

Effect of Planting Time on Growth, Development and Yield Performance of Ten Garlic Genotypes

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Abstract:

A field experiment was conducted at the USDA Alliums' Project Field Laboratory at Horticulture Farm, Bangladesh Agricultural University, Mymensingh, during November, 2014 to April, 2015 to study the effect of planting time on growth, development and yield performance of ten garlic genotypes. The experiment consisted of two planting time (7 November and 22 November) and ten genotypes of garlic. The genotypes used were BAU-1, BAU-2, BAU-3, BAU-4, G-29, G-30, G-32, G-33, G-35 and G-51. The experiment was laid out in randomized complete block design with three replications. Result showed that plant height (49.99 cm), number of leaves per plant (6.78), length of leaves (30.74 cm), bulb fresh weight (23.06 g), bulb dry weight (5.94 g), bulb length (3.36 cm), bulb diameter (3.44 cm), number of cloves per bulb (22.88), bulb yield per plot (2.01 kg) and bulb yield per hectare (10.01 ton) were recorded maximum from 7 November planting. These parameters were recorded minimum in 22

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November planting. It was also found that BAU-3 produced the highest bulb yield per hectare (12.20 ton) followed by G-29 (11.20 ton). The lowest bulb yield per hectare (5.20 ton) was obtained from G-32. The highest bulb yield per hectare (14.30 ton) was observed in the treatment combination of planting time 1 (7 November) with BAU-3. The lowest bulb yield per hectare (4.70 ton) was observed in the treatment combination of planting time 2 (22 November) with G-32. It can be concluded that BAU-3 genotype would give better growth and higher bulb yield if it is planted by early of November.

Key words: Planting time, Genotypes, Garlic, Yield

INTRODUCTION

Garlic (*Allium sativum* L.) is a bulbous plant and monocot (Swiader, 1994) belonging to the family Alliaceae, it is one of the most aromatic herbaceous annual spices (Kurian, 1995). Garlic is widely used as valuable spice for different dishes around the world for its pungent flavor as a seasoning or condiment. Garlic has been found to have antibacterial, antiviral and antifungal activities. It is also claimed to help in prevention heart disease (including atherosclerosis, high cholesterol and high blood pressure) and cancer. Planting time plays an important role on the growth and yield of garlic. Garlic is known to be thermo and photo-sensitive crop (Jones and Mann, 1963) and its vegetative growth and bulb formation are greatly influenced by growing environment (Rahim and Fordham, 1988). Use of high yielding cultivar is the most important consideration for cultivation of any crop. The production of garlic can be greatly increased by identifying and adopting suitable genotypes for particular area. Therefore, the present investigation was undertaken to study the effect of planting time on growth, development and yield performance of ten garlic genotypes.

MATERIALS AND METHODS

The experiment was conducted at USDA Alliums' Project Field Laboratory in Horticulture Farm, Bangladesh Agricultural University, Mymensingh, during November, 2014 to April, 2015, to study the effect of planting time on growth, development and yield performance of ten garlic genotypes. The experiment consisted of two factors. Factor A: Two planting Time i) 7 November, ii) 22 November and Factor B: Ten Genotypes of garlic i) BAU-1, ii)BAU-2, iii) BAU-3,iv) BAU-4,v) G-29, vi) G-30, vii) G-32, viii) G-33, ix) G-35, x) G-51.The experiment was laid out in a randomized complete block design with three replications. The experimental land was first divided into three blocks, each containing 20 plots. Thus, there were in total 60 plots for this experiment. The size of unit plot was 2m x 1m.One hundred cloves were planted in each unit plot maintaining spacing of 20cm x 10cm. Intercultural operations such as gap filling, weeding, irrigation, insecticide and fungicide application were practiced when necessary. Five plants were selected randomly from each unit plot for the collection of data during growth stages of plants.Data were collected at 90, 105, 120 and 135 days after planting (DAP) in respect of plant height, bulb fresh weight, bulb length, bulb diameter, number of cloves per bulb, bulb yield per plot and bulb yield per hectare. The collected data from the experimental plot on yield and yield contributing characters were compiled and analyzed using MSTAT-C package program.

RESULTS AND DISCUSSION

Effect of planting time

The effect of planting time on plant height, bulb fresh weight, bulb length, bulb diameter, number of cloves per bulb, bulb yield per plot and bulb yield per hectare was significant. Result

revealed that delayed planting decreased plant height at different growth stages. The tallest plant was recorded at planting time 1 (7 November) in all growth stages (41.78, 45.71, 48.68 and 49.99 cm for 90, 105, 120 and 135 DAP, respectively). In contrast, the shortest plant was recorded at planting time 2 (22 November) in all growth stages (39.91, 43.50, 46.70 and 48.22 cm for 90, 105, 120 and 135 DAP, respectively). The higher bulb fresh weight was recorded at planting time 1 (7 November) in all growth stages (10.51, 16.59, 20.61 and 23.06 g for 90, 105, 120 and 135 DAP, respectively). In contrast, the lower bulb fresh weight was recorded at planting time 2 (22 November) in all growth stages (9.61, 14.81, 18.80 and 21.28 g for 90, 105, 120 and 135 DAP, respectively). The higher length of bulb was recorded at planting time 1 (7 November) in all growth stages (1.91, 2.46, 2.99 and 3.36 cm for 90, 105, 120 and 135 DAP, respectively). In contrast, the lower length of bulb was recorded at planting time 2 (22 November) in all growth stages (1.74, 2.17, 2.83 and 3.15 cm for 90, 105, 120 and 135 DAP, respectively). The higher diameter of bulb was recorded at planting time 1 (7 November) in all growth stages (2.13, 2.61, 3.10 and 3.44 cm for 90, 105, 120 and 135 DAP respectively). In contrast, the lower diameter of bulb was recorded at planting time 2 (22 November) in all growth stages (1.99, 2.51, 3.02 and 3.38 cm for 90, 105, 120 and 135 DAP, respectively). The highest number of cloves per bulb was observed from planting time 1 (7 November) at all growth stages (11.82, 16.30, 20.54 and 23.21 per plant at 90, 105, 120, and 135 DAP respectively). On the other hand, the lowest number of cloves per bulb was observed from planting time 2 (22 November) at all growth stages (11.44, 14.77, 18.47 and 22.42 per plant at 90, 105, 120, and 135 DAP respectively). It was found that the yield per plot was greater in planting time 1 (2.01 kg) compared to planting time 2 (1.79 kg) and the yield per hectare was greater in

planting time 1(10.01 ton) compared to planting time 2 (8.24 ton).

Table 1. Main effect of planting time on plant height of garlic

Planting time	Plant height (cm) at different days after planting			
	90	105	120	135
Plant time 1	41.78	45.71	48.68	49.99
Plant time 2	39.91	43.50	46.70	48.22
LSD0.05	0.295	0.329	0.178	0.229
LSD0.01	0.397	0.443	0.239	0.308
Level of significance	**	**	**	**

Note: ** = Significant at 1% level of significance

Table 2. Main effect of planting time on fresh weight of bulb of garlic

Planting time	Fresh weight of bulb at different days after planting			
	90	105	120	135
Planting time 1	10.51	16.59	20.61	23.06
Planting time 2	9.61	14.81	18.80	21.28
LSD0.05	0.064	0.057	0.138	0.132
LSD0.01	0.086	0.077	0.186	0.178
Level of significance	**	**	**	**

Note: ** = Significant at 1% level of significance

Table 3. Main effect of planting time on length of garlic bulb at different days after planting

Planting time	Length of bulb (cm) at different days after planting			
	90	105	120	135
Planting time 1	1.91	2.46	2.99	3.36
Planting time 2	1.74	2.17	2.83	3.15
LSD0.05	0.01	0.04	0.01	0.02
LSD0.01	0.02	0.05	0.02	0.03
Level of significance	**	**	**	**

Note: ** = Significant at 1% level of significance

Table 4. Main effect of planting time on diameter of garlic bulb at different days after planting

Planting time	Diameter of bulb (cm) at different days after planting			
	90	105	120	135
Planting time 1	2.13	2.61	3.10	3.44
Planting time 2	1.99	2.51	3.02	3.38
LSD0.05	0.03	0.04	0.01	0.01
LSD0.01	0.05	0.05	0.02	0.01
Level of significance	**	**	**	**

Note: ** = Significant at 1% level of significance

Table 5. Main effect of planting time on number of clove per garlic bulb

Planting time	Number of clove per bulb at different days after planting			
	90	105	120	135
Planting time 1	11.82	16.30	20.54	23.21
Planting time 2	11.44	14.77	18.47	22.42
LSD0.05	0.049	0.214	0.104	0.120
LSD0.01	0.067	0.288	0.140	0.162
Level of significance	**	**	**	**

Note: ** = Significant at 1% level of significance

Table 6. Main effect of planting time on yield of garlic

Planting time	Yield of Bulb(Kg/Plot)	Yield of Bulb(t/ha)
Planting time 1	2.014	10.01
Planting time 2	1.790	8.24
LSD0.05	0.023	0.081
LSD0.01	0.031	0.109
Level of significance	**	**

Note: ** = Significant at 1% level of significance

Effect of garlic genotypes

Different garlic genotypes showed highly significant variation in respect of plant height, bulb fresh weight, bulb length, bulb diameter, number of cloves per bulb, bulb yield per plot and bulb yield per hectare. It was observed that BAU-3 produced the highest plant height (58.73 cm) at 135 DAP. On the other hand, the lowest plant height (30.54 cm) were found in G-32 at 90 DAP. It was also observed that BAU-3 produced maximum

fresh weight(29.22 g), length(3.81 cm), diameter of bulb(4.20 cm), no. of cloves per bulb(32.10), yield of bulb per plot (2.64 kg), yield of bulb per hectare(12.20 ton). On the other hand G-32 produced minimum fresh weight(16.87 g), diameter of bulb(1.25 cm), yield of bulb per plot (1.04 kg), yield of bulb per hectare(5.20 ton). G-35 produced minimum length of bulb(1.22 cm). BAU-4 (7.50) produced minimum no. of cloves per bulb.

Table 7. Main effect of garlic genotypes on plant height

Genotypes	Plant height (cm) at different days after planting			
	90	105	120	135
BAU-1	47.08	50.66	55.25	57.31
BAU-2	36.45	39.01	41.79	43.70
BAU-3	48.91	53.89	56.60	58.73
BAU-4	42.16	45.60	48.89	49.65
G-29	39.32	42.77	45.43	45.36
G-30	40.05	43.81	46.01	48.41
G-32	30.54	34.66	38.86	40.84
G-33	45.10	49.81	52.29	53.60
G-35	37.52	40.72	43.89	44.77
G-51	41.35	45.13	47.90	48.72
LSD0.05	0.661	0.738	0.398	0.514
LSD0.01	0.892	0.995	0.537	0.693
Level of significance	**	**	**	**

Note: ** = Significant at 1% level of significance

Table 8. Main effect of genotypes on fresh weight of garlic bulb

Genotypes	Fresh weight of bulb at different days after planting			
	90	105	120	135
BAU-1	10.12	14.99	19.88	23.72
BAU-2	9.79	12.79	17.94	21.91
BAU-3	15.11	19.95	25.53	29.22
BAU-4	11.40	16.56	17.98	19.55
G-29	13.15	20.57	26.36	27.16
G-30	10.47	16.88	21.22	21.61
G-32	5.92	11.71	14.60	16.87
G-33	8.01	16.65	20.80	24.69
G-35	7.01	11.35	14.97	17.21
G-51	9.60	15.59	17.82	19.76
LSD0.05	0.143	0.128	0.309	0.296
LSD0.01	0.193	0.173	0.417	0.399
Level of significance	**	**	**	**

Note: ** = Significant at 1% level of significance

Table 9. Main effect of genotypes on length of garlic bulb at different days after planting

Genotypes	Length of bulb (cm) at different days after planting			
	90	105	120	135
BAU-1	1.67	2.42	3.10	3.72
BAU-2	1.99	2.38	3.03	3.04
BAU-3	2.11	2.47	3.25	3.81
BAU-4	1.75	2.27	3.15	3.48
G-29	2.19	2.32	3.05	3.27
G-30	1.98	2.28	2.90	3.17
G-32	1.90	2.11	2.21	2.73
G-33	1.93	2.42	2.95	3.22
G-35	1.22	2.26	2.46	2.85
G-51	1.54	2.24	3.00	3.31
LSD _{0.05}	0.03	0.09	0.03	0.05
LSD _{0.01}	0.05	0.12	0.05	0.07
Level of significance	**	**	**	**

Note: ** = Significant at 1% level of significance

Table 10. Main effect of genotypes on bulb diameter of garlic at different days after planting

Genotypes	Diameter of bulb (cm) at different days after planting			
	90	105	120	135
BAU-1	2.62	3.09	3.51	4.01
BAU-2	2.21	2.74	3.20	3.50
BAU-3	2.74	3.37	3.85	4.20
BAU-4	1.95	2.55	2.91	3.31
G-29	2.05	2.52	3.04	3.49
G-30	2.09	2.53	3.34	3.50
G-32	1.25	1.88	2.28	2.66
G-33	2.01	2.30	2.90	3.39
G-35	1.86	2.18	2.58	2.94
G-51	1.88	2.42	2.99	3.15
LSD _{0.05}	0.08	0.09	0.03	0.01
LSD _{0.01}	0.11	0.13	0.05	0.01
Level of significance	**	**	**	**

Note: ** = Significant at 1% level of significance

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Table 11. Main effect of genotypes on number of clove per garlic bulb

Genotypes	Number of clove/bulb at different days after planting			
	90	105	120	135
BAU-1	10.00	12.90	17.40	20.70
BAU-2	11.30	14.57	18.50	21.97
BAU-3	16.50	23.80	28.47	32.10
BAU-4	7.50	11.20	14.20	16.67
G-29	11.10	14.90	18.50	22.17
G-30	13.00	17.90	21.30	24.87
G-32	10.70	13.30	17.60	21.00
G-33	11.60	14.10	18.00	21.50
G-35	11.00	13.70	17.70	21.20
G-51	13.60	19.00	23.40	26.00
LSD0.05	0.111	0.479	0.234	0.269
LSD0.01	0.150	0.646	0.315	0.363
Level of significance	**	**	**	**

Note: ** = Significant at 1% level of significance

Table 12. Main effect of genotypes on yield of garlic

Genotypes	Yield of Bulb(Kg/Plot)	Yield of Bulb(t/ha)
BAU-1	2.08	10.08
BAU-2	1.99	9.53
BAU-3	2.64	12.20
BAU-4	1.61	7.81
G-29	2.35	11.20
G-30	2.02	9.96
G-32	1.04	5.20
G-33	2.13	10.40
G-35	1.20	6.00
G-51	1.96	8.89
LSD0.05	0.052	0.181
LSD0.01	0.071	0.244
Level of significance	**	**

Combined effect of planting time and garlic genotypes

Significant combined effects were found due to the combinations of different genotypes and planting time in respect of growth stage with some yield contributing character. The highest (59.65 cm) and the lowest (29.94 cm) plant height were recorded from the treatment combination of BAU-3 at 135 DAP with planting time 1 and G-32 at 90 DAP with planting

time 2 respectively. When the plants were grown under treatment combination of planting time 1 with BAU-3, it produced the maximum fresh weight(30.14 g), length(3.91 cm), diameter of bulb(4.23 cm), number of cloves per bulb (32.40), yield of bulb per plot (2.86 ton) and yield of bulb per hectare(14.30 ton). Whereas the minimum fresh weight (16.40), length (2.63), diameter of bulb (2.63), yield of bulb per plot (0.94 ton) and yield of bulb per hectare(4.70 ton) were grown under treatment combination of planting time 2 with G-32. On the other hand, number of cloves per bulb was grown under treatment combination of planting time 2 with BAU-4 (16.20).

Table 13. Combined effect of planting time and genotypes on plant height of garlic

Treatment combination		Plant height (cm) at different days after planting			
		90	105	120	135
Planting time 1	BAU-1	48.29	51.64	56.87	58.34
	BAU-2	37.44	39.91	42.56	44.87
	BAU-3	49.17	54.95	57.43	59.65
	BAU-4	43.48	47.48	49.86	50.94
	G-29	40.16	43.51	46.22	46.42
	G-30	40.79	44.45	46.73	49.03
	G-32	31.13	35.21	39.49	41.31
	G-33	46.35	51.33	53.16	54.39
	G-35	38.74	41.96	45.18	45.68
	G-51	42.28	46.61	49.29	49.29
Planting time 2	BAU-1	45.87	49.68	53.62	56.27
	BAU-2	35.46	38.11	41.02	42.52
	BAU-3	48.64	52.83	55.77	57.80
	BAU-4	40.83	43.72	47.91	48.36
	G-29	38.47	42.02	44.64	44.30
	G-30	39.31	43.16	45.28	47.79
	G-32	29.94	34.10	38.22	40.36
	G-33	43.85	48.28	51.42	52.81
	G-35	36.29	39.48	42.59	43.85
	G-51	40.42	43.65	46.51	48.14
LSD0.05		0.939	1.047	0.565	0.729
LSD0.01		1.266	1.412	0.762	0.983
Level of significance		*	*	**	*

Note: ** = Significant at 1% level of significance, * = Significant at 5% level of significance

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Table 14. Combined effect of planting time and genotypes on fresh weight of garlic bulb at different days after planting

Treatment combination		Fresh weight of garlic bulb (g) at different days after planting			
		90	105	120	135
Planting time 1 (7 November)	BAU-1	10.63	15.60	20.66	25.04
	BAU-2	10.32	13.55	18.43	22.38
	BAU-3	15.65	21.65	26.24	30.14
	BAU-4	12.02	17.34	19.18	20.57
	G-29	13.55	21.72	27.35	28.41
	G-30	10.91	17.87	21.88	22.68
	G-32	6.12	12.71	15.31	17.34
	G-33	8.36	17.40	21.83	26.17
	G-35	7.60	11.88	15.82	17.52
	G-51	9.92	16.20	19.42	20.34
Planting time 2 (22 November)	BAU-1	9.62	14.38	19.09	22.39
	BAU-2	9.26	12.03	17.46	21.44
	BAU-3	14.56	18.25	24.82	28.30
	BAU-4	10.78	15.78	16.78	18.54
	G-29	12.75	19.41	25.36	25.91
	G-30	10.03	15.88	20.56	20.53
	G-32	5.71	10.71	13.89	16.40
	G-33	7.67	15.89	19.76	23.22
	G-35	6.42	10.82	14.11	16.91
G-51	9.28	14.99	16.21	19.18	
LSD0.05	0.20	0.18	0.43	0.42	
LSD0.01	0.27	0.24	0.59	0.56	
Level of significance	**	**	**	**	

Note: ** = Significant at 1% level of significance

Table 15. Combined effect of planting time and genotypes on length of garlic bulb at different days after planting

Treatment combination		Length of bulb (cm) at different days after planting			
		90	105	120	135
Planting time 1 (7 November)	BAU-1	1.76	2.57	3.16	3.84
	BAU-2	2.11	2.54	3.13	3.07
	BAU-3	2.25	2.69	3.33	3.91
	BAU-4	1.88	2.48	3.22	3.74
	G-29	2.32	2.49	3.11	3.38
	G-30	2.05	2.33	2.94	3.26
	G-32	1.91	2.17	2.33	2.83
	G-33	1.95	2.59	3.04	3.33
	G-35	1.27	2.34	2.55	2.91
	G-51	1.62	2.39	3.11	3.38
Planting time 2 (22 November)	BAU-1	1.58	2.24	3.04	3.59
	BAU-2	1.86	2.22	2.92	3.00
	BAU-3	1.97	2.27	3.16	3.71
	BAU-4	1.61	2.06	3.08	3.23
	G-29	2.05	2.15	3.00	3.16
	G-30	1.91	2.22	2.86	3.08
	G-32	1.88	2.06	2.08	2.63

Joysen Shuvra, Mokter Hossain, Musfiqur Rahman, Uzzal Shaha- **Effect of Planting Time on Growth, Development and Yield Performance of Ten Garlic Genotypes**

	G-33	1.91	2.24	2.86	3.11
	G-35	1.16	2.17	2.36	2.78
	G-51	1.46	2.10	2.89	3.24
LSD0.05		0.05	0.12	0.05	0.07
LSD0.01		0.07	0.17	0.07	0.10
Level of significance		**	**	**	**

Note: ** = Significant at 1% level of significance

Table 16. Combined effect of planting time and genotypes on bulb diameter of garlic at different days after planting

Treatment combination		Diameter of bulb (cm) at different days after planting			
		90	105	120	135
Planting time 1 (7 November)	BAU-1	2.62	3.07	3.58	4.04
	BAU-2	2.44	2.96	3.25	3.57
	BAU-3	2.82	3.42	3.89	4.23
	BAU-4	1.98	2.62	2.96	3.35
	G-29	2.08	2.54	3.07	3.52
	G-30	2.15	2.56	3.38	3.52
	G-32	1.39	1.91	2.30	2.68
	G-33	2.06	2.34	2.93	3.41
	G-35	1.90	2.21	2.60	2.94
	G-51	1.90	2.44	3.04	3.16
Planting time 2 (22 November)	BAU-1	2.61	3.10	3.44	3.97
	BAU-2	1.97	2.52	3.15	3.43
	BAU-3	2.65	3.33	3.81	4.16
	BAU-4	1.92	2.48	2.87	3.26
	G-29	2.03	2.49	3.01	3.45
	G-30	2.02	2.50	3.29	3.47
	G-32	1.11	1.84	2.27	2.63
	G-33	1.95	2.27	2.88	3.36
	G-35	1.81	2.15	2.55	2.94
G-51	1.86	2.39	2.93	3.13	
LSD0.05	0.11	0.13	0.05	0.01	
LSD0.01	0.15	0.18	0.07	0.02	
Level of significance	**	**	**	**	

Note: ** = Significant at 1% level of significance

Joysen Shuvra, Mokter Hossain, Musfiqur Rahman, Uzzal Shaha- **Effect of Planting Time on Growth, Development and Yield Performance of Ten Garlic Genotypes**

Table 17. Combined effect of planting time and genotypes of garlic on number of clove per bulb

Treatment combination		Number of clove per bulb at different days after planting			
		90	105	120	135
Planting time 1 (7 November)	BAU-1	10.20	13.80	18.40	21.00
	BAU-2	11.60	15.40	19.40	22.33
	BAU-3	16.80	25.20	29.60	32.40
	BAU-4	7.60	11.60	15.20	17.13
	G-29	11.20	15.80	19.80	22.53
	G-30	13.20	18.20	22.40	25.53
	G-32	10.80	14.00	18.60	21.40
	G-33	11.80	14.80	18.80	21.80
	G-35	11.20	14.40	18.60	21.60
	G-51	13.80	19.80	24.60	26.40
Planting time 2 (22 November)	BAU-1	9.80	12.00	16.40	20.40
	BAU-2	11.00	13.73	17.60	21.60
	BAU-3	16.20	22.40	27.33	31.80
	BAU-4	7.40	10.80	13.20	16.20
	G-29	11.00	14.00	17.20	21.80
	G-30	12.80	17.60	20.20	24.20
	G-32	10.60	12.60	16.60	20.60
	G-33	11.40	13.40	17.20	21.20
	G-35	10.80	13.00	16.80	20.80
G-51	13.40	18.20	22.20	25.60	
LSD0.05	0.157	0.680	0.332	0.382	
LSD0.01	0.212	0.917	0.448	0.515	
Level of significance	**	**	**	**	

Note: ** = Significant at 1% level of significance

Table 18. Combined effect of planting time and genotypes on yield of garlic

Treatment combination		Yield of Bulb (Kg/Plot)	Yield of Bulb (ton/ha)
Planting time 1 (7 November)	BAU-1	2.20	10.58
	BAU-2	2.06	10.30
	BAU-3	2.86	14.30
	BAU-4	1.68	8.40
	G-29	2.54	12.70
	G-30	2.10	10.52
	G-32	1.14	5.70
	G-33	2.24	11.20
	G-35	1.28	6.40
G-51	2.04	10.08	
Planting time 2 (22 November)	BAU-1	1.96	9.59
	BAU-2	1.92	8.77
	BAU-3	2.42	10.10
	BAU-4	1.54	7.23
	G-29	2.16	9.70
	G-30	1.94	9.40
G-32	0.94	4.70	

Joysen Shuvra, Mokter Hossain, Musfiqur Rahman, Uzzal Shaha- **Effect of Planting Time on Growth, Development and Yield Performance of Ten Garlic Genotypes**

	G-33	2.02	9.60
	G-35	1.12	5.60
	G-51	1.88	7.70
LSD0.05		0.074	0.257
LSD0.01		0.100	0.347
Level of significance		**	**

Note: ** = Significant at 1% level of significance

CONCLUSION

The results of this study showed that growth, development and yield performance of garlic decreased with delayed planting and early planting gave better growth, development and yield performance. Early planted crops availed favorable environment, longer cool period and shorter day-length, which enhanced meristematic elongation of garlic plant resulting maximum plant height and gave better yield. It is also found that on the basis of growth, development and yield performance BAU-3 performed the better result. Among all the genotypes, BAU-3 showed the maximum growth and higher bulb yield.

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