.644b	5.22b	6.4a	0.33b	0.44ab	1.75ab	1.83b
Dec. 07	25.32b	32.81a	34.17b	34.46b	3.911c	4.356c	4.64c	5.49b	0.3089c	0.4122b	1.704b	1.78b
Dec. 22	22.72b	2.61b	31.28c	33.08b	3.381d	3.793d	4.211d	5c	0.2022d	0.3133c	1.56c	1.62c
LSD at 5%	1.086	1.302	0.8739	2.037	0.2395	0.1829	0.3076	0.2492	0.00977	0.3092	0.0309	0.1025

Treatment	Dry weight(g)											
	Weight of leaves/plant				Weight of bulb/plant				Weight of roots/plant			
	30 DAP	60 DAP	90 DAP	120 DAP	30 DAP	60 DAP	90 DAP	120 DAP	30 DAP	60 DAP	90 DAP	120 DAP
Nov. 07	0.1411b	0.2222a	0.9167c	1.759a	0.18a	0.0689a	1.153b	2.916a	0.0244b	0.09778a	0.2233a	0.2278bc
Nov. 22	0.1233c	0.2356a	1.17a	1.657b	0.1344b	0.2478b	1.22a	2.139b	0.0233b	0.07444b	0.2076b	0.2689a
Dec. 07	0.2278a	0.2233a	1.131b	1.67ab	0.0977c	0.2178c	0.6822d	2.119b	0.053a	0.09222a	0.1333c	0.25ab
Dec. 22	0.1022d	0.188b	0.6867d	1.58b	0.09c	0.1444d	0.8922c	1.43c	0.053a	0.07778b	0.1278c	0.2033c
LSD at 5%	0.00977	0.03092	0.09275	0.09275	0.00977	0.00977	0.03092	0.06193	0.00977	0.00977	0.00977	0.03092

In a column, means followed by the common letters do not differ significantly at the 5% level by LSD

Table 2. Effect of planting date on growth of garlic plant at different days after planting (DAP)

Treatment	Plant height (cm)				No. of leaves/plant				Bulb diameter (cm)			
	30 DAP	60 DAP	90 DAP	120 DAP	30 DAP	60 DAP	90 DAP	120 DAP	30 DAP	60 DAP	90 DAP	120 DAP
0 ppm	27.34a	34.6a	37.79a	38.67a	4.142a	4.875a	5.317a	6.33a	0.3258a	0.4208a	1.762a	1.928a
100 ppm	25.16d	31.05b	36.42b	35.75b	3.997ab	4.483b	5.1a	5.769b	0.3042b	0.4075ab	1.699b	1.847ab
200 ppm	23.33c	27.86c	32c	33.12c	3.848b	4.37b	4.808b	5.53c	0.2633c	0.3875b	1.638c	1.765b
LSD at 5%	0.9405	1.127	0.7568	1.764	0.2074	0.1584	0.2664	0.2159	0.008467	0.02677	0.02677	0.0888
Dry weight(g)												
Treatment	Weight of leaves/plant				Weight of bulb/plant				Weight of roots/plant			
	30 DAP	60 DAP	90 DAP	120 DAP	30 DAP	60 DAP	90 DAP	120 DAP	30 DAP	60 DAP	90 DAP	120 DAP
0 ppm	0.2125a	0.238a	1.012a	1.778a	0.124	0.261a	1.018a	0.308a	0.05a	0.11a	0.1908a	0.2783a
100 ppm	0.1208b	0.2092b	0.9917a	1.671b	0.131	0.214b	0.99b	2.175b	0.034b	0.08785b	0.1742b	0.2342b
200 ppm	0.1125b	0.2042b	0.9283b	1.554c	0.122	0.1842c	0.955c	1.969c	0.028b	0.059c	0.153c	0.2c
LSD at 5%	0.00846	0.02677	0.02677	0.08032	0	0.00847	0.2677	0.0598	0.008467	0	0.00847	0.02677

In a column, means followed by the common letters do not differ significantly at the 5% level by LSD

Table 3. Effect of planting date on growth of garlic plant at different days after planting (DAP)

Treatment	Plant height (cm)				No. of leaves/plant				Bulb diameter (cm)				
	30 DAP	60 DAP	90 DAP	120 DAP	30 DAP	60 DAP	90 DAP	120 DAP	30 DAP	60 DAP	90 DAP	120 DAP	
	0ppm	30	36.67a	43.67a	44.36a	4.65	6	6.667	7.24	0.363a	0.46	1.86	2.203
Nov. 07	100ppm	26.207	33.41bc	43a	42.46ab	4.54	5.287	6.333	6.32	0.353a	0.447	1.757	2.22
	200ppm	23.733	31.63bcd	37.67b	38.4cd	4.267	5.27	5.667	6.287	0.333bc	0.44	1.71	2.033
	0ppm	28.91	36.37a	39b	39.28bc	4.233	4.8	5.333	6.253	0.33c	0.433	1.767	1.793
Nov. 22	100ppm	25.967	27.05e	35.5c	32.62ef	4.083	4.633	6.253	0.33c	0.433	0.433	1.653	1.753
	200ppm	24.333	21.67f	28f	28.45g	4.3	4.5	5	5.943	0.31d	0.43	1.633	1.753
	0ppm	26.6	34.02b	35.67c	36.11df	4.133	4.667	4.867	5.817	0.32cd	0.43	1.75	1.88
Dec. 07	100ppm	25.467	32.93bcd	35cd	35.4def	3.967	4.233	4.5	5.423	0.32cd	0.43	1.707	1.777
	200ppm	23.907	31.47cd	33.5de	33.86ef	3.633	4.167	4.567	5.23	0.28e	0.377	1.657	1.89
	0ppm	23.833	31.35cd	32.83e	34.91def	3.553	4.033	4.4	5.267	0.2667e	0.337	1.6	1.673
Dec. 22	100ppm	23	30.82d	32.17e	32.53ef	3.397	3.78	4.233	5.08	0.21f	0.32	1.567	1.6
	200ppm	21.333	26.67e	28.83f	31.78fg	3.193	3.567	4	4.65	0.13g	0.283	1.53	1.583
LSD at 5%	0	2.255	1.514	3.528	0	0	0	0.4317	0.01693	0	0	0	
level of significance	NS	**	**	*	NS	NS	NS	NS	**	NS	NS	NS	

(B) Dry weight (g)

Treatment	Weight of leaves/plant				Weight of bulb/plant				Weight of roots/plant			
	30 DAP	60 DAP	90 DAP	120 DAP	30 DAP	60 DAP	90 DAP	120 DAP	30 DAP	60 DAP	90 DAP	120 DAP
0ppm	0.15b	0.25a	0.9367c	1.92a	0.1767a	0.3067a	1.203	3.113a	0.03cde	0.1333a	0.243	0
Nov. 07 100ppm	0.14b	0.1867bc	0.9133c	1.72bc	0.167a	0.2667b	1.133	3.043a	0.02ef	0.1267ab	0.223	0
200ppm	0.133bcd	0.23ab	0.9c	1.637c	0.1867a	0.2333cd	1.23	2.59b	0.023def	0.033g	0.203	0
0ppm	0.1367bc	0.243ab	1.227a	1.843ab	0.14b	0.2667b	1.137	2.253c	0.04cd	0.09667cb	0.233	0
Nov. 22 100ppm	0.12cde	0.2367ab	1.203a	1.72bc	0.1167c	0.2467c	1.223	2.12d	0.01f	0.0733e	0.217	0
200ppm	0.1133e	0.2267ab	1.093b	1.407d	0.1467b	0.23cd	1.21	2.043d	0.02ef	0.0533f	0.17	0
0ppm	0.123a	0.2367ab	1.147b	1.72bc	0.11c	0.2433cd	0.713	2.253d	0.07a	0.1133bc	0.15	0
Dec. 07 100ppm	0.1167de	0.22ab	1.137b	1.66c	0.1033cd	0.2333cd	0.717	2.083d	0.04667bc	0.08de	0.133	0
200ppm	0.1133e	0.2133ab	1.11b	1.63c	0.08fg	0.1767e	0.617	2.02d	0.0433bc	0.0833de	0.117	0
0ppm	0.11e	0.224ab	0.7367d	1.627c	0.11c	0.2267d	0.92	1.613e	0.07667a	0.09667cd	0.137	0
Dec. 22 100ppm	0.1067ef	0.1933abc	0.7133d	1.583c	0.09df	0.11e	0.887	1.453f	0.06ab	0.07ef	0.123	0
200ppm	0.09f	0.1467c	0.61e	1.543cd	0.07f	0.09667f	0.87	1.223g	0.0233def	0.06667ef	0.123	0
LSD at 5%	0.01693	0.05355	0.05355	0.01693	0.01693	0.01693	0	0.1197	0.01693	0.01693	0	0
level of significance	**	*	*	*	*	**	NS	**	**	**	NS	*

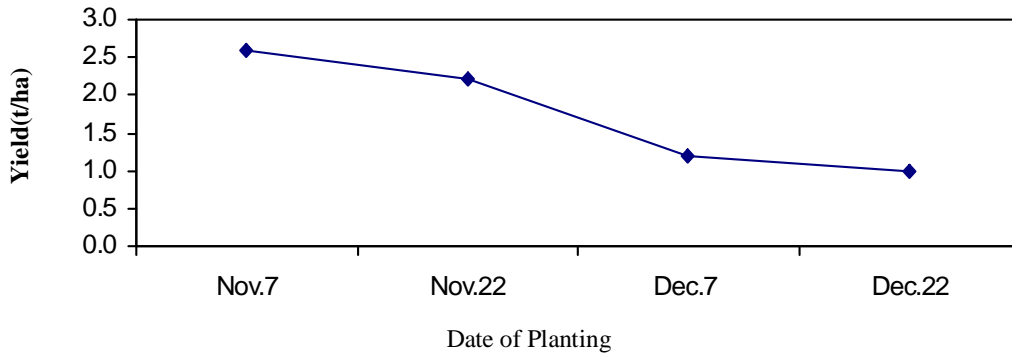


Fig.1 Effect of Planting date on the yield of garlic.

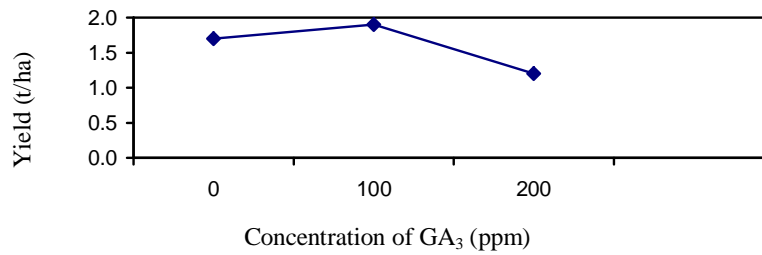


Fig.2 Effect of GA₃ on the yield of garlic.

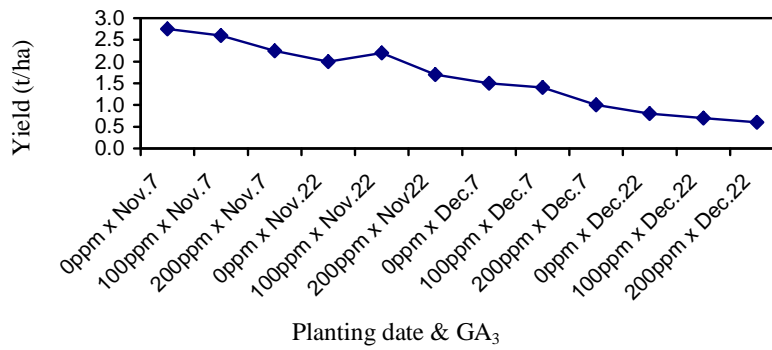


Fig.3 Interaction effects of planting date and GA₃ on the yield of Garlic.

3.2. Effects of gibberellic acid on the growth and yield of garlic

Effects of gibberellic acid on the growth of garlic are presented in table 2. The significantly higher plant height was obtained from the control plants while 100 ppm and 200 ppm of GA₃ reduced the plant height at all the growth stages. Similar result was reported by Ara (1993). Gibberellic acid enhanced rapid leaf proliferation by secondary lateral branching (Takagi and Aoba, 1976). The highest number of leaves was obtained from control plants. The number of leaves decreased gradually with the higher concentration of GA₃. At 120 DAP the control plants produced bulbs of 1.93 cm in diameter while bulb size decreased at higher concentrations of GA₃. Foliar spray of higher concentrations of GA₃ caused reduction in bulb growth (Takagi and Aoba, 1976). Higher concentration of GA₃ showed deleterious effect on leaves, bulbs and roots dry weight. Yield differed significantly due to different concentrations of GA₃. Bulb yield per hectare was higher in control plants than those of GA₃ treated plants (Fig. 2). In the present study 100 ppm and 200 ppm of GA₃ showed deleterious effect on the growth and yield of garlic.

3.3. Effects of interaction between planting date and gibberellic acid on the growth and yield of garlic

The interaction effects of planting date and gibberellic acid on the growth of garlic are presented in table 3. These were significant. From the interaction effect it was observed that control plants which were planted on November 7 gave the higher plant height, number of leaves per plant and bulb diameter than that of late planted with GA₃ treated plants at all the growth stages. Dry weight of leaves, bulb and roots per plant were remarkably influenced by planting date and GA₃. The plants those planted on

November 7, without growth regulator had the highest dry weight. Significantly the highest yield (2.87 t/ha) obtained from the plants those planted on November 7 without application of GA₃ (Fig. 3). The yield of garlic gradually decreased due to late planting with 100 ppm, 200 ppm of GA₃. Significantly higher amount of dry weight of leaves, bulb and root were obtained from control plants and they were lower in GA₃ treated plant in all the growth stages.

4. Conclusions

From the above results it may be concluded that early planting gave the higher yield than that of late planting. In case of gibberellic acid controlled plants produced higher yield than the plants treated with different concentrations. So early planting can influence higher yield without application of GA₃.

5. Acknowledgement

All praises are due to Almighty Allah and the author is thankful to respectable teachers Dr. Md. Shahidur Rahman, Dr. Md. Abdul Karim, Dr. M. Shahidul Haque, Department of Crop Botany, BAU, parents, elder sister, Munni and all wishers.

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