

## Response of garlic (*Allium sativum*) cultivars to different date of sowing in Malwa region of Madhya Pradesh\*

PRATIBHA SINGH<sup>1</sup>, I S NARUKA<sup>2</sup>, S S RATHORE<sup>3</sup>, R P S SHAKTAWAT<sup>4</sup> and P P SINGH<sup>5</sup>

KNK College of Horticulture, Mandsaur, Madhya Pradesh 458 001

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Garlic (*Allium sativum* L.) is the second most important bulb crop of family *Alliaceae*, after onion and used as a spice, flavouring agents and pharmaceutical preparation. In India, garlic is cultivated in 171.45 thousand ha producing 923.25 thousand tonnes with an average yield of 5.23 tonnes/ha (NHRDF 2007). India ranks second in area and production in the world. In Madhya Pradesh it is grown in about 67.50 thousand ha with total production of 5.43 tonnes/ha. Madhya Pradesh ranks first in area and production of garlic in India (NHRDF 2007). Garlic is grown on a larger area in Malwa plateau of Madhya Pradesh but its cultivation is affected by several factors, like selection of cultivar, time of planting, balanced nutrition, hoeing and weeding etc. Among the different factors affecting growth, yield and quality of garlic, time of planting and selection of cultivars appears to be most important factors for maximizing the growth and good quality garlic bulb production. Weather conditions and characters of cultivars considerably influence the sprouting of cloves, growth of plant, bulb initiation, clove differentiation and its development, all exerting effect on yield. Considering all these, an experiment was conducted to study the response of garlic cultivar to different date of sowing in Malwa region of Madhya Pradesh.

An experiment was conducted in winter (*rabi*) season of 2008–09 at research farm of the College, Mandsaur to study the performance of different cultivars of garlic sown on different date of sowing. The soil was light-black loamy in texture with pH 7.1, 0.24 dS/m EC, low in available nitrogen (140 kg/ha), medium in available phosphorus (21 kg/ha) and low in available potassium (144 kg/ha). The experiment was

laid out in split-plot design with 3 replications. The 16 treatment combinations consisted of 4 date of sowing in main plots and 4 cultivars in sub-plots. The 4 cultivars ‘G 1’, ‘G 282’, ‘Amletha’ and ‘Mahadev’ were sown on 4 date of sowing 15 September, 30 September, 15 October and 30 October as per treatment. The crop was planted on ridge at a spacing of 15 cm × 10 cm using recommended dose of fertilizer and cultural practices. Garlic crop was harvested on different dates as per maturity. Estimation of volatile oil content in garlic bulb was done by using essential oil distillation assembly (AOAC 1970) while for ascorbic acid estimation by use of metaphosphoric acid method as suggested by AOAC (1960). The data recorded were subjected to statistical analysis using split-plot design and ANOVA technique suggested by Panse and Sukhatme (1985).

The sowing of 30 September significantly increased the growth attributes like plant height (33.90, 53.81 and 71.85 cm), leaves/plant (5.70, 8.40 and 10.67) at 30, 60 and 90 days after sowing, respectively in comparison to other dates of sowing (Table 1). Significantly higher plant height at 30 and 60 days after sowing, leaves/plant at 30, 60 and 90 days after sowing and chlorophyll content of leaves at 60 and 90 days after sowing were recorded as a result of early date of sowing of garlic, i.e. 30 September as compared to other dates of sowing. These significant variations may be attributed to vigorous vegetative growth which resulted from favourable climatic conditions including temperature, humidity and day length. The vigorous growth in garlic means production of more leaves which helped in the synthesis of more photosynthates and thus resulting in increased accumulation of carbohydrates and other metabolites which ultimately determined the size and weight of bulbs. The most important environment factors are temperature and photoperiod.

The late planting crops (30 October) made poor vegetative growth, thus causing reduced photosynthetic activity due to lesser foliage area which resulted in lower yield of bulbs. The response to date of sowing in terms of overall improvement in growth parameters is further supported by the fact that the climate of the experimental region favours

\*Short note

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<sup>1</sup>Research scholar, MSc (Horticulture), <sup>2</sup>Scientist (e mail: drisnaruka@yahoo.com); <sup>3</sup>Scientist, Department of Plantation and Spice Crops, <sup>3</sup>Scientist (e mail: drssrathore@yahoo.co.in), Department of Biochemistry, <sup>4</sup>Scientist (Agronomy), (e mail: rpssbkn@yahoo.co.in)

Table 1 Effect of different dates of sowing on growth and yield attributes in different garlic cultivars

Treatment	Plant height (cm)			Leaves/plant			Chlorophyll content (mg/g of leaf)		Neck thickness (cm)	Bulb diameter (cm)
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	60 DAS	90 DAS		
<i>Date of sowing</i>										
15 September	31.51	48.98	68.75	5.10	7.46	9.60	0.888	0.985	0.50	4.07
30 September	33.90	53.81	71.85	5.70	8.40	10.67	1.283	1.179	0.75	4.92
15 October	31.98	49.63	70.75	5.33	7.93	9.62	1.010	1.153	0.64	4.75
30 October	29.56	47.45	66.48	5.03	6.53	7.64	0.755	0.706	0.43	3.59
S Em ±	0.538	0.924	0.855	0.116	0.190	0.127	0.0100	0.0119	0.012	0.024
CD (P=0.05)	1.862	3.198	2.960	0.404	0.657	0.442	0.0348	0.0413	0.042	0.083
<i>Cultivar</i>										
'G 1'	31.28	49.86	65.92	5.21	7.38	9.23	0.941	0.998	0.53	4.26
'G 282'	32.77	52.32	73.95	5.51	8.03	9.85	1.107	1.112	0.68	4.53
'Amletha'	30.49	45.55	64.00	5.15	7.03	9.05	0.882	0.873	0.47	4.13
'Mahadev'	32.40	52.14	74.94	5.28	7.88	9.41	1.008	1.041	0.64	4.41
S Em ±	0.585	1.090	1.254	0.089	0.176	0.179	0.0110	0.0118	0.018	0.031
CD (P=0.05)	1.708	3.181	3.662	0.260	0.516	0.552	0.0322	0.0346	0.053	0.093

DAS, Days after sowing

the crop growth. The rise in temperature during the growth period of late planting garlic increases the rate of respiration which results in more utilization of carbohydrates and other products of photosynthesis. Due to this, the lesser quantity of assimilates is available for translocation from source to sink during the bulbing period.

Early date of sowing 30 September significantly increased the yield parameters like neck thickness (0.754 cm), bulb diameter (4.92 cm), number of cloves/bulb (26.58), fresh weight of bulb (41.72 g), dry weight of bulb (15.90 g), fresh weight of 20 cloves (45.41 g), dry weight of 20 cloves (18.49 g) and bulb yield (14.21 tonnes/ha) in comparison to later date of sowing. However, non-significant difference was recorded at 30 September and 15 October date of sowing (Table 1). The early date of sowing significantly influenced the neck thickness, bulb diameter, number of cloves/bulb, fresh weight and dry weight of bulb, fresh weight and dry weight of 20 cloves and bulb yield. The significant improvement in yield attributes of garlic with the date of sowing could be ascribed to overall improvement in vigour and crop growth. Since an early date of sowing is considered important in promoting rapid vegetative growth like plant height, number of leaves/plant and chlorophyll content of leaves, thereby increasing the sink size in terms of bulb size. Thus, vigorous growth in garlic means production of more leaves, which helped in the synthesis of more photosynthates and thus resulting in increased accumulation of carbohydrates and other metabolites which ultimately determined the size, and weight of bulbs. Late planted crops made poor vegetative growth, thus causing reduced photosynthetic activity due to lesser foliage area which resulted lower yield of bulbs in crop planted on 30 October. The results showed that different dates of sowing provided the variable atmosphere to the crop,

thus affecting the yield significantly. Earliest planting gave the highest bulb weight may be due to plant received cool temperature for longer period which possibly increased the vegetative growth and yield of bulb. The present trend of increase in bulb yield of garlic with the early date of sowing is in close conformity with the findings of Rahim *et al.* (2003), Rahman *et al.* (2004).

Early date of sowing, ie 30 September significantly increased the TSS content of bulb, volatile oil content of bulb, moisture content of bulb and ascorbic acid content of bulb under present study. TSS content, volatile oil and ascorbic acid significantly increased with the early date of sowing. This may be due to the vigorous vegetative growth and imparted deep green colour to the foliage which favour higher photosynthetic activity of the plants. So, there was greater accumulation of food material, i e carbohydrates in the bulb and there was more synthesis of TSS content, volatile oil and ascorbic acid content of bulb. Late planted crops, ie 30 October made poor vegetative growth, thus causing reduced photosynthetic activity due to lesser foliage area, which resulted in lower quality of bulb.

Among various cultivars, 'G 282' exhibited maximum plant height at 30, 60 and 90 days after sowing (32.77, 52.32 and 73.95 cm, respectively), leaves/plant (5.51, 8.03 and 9.85) at 30, 60 and 90 days after sowing, respectively. A perusal of data indicated that 'G 282' was significantly superior compared with 'Mahadev', 'G 1' and 'Amletha' with respect to growth parameters, viz plant height and leaves/plant at 30, 60 and 90 days after sowing and chlorophyll content in leaves at 60 and 90 days after sowing. This might be due to difference in their genotypic potential and adaptability to soil and climate. The variation in plant height and number of leaves, which are indication of the growth, might be due to

Table 2 Effect of different dates of sowing on growth and yield attributes in different garlic cultivars

Treatment	Cloves/ bulb	Weight of bulb (g)		Weight of 20 cloves (g)		Bulb yield (tonnes/ha)	TSS content of bulb (%)	Volatile oil content of bulb (%)	Moisture content of bulb (%)	Ascorbic acid in bulb (mg/g)
		Fresh	Dry	Fresh	Dry					
<i>Date of sowing</i>										
15 September	24.55	30.11	12.05	26.08	12.27	1.22	40.33	0.554	62.70	0.151
30 September	26.58	41.72	15.90	45.41	18.49	14.21	43.75	0.630	60.27	0.189
15 October	25.68	41.20	15.33	40.62	15.08	13.20	41.41	0.588	61.78	0.163
30 October	18.48	20.74	7.60	20.25	8.14	9.32	38.41	0.495	63.05	0.147
S Em ±	0.645	0.917	0.248	1.172	0.453	1.577	0.207	0.0087	1.066	0.0028
CD (P=0.05)	2.233	3.176	0.860	4.058	1.567	5.459	0.716	0.0302	NS	0.0100
<i>Cultivar</i>										
'G 1'	23.93	32.90	12.08	33.91	13.00	1.18	39.75	0.548	61.57	0.153
'G 282'	25.11	37.54	14.10	36.83	16.07	1.32	43.50	0.636	60.93	0.188
'Amletha'	21.78	30.65	11.39	27.20	10.55	1.12	39.41	0.498	63.96	0.140
'Mahadev'	24.46	32.69	13.31	34.41	14.36	1.25	41.25	0.586	61.33	0.170
S Em ±	0.629	1.197	0.410	1.861	0.472	1.593	0.296	0.0102	1.186	0.0035
CD (P=0.05)	1.836	3.494	1.196	5.432	1.379	4.650	0.864	0.0299	NS	0.0104

DAS, Days after sowing

Table 3 Combined effect of different date of sowing on growth and yield attributes of different garlic cultivars

Treatment combination		Chlorophyll content (mg/g leaf)		Neck thickness (cm)	Bulb diameter (cm)	Dry weight (g)		Bulb yield (tonnes/ ha)	Contents in bulb		
Date of sowing	Cultivar	60 DAS	90 DAS			Bulb	20 cloves		TSS (%)	Volatile oil (%)	Ascorbic acid (mg/g)
15 September	'G 1'	0.807	0.887	0.510	3.86	9.93	13.16	11.18	40.00	0.542	0.147
15 September	'G 282'	1.030	1.180	0.573	4.45	14.40	14.76	13.34	43.00	0.639	0.170
15 September	'Amletha'	0.773	0.853	0.407	3.79	10.33	7.50	11.65	38.00	0.488	0.137
15 September	'Mahadev'	0.943	1.020	0.517	4.17	13.53	13.66	12.67	40.33	0.456	0.150
30 September	'G 1'	1.260	1.210	0.687	4.92	16.73	16.83	13.92	42.00	0.615	0.167
30 September	'G 282'	1.490	1.277	0.887	5.07	17.06	22.82	15.80	46.00	0.658	0.233
30 September	'Amletha'	1.107	1.013	0.581	4.73	12.86	14.66	12.67	41.66	0.602	0.153
30 September	'Mahadev'	1.277	1.217	0.863	4.95	16.96	19.66	14.42	45.33	0.646	0.203
15 October	'G 1'	0.967	1.180	0.627	4.77	14.33	14.00	13.39	40.33	0.574	0.157
15 October	'G 282'	1.087	1.210	0.707	4.86	15.93	17.66	13.74	43.66	0.644	0.183
15 October	'Amletha'	0.933	1.033	0.583	4.57	15.40	13.00	12.46	41.33	0.519	0.140
15 October	'Mahadev'	1.053	1.190	0.653	4.82	15.66	15.66	13.21	40.66	0.616	0.173
30 October	'G 1'	0.730	0.717	0.317	3.50	7.33	8.03	8.84	37.00	0.461	0.140
30 October	'G 282'	0.820	0.780	0.570	3.76	9.03	9.03	10.10	41.33	0.601	0.163
30 October	'Amletha'	0.713	0.590	0.311	3.42	6.96	7.03	8.35	36.66	0.381	0.130
30 October	'Mahadev'	0.757	0.737	0.527	3.69	7.10	8.46	10.00	38.66	0.537	0.153
S Em ±		0.0191	0.0205	0.0317	0.055	0.710	0.818	2.759	0.512	0.0178	0.0061
CD (P=0.05)		0.0559	0.0599	0.0927	0.161	2.072	2.388	8.054	1.496	0.0519	0.0180

DAS, Days after sowing

varietal behaviour in a particular climatic condition.

'G 282' significantly increased the yield parameters like neck thickness (0.684 cm), bulb diameter (4.53 cm), number of cloves/bulb (25.11), fresh weight of bulb (37.54 g), dry weight of bulb (14.10 g), fresh weight of 20 cloves (36.83 g), dry weight of 20 cloves (16.07 g) and bulb yield (13.24 tonnes/ha) in comparison to other cultivars. Table 1 revealed that yield-attributing characters namely neck thickness, bulb

diameter, number of cloves/bulb, fresh weight of bulb, dry weight of bulb, fresh weight of 20 cloves and dry weight of 20 cloves were higher in 'G 282' as compared to 'Mahadev', 'G 1', 'Amletha' which might be due to variation in genetic potential of the cultivar. The higher value for growth parameters recorded in cultivar G 282 is one of the reasons to contribute directly or indirectly towards yield and yield-attributing characters. These results are in close conformity

with the findings of Rahim *et al.* (2003).

A perusal of data indicated that 'G 282' was significantly superior in respect to quality attributes. The TSS, volatile oil, moisture and ascorbic acid content of bulb was higher in the 'G 282' as compared to 'Mahadev', 'G 1' and 'Amletha'. This might be due to the difference in their genotypic potential and adaptability to soil and climate. (Table 2).

The interaction effect of date of sowing and cultivar was found significant for chlorophyll content in leaves at 60 and 90 days after sowing, neck thickness, bulb diameter, dry weight of bulb, dry weight of 20 cloves, bulb yield, and quality attributes, like TSS content, volatile oil content and ascorbic acid content of bulb. Maximum value for chlorophyll content in leaves at 60 and 90 days after sowing, neck thickness, bulb diameter, dry weight of bulb, dry weight of 20 cloves, bulb yield, TSS content, volatile oil content and ascorbic acid content were observed with treatment combination cultivar 'G 282' sown on 30 September (Table 3). Although the date of sowing and cultivar independently brought significant increase in yield attributes but interaction of both showed that response to sowing was governed by cultivar and *vice-versa*, exhibiting their interdependence for obtaining higher value of these parameters. Thus, it is clear that 30 September sowing in combination with 'G 282' cultivar showed the positive response regarding the yield and yield-attributing characters as obtained in the present study. Different date of sowing provided the variable atmosphere to the crop thus affecting the yield significantly. Similarly, the variation among the cultivars for different date is due to the fact that these are adapted to variable environments. Similar findings have also been reported by Rahman *et al.* (2004).

## SUMMARY

An experiment was conducted in winter (*rabi*) season of 2008–09 at KNK College of Horticulture, Mandasaur to study the performance of different cultivars of garlic sown on different date of sowing. The 4 cultivars ('G1', 'G 282', 'Amletha' and 'Mahadev') were sown on 4 date of sowing (15 September, 30 September, 15 October and 30 October) using split-plot design. Garlic sown on 30 September recorded significantly higher plant height, number of leaves/plant, neck thickness, bulb diameter, number of cloves/bulb, fresh weight of bulb, dry weight of bulb, fresh weight of 20 cloves, dry weight of 20 cloves and bulb yield. Among different cultivar tried 'G 282' exhibited significantly higher growth, yield and yield attributes. Significantly higher yield of garlic was also obtained sown on 30 September.

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