

Short Note

STUDIES ON SOME GENOTYPES FOR YIELD, QUALITY AND STORAGE IN GARLIC

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Garlic (*Allium sativum* L.) is an important bulbous crop and widely cultivated throughout India. It is highly placed for its flavor enhancing capacity (Roy and Chakraborti, 2002). Garlic has higher nutritive values than other bulbous crops and can also be used for preparation of pickle (Pandey and Singh, 1987). As per FAO estimates for the year 2010, the world area is 1.32 million ha and production is 22.56 million tones. China, India, Korea, Russian Federation, Myanmar, Ethiopia, USA and Egypt are the major garlic growing countries. China ranks first in area and production (7.79 lakhs ha and 179.68 lakh MT respectively). Egypt tops the list (23.83 t ha⁻¹) in productivity followed by China (23.06 t ha⁻¹), USA (18.94 t ha⁻¹), Uzbekistan (16.33 t ha⁻¹) and Republic of Korea (12.67 t ha⁻¹). In India area, production, productivity and per capita availability of garlic have improved by about 72.56, 116.03, 25.19 and 86.55% respectively. As per Horticulture Division, Ministry of Agriculture estimates the annual area under garlic during the year 2010-11 is 1.97 lakh ha and production is 11.31 lakh tones with average productivity of 5.75 t ha⁻¹. Among different states in India, Madhya Pradesh is the leading state accounting for more than 27% of area and 21% of production with average yield of 4.47t ha⁻¹. The productivity in India is quite low (5.75 t ha⁻¹) compared to world average (16.26 t ha⁻¹). The world area, production, productivity and per capita availability trends during the past decade show that during 2009 these have improved by about 37.91, 128.69, 65.83 and 102.77% respectively.

Lack of high yielding varieties of garlic with good keeping quality is one of the main constraints in limiting the production and productivity. Garlic exhibits greater susceptibility to agro-techniques and environmental condition and possesses a wide range of variability on bulb traits and yield attributes as well as the storability in spite of being vegetatively propagated crop. To meet the domestic as well as export

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requirement, selection of suitable genotypes for growing under different agro climatic conditions and better storage quality is required. Sprouting, physiological loss of weight (PLW) and rotting are the main causes of loss during storage. These losses depend on the varieties, type of storage and weather conditions. Therefore it is essential to increase the storage ability of garlic without deterioration of their quality.

The present experiment was carried out at National Horticultural Research and Development Foundation, Regional Research Station, Salaru, Karnal, Haryana during 2007-08 and 2008-09. Nineteen advanced lines including four checks Yamuna Safed (G-1), Agrifound White (G-41), Yamuna Safed-2 (G-50) and Yamuna Safed-3 (G-282) selected from more than three hundred germplasm were evaluated at the centre. Planting of cloves of selected lines were done every year in first fortnight of October in bed size of 3.0 m X 1.5 m. Recommended package of practices were followed to ensure a healthy crop growth and development. The climate of Karnal is subtropical, minimum and maximum temperature ranging between 2⁰C to 45⁰C respectively. Both field as well as storage studies were arranged in randomized complete block design with three replications. Observations were recorded as shown in table 1 and 2. After proper field curing and neck cutting well cured and representative bulbs of same advance lines were kept in storage to identify superior clones for storage under ambient conditions in perforated plastic crates and observations recorded losses due to sprouting, physiological loss of weight (PLW), rotting and total loss monthly for four months. Total soluble solids were measured with hand refractometer. The pooled data for both years of field as well as storage were analyzed to identify the high yielding, processing as well as good keeping quality genotypes. The pooled data of field crop presented in table-1, showed that, the highest gross (16.99 t ha⁻¹) and marketable yield (15.84 t ha⁻¹) were noted for check G-41 and were at par with G-189 (15.64 t ha⁻¹) (14.12 t ha⁻¹) and G-324 (15.98 t ha⁻¹) (14.29 t ha⁻¹). These ranges showed lines which have high gross as well as marketable yield can be utilized in crop improvement for higher yield production. The highest and significant average bulb weight ranged from 33-37.50 g and highest average bulb weight (37.50 g) was noted for G-324 and at par with G-302 (36.50 g), G-366 (36.0 g), G-305 (36.50 g), G-192 (36.00 g), G-264 (35.50 g), G-189 (36.0 g), G-41 (36.0 g) and G-282 (36.50 g). Check G-41 also showed higher and significant bulb size index (16.72 cm²) among all genotypes. Traits clove diameter, clove size index and weight of 50 cloves ranges from 0.96–1.62 cm, 2.49-4.17 cm² and 46-95 g respectively. Highest clove diameter 1.62 cm, clove size index 4.17 cm² and average cloves weight 1.90 g were noted for G-282 and significantly different from other genotypes. Significant lowest cloves per bulb (17.54) were noted for check G-282 and highest number of cloves per bulb was noted for G-4 (40.40). It is noted that increase in bulb weight was associated with increase in plant height, leaves per plant, bulb diameter, bulb size index, number of cloves per bulbs and cloves weight. This is in consonance with the findings of Singh, *et al.*, 2012; Singh, *et al.*, 2012; Dubey and Singh, (2010), Singh *et al.*, (2011), Islam *et al.*, (2004) and Singh and Chand (2003). Total soluble solids and dry matter content ranged from 36.70–39.25% and 38.77–41.14%. Higher total

soluble solids and dry matter content 39.25% and 41.14% was noted for G-200 and G-305 respectively, which was at par with G-189 (38.87%) (40.82%), G-222 (38.35%) (40.21%), G-255 (39.15%) (40.99%) G-304 (38.99%) (40.95%) and G-324 (39.00%) (41.06%). Genotypes which have higher total soluble solids and dry matter content can be utilized for processing purpose (Singh *et al.*, 2011). The minimum bolter (8.12%) was indicated by G-366 and maximum (31.49%) in G-324. Plant height, leaves per plant and neck thickness ranged 86.35–100.23 cm, (7.33–8.73) and 1.43–1.56 cm. Higher plant height (100.23 cm), leaves per plant (8.73) and minimum neck thickness (1.43 cm) were observed for G-324 and G-50 respectively. Lowest stemphylium blight incidence (53.74%) was noted for G-324. The intensity of stemphylium blight ranges from 9.53%-14.40%. Minimum intensity was recorded for G-324. Thrips incidence and nymphs per plant ranged from 91.67–100% and 5.95–7.95%. Lowest thrips incidence (91.67%) and nymphs per plant (5.95) was noted for G-41 and G-366 and it showed non-significant differences regarding thrips incidence.

Pooled data on storage of same year are presented in table-2 and revealed that after one month of storage nil sprouting and decay loss was noted for all genotypes. Lowest physiological loss of weight (1.00%) and total loss also (1.00%) was noted for G-192. After two months of the storage no sprouting was noted and only three genotypes G-302, G-368 and G-282 showed decay loss (1.67%), (0.67%) and (0.84%). Lowest physiological loss of weight 2.50% was recorded in G-4, G-176 and G-192. Lowest total loss 2.50% and maximum 6.34% was recorded in G-4, G-176, G-192 and G-302. After three months of storage only four genotypes *viz.* G-192 (0.34%), G-222 (0.34%) G-302 (0.67) and G-304 (0.50%) showed sprouting. Highest decay loss (1.67%) was noted for G-302. Physiological loss of weight and total loss ranges from 3.67–10.17%. Lowest total loss (3.67%) was noted for genotypes G-200 but maximum losses (10.177%) were indicted by G-369. After four months of storage, sprouting loss did not vary significantly. Only four genotypes showed decay loss *viz.* - G-302 (1.67 %), G-368 (0.67 %), G-369 (1.50 %) and G-282 (0.84 %). Physiological loss of weight was minimum (4.50%) recorded for G-200 and highest loss (13.75%) was noted for G-369. Total loss ranges from 4.50%–15.25%. Lowest total loss (4.50%) was noted for G-200 and was at par with G-4, G-264, G-189, G-176, G-324, G-305, G-366, G-255 and G-50. The highest total loss 15.25% was observed for genotype G-369.

On the basis of both years results considering yield potentiality, quality parameters and other desirable traits, the genotypes G-189 and G-324 were identified as promising germplasm and would be selected for higher yield and quality. For good keeping quality advanced line G-200 performed better and it could be utilized for storage.

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Table-1: Performance evaluation of Garlic (*Allium sativum* L) advanced lines during 2007-09 (Pooled)

Advanced line	Plant height	Neck thickness	Leaves/Plant	Bulb diameter	Bulb size	Av. wt. of bulb	Clove diameter	Clove size	Av. wt. of cloves	cloves/bulbs	Bolters	TSS	DM	Gross yield	Marketable yield	Thrips		Stemphylium Blight	
																Ince.	Nym/pl	Inc.	Int.
	Cm	cm		cm	cm ²	g	cm	cm ²	g		%	%	%	t/ha	t/ha	%		%	%
G-4	88.38	1.45	7.80	4.45	13.92	35.50	1.09	2.89	1.02	40.40	19.00	36.92	39.01	14.77	13.75	100	6.24	60.71	11.32
G-176	89.89	1.45	8.07	4.61	14.07	35.00	1.09	2.80	1.05	32.12	19.60	36.87	38.84	14.71	13.73	100	7.62	60.69	11.65
G-189	92.07	1.51	7.95	4.62	15.50	36.00	0.96	2.56	1.07	35.82	18.33	38.87	40.82	15.64	14.12	100	6.20	60.39	12.85
G-192	91.25	1.51	8.22	4.65	14.32	36.00	1.06	2.67	0.96	40.09	21.87	37.02	39.04	14.37	13.68	100	6.32	60.29	12.99
G-200	94.23	1.49	7.53	4.41	12.98	33.00	1.19	3.11	1.11	30.12	25.95	39.25	41.10	13.01	12.06	100	6.40	56.75	12.07
G-222	92.88	1.43	7.64	4.53	13.38	34.00	1.21	2.85	1.11	32.95	15.05	38.35	40.21	13.79	11.61	100	6.85	57.92	12.60
G-255	94.91	1.51	7.72	4.52	13.52	34.50	1.14	2.72	0.98	40.07	30.82	39.15	40.99	13.25	12.17	100	7.45	63.41	12.32
G-264	94.16	1.49	8.67	4.41	13.84	35.50	1.07	2.49	0.92	36.92	29.07	38.08	40.16	14.46	13.60	100	7.95	62.10	12.27
G-302	90.98	1.54	7.69	4.61	14.58	36.50	1.25	3.40	1.44	25.17	10.54	37.72	39.83	11.47	9.51	100	6.45	60.96	13.29
G-304	94.58	1.49	7.87	4.54	14.06	36.00	1.18	2.77	1.01	39.52	29.50	38.99	40.95	14.66	13.28	100	7.15	57.90	11.37
G-305	86.35	1.50	8.27	4.51	14.70	36.50	1.36	2.89	1.18	28.92	9.83	39.19	41.14	13.95	12.92	98.34	6.87	57.90	10.89
G-324	100.23	1.54	8.73	4.84	15.55	37.50	1.18	3.09	1.18	36.60	31.49	39.00	41.06	15.98	14.29	100	5.97	53.74	9.53
G-366	94.44	1.43	7.33	4.35	14.06	36.00	1.32	3.39	1.35	26.30	8.12	38.29	40.38	13.69	11.75	100	5.95	57.29	11.52
G-368	99.29	1.56	8.65	4.23	13.47	34.00	1.22	2.99	1.09	33.55	19.95	36.70	38.77	10.79	9.69	100	7.92	59.90	10.92
G-369	88.76	1.49	7.77	4.20	11.88	31.50	1.21	3.20	1.23	29.55	12.70	37.17	39.14	9.97	8.65	95	7.75	58.20	11.29
G-1 (C)	93.92	1.47	8.15	4.64	14.63	33.00	0.99	2.51	1.00	40.37	15.59	38.58	40.12	14.37	12.72	100	7.39	60.09	11.80
G-41 (C)	88.93	1.48	8.38	4.76	16.95	36.00	1.14	3.20	1.16	35.09	15.53	38.45	40.38	16.99	15.84	91.67	7.69	63.84	14.40
G-50 (C)	90.38	1.43	7.97	4.39	13.26	32.50	1.08	2.85	0.98	40.29	12.49	38.47	40.44	13.69	12.52	100	7.39	58.17	13.42
G-282 (C)	94.00	1.52	8.37	4.66	15.01	36.50	1.62	4.17	1.90	17.54	13.67	37.33	39.49	14.17	11.84	100	7.34	62.59	14.24
Min.	86.35	1.43	7.33	4.20	11.88	33.00	0.96	2.49	0.92	17.54	8.12	36.70	38.77	9.97	8.65	91.67	5.95	53.74	9.53
Max.	100.23	1.56	8.73	4.84	16.95	37.50	1.62	4.17	1.90	40.40	31.49	39.25	41.14	16.99	15.84	100	7.95	63.84	14.40
S. Em+-	1.94	0.04	0.16	0.13	0.38	1.00	0.05	0.10	0.05	1.75	1.47	0.55	0.51	.873	1.00	3.50	0.82	2.72	0.98
CD at 5%	3.93	0.07	0.32	0.25	0.76	2.00	0.10	0.19	0.11	3.54	2.71	1.11	1.03	1.77	2.03	NS	2.21	4.72	1.98

Table-2: Storage performance of 19 advanced garlic lines during 2007-2009 (Pooled)

Advanced lines	After one month of storage				After two months of storage				After three months of storage				After four months of storage			
	Sprouting	Decay loss	PLW	Total loss	Sprouting	Decay loss	PLW	Total loss	Sprouting	Decay loss	PLW	Total loss	Sprouting	Decay loss	PLW	Total loss
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
G-4	0.00	0.00	1.33	1.33	0.00	0.00	2.50	2.50	0.00	0.00	4.17	4.17	0.00	0.00	5.84	5.84
G-176	0.00	0.00	1.67	1.67	0.00	0.00	2.50	2.50	0.00	0.00	3.84	3.84	0.00	0.00	6.00	6.00
G-189	0.00	0.00	1.50	1.50	0.00	0.00	3.00	3.00	0.00	0.00	4.00	4.00	0.00	0.00	6.33	6.33
G-192	0.00	0.00	1.00	1.00	0.00	0.00	2.50	2.50	0.34	0.00	5.34	5.67	0.34	0.00	7.17	7.50
G-200	0.00	0.00	2.17	2.17	0.00	0.00	3.33	3.33	0.00	0.00	3.67	3.67	0.00	0.00	4.50	4.50
G-222	0.00	0.00	2.17	2.17	0.00	0.00	3.17	3.17	0.34	0.00	5.84	6.17	0.34	0.00	7.50	7.84
G-255	0.00	0.00	1.84	1.84	0.00	0.00	3.00	3.00	0.00	0.00	4.34	4.34	0.00	0.00	5.83	5.83
G-264	0.00	0.00	1.50	1.50	0.00	0.00	3.00	3.00	0.00	0.00	4.42	4.42	0.00	0.00	6.33	6.33
G-302	0.00	0.00	3.17	3.17	0.00	1.67	4.67	6.34	0.67	1.67	7.34	9.67	0.67	1.67	9.67	12.00
G-304	0.00	0.00	1.83	1.83	0.00	0.00	3.34	3.34	0.50	0.00	5.84	6.34	0.50	0.00	8.17	8.67
G-305	0.00	0.00	1.50	1.50	0.00	0.00	3.00	3.00	0.00	0.00	4.84	4.84	0.00	0.00	7.17	7.17
G-324	0.00	0.00	1.83	1.83	0.00	0.00	2.84	2.84	0.00	0.00	5.50	5.50	0.00	0.00	7.34	7.34
G-366	0.00	0.00	2.34	2.34	0.00	0.00	3.17	3.17	0.00	0.00	6.00	6.00	0.00	0.00	6.84	6.84
G-368	0.00	0.00	2.67	2.67	0.00	0.67	3.83	4.50	0.00	0.67	5.67	6.33	0.00	0.67	8.00	8.67
G-369	0.00	0.00	2.84	2.84	0.00	0.00	6.00	6.00	0.00	0.00	10.17	10.17	0.00	1.50	13.75	15.25
G-1 (C)	0.00	0.00	2.00	2.00	0.00	0.00	4.00	4.00	0.00	0.00	6.33	6.33	0.00	0.00	8.17	8.17
G-41 (C)	0.00	0.00	2.50	2.50	0.00	0.00	5.67	5.67	0.00	0.00	7.67	7.67	0.00	0.00	12.17	12.17
G-50 (C)	0.00	0.00	2.17	2.17	0.00	0.00	3.33	3.33	0.00	0.00	5.50	5.50	0.00	0.00	6.50	6.50
G-282 (C)	0.00	0.00	2.50	2.50	0.00	0.84	4.84	5.67	0.00	0.84	8.84	9.67	0.00	0.84	11.59	12.42
Min.	0.00	0.00	1.00	1.00	0.00	0.00	2.50	2.50	0.00	0.00	3.67	3.67	0.00	0.00	4.50	4.50
Max.	0.00	0.00	3.17	3.17	0.00	1.67	6.00	6.34	0.67	1.67	10.17	10.17	0.67	1.67	13.75	15.25
S. Em++	0.00	0.00	0.81	0.81	0.00	1.04	1.20	1.50	0.62	1.04	1.30	1.67	0.62	0.64	1.35	1.68
C.D at 5%	---	---	0.89	0.89	---	NS	2.44	1.56	NS	NS	2.64	3.38	NS	0.49	2.74	3.40