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VARIABILITY AND CORRELATION STUDIES ON BULB YIELD, MORPHOLOGICAL AND STORAGE CHARACTERS IN ONION (*Allium cepa* L.)

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ABSTRACT

The field experiments were carried out at National Research Centre for Onion and Garlic, Rajgurunagar, Pune during late kharif 2002 and 2003 to evaluate some onion germplasm lines against the commercial varieties/ hybrids for improvement in bulb yield. So improvement in bulb yield, selection pressure can be exercised for the genotypes possessing maximum bulb weight having maximum number of 'A' grade bulbs with physiological loss in weight which were contributing towards total losses in onion during storage.

Key words: *Genotypes, onion and yield.*

INTRODUCTION

Onion is a commodity of masses and used in the preparation of pickle, salads, condiments and all types of vegetarian and non-vegetarian dishes. Besides fresh consumption, onion provides very good raw material for processing industries as it is processed in the form of dehydrated powder, rings and in vinegar. The productivity of onion in India is far below than that of western countries. Hence, immediate attention needs to be given to improve the productivity of onion. Along with this uniformity in size, shape and colour of bulb, storage life and export qualities should be improved.

To improve the productivity through genetic improvement needs information like extend of variability and association between the characters. Hence, in the present study an attempt was made to evaluate some onion germplasm lines against the commercial varieties/ hybrids, so as to find the good performing germplasm, variability available and correlation between the yield, morphological and storage characters.

MATERIALS AND METHODS

The field experiment was conducted during the late *kharif* (rangda) seasons of 2002 and 2003 at National Research Centre for Onion and Garlic, Pune, Eighteen genotypes and four check varieties of onion maintained in genetic resource section in the institute were evaluated by using random block design with three replication.

The 15 cm distance was kept between the row and 10 cm distance was kept within the plants. The each row contains 200 plants. Observations was recorded on randomly selected 10 plants on number of leaves, plant height(cm), average bulb weight(gm), dry matter of bulb(%), equatorial and polar diameter(cm), T.S.S. percentage of total losses, losses due to rotting and sprouting, percentage physical loss of weight and bulb yield(t/ha).

The seeds were sown in nursery during July, on raised bed (3 x 1m) in raw and the cultural operations were carried out as per normal recommended practices. The 45 days old healthy seedlings were transplanted in August in the flat bed. The recommended basal dose of N.P.K. (50-50-50) fertilizer was given at the time of transplanting and the remaining 50 kg of nitrogen was given in two splits as top dressing at 30 and 60 days after transplanting. The harvesting of bulbs was done in

January and the bulbs were kept in storage in plastic crates. The stored bulbs were checked after 15 days for recording various parameters. The observations on plant height, number of leaves, polar diameter, equatorial diameter, neck thickness, total soluble solids, bulb weight, dry matter of bulb, percentage of A, B and C grade bulbs, bolters, doubles, and bulb yield were recorded. Observations on stored bulbs were recorded at 30 days intervals for the storage losses, due to rotting, sprouting, physiological loss in weight (PLW) and total losses. At each observation rotted and sprouted bulbs were discarded after recording the data. The data obtained for the characters A,B and C grade bulbs, bolters, doubles, total storage losses, sprouting losses, rotting losses, and physical losses in weight were recorded in percentage. These data were angularly transformed and subject to the statical analysis.

The analysis of variance and performance of the varieties and character association were calculated separately and presented in the tables separately [1].

RESULTS AND DISCUSSION

The analysis of variances indicated that significant differences were observed for bulb yield, polar diameter and T.S.S. of the onion bulbs. The remaining attributes have not showed any differences among the genotypes tested. The yield performance of 18 genotypes and four check varieties ranged from 240.00 to 532.50.q/ ha. (Table - 1)

The NRCOG-593 had the best yield followed by NRCOG-574 (447 q/ha). NRCOG-593 has recorded significantly higher yield than the best control varieties Basawant-780 and N-2-4-1 where NRCOG-574 was superior in yield over one check variety i.e. DPS-1029 (375.00 q/ha)

Maximum TSS was recorded in NRCOG-596 (15.17%), which was followed, by NRCOG-590 (14.98%), NRCOG- 581 (14.88%), NRCOG-551 (14.34%), NRCOG-567 (14.20%), NRCOG-547 (14.14%), NRCOG-542 (14.08%) and NRCOG-598 (14.00%). All the genotypes expressed higher TSS than all check varieties. The T.S.S. values recorded in check varieties were as follows- N-2-4-1 (13.41), B-780 (13.06), Hy-3667 (9.92) and DPS-1029 (9.00).

The overall results indicated that six genotypes NRCOG-581, 563, 539, 593, 574 and 551 recorded minimal storage losses (25.25, 27.42, 30.00, 30.37, 31.20 and 32.0 % respectively) after 180 days of storage under modified storage

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Table - 1 Performance of onion genotypes.

Genotype	Plant height (cms)	Number of Leaves (cms)	Polar diameter (cms)	Equatorial diameter (cms)	Neck thickness	T.S.S (%)	Average weight Bulb	Dry matter of bulbs	'A' grade bulbs (%)	'B' grade bulbs (%)	'C' grade bulbs (%)	Doubles (%)	Bolter (%)	Total loss (%)	Rotting losses (%)	Sprouting losses (%)	Physical loss of weight	IELD t/ Ha
NRCOG-539	56.40	8.65	4.87	4.99	1.11	13.70	46.77	10.99	19.62	22.05	23.19	50.30	0.01	33.18	18.15	0.01	26.57	355.00
NRCOG-542	46.30	6.70	4.61	5.40	0.60	14.08	71.97	12.11	31.49	29.23	16.40	36.90	12.12	50.73	28.77	6.57	36.89	315.00
NRCOG-547	48.45	8.25	4.75	5.38	0.75	14.14	71.64	11.73	41.11	28.19	17.17	21.22	20.79	41.42	26.71	0.01	29.02	370.00
NRCOG-551	50.45	9.10	5.01	4.75	1.11	14.34	61.15	13.53	30.41	21.73	35.91	22.63	18.31	34.36	16.40	0.01	29.34	240.00
NRCOG-563	49.10	8.80	4.36	4.70	0.75	13.35	57.05	13.51	29.08	25.76	21.47	38.16	11.89	31.35	16.47	0.01	26.06	357.50
NRCOG-567	50.20	10.05	4.15	4.78	0.75	14.20	51.41	11.81	21.48	30.53	25.67	38.35	16.94	53.26	43.93	0.01	23.59	300.00
NRCOG-568	52.95	8.15	4.82	5.24	0.73	13.38	68.49	12.06	30.96	28.38	28.75	17.42	25.06	39.25	16.42	11.25	31.96	330.00
NRCOG-574	55.20	6.95	4.76	5.30	0.52	13.39	90.40	11.93	46.38	33.29	18.63	11.54	7.49	33.94	18.05	14.36	23.09	447.50
NRCOG-577	54.75	8.20	4.94	5.55	0.77	13.22	65.42	11.77	28.02	31.24	35.84	22.14	7.04	41.82	11.83	19.47	32.70	332.50
NRCOG-580	58.95	9.90	4.83	5.33	0.67	13.96	69.21	12.15	36.62	25.81	24.23	23.19	20.70	38.42	11.97	22.21	26.57	360.00
NRCOG-581	60.20	7.80	4.40	4.60	0.82	14.88	46.62	13.07	26.69	38.63	23.23	25.18	15.68	30.17	16.96	0.01	24.10	250.00
NRCOG-588	51.05	8.65	5.02	6.07	0.66	12.36	78.41	9.57	55.56	17.67	17.38	22.04	0.01	36.96	20.36	0.01	29.33	352.50
NRCOG-590	54.40	8.75	5.13	5.66	0.76	14.98	59.69	12.21	37.91	27.88	23.29	21.90	18.66	43.41	25.99	11.50	28.26	302.50
NRCOG-593	50.55	6.95	4.59	5.75	0.64	13.79	85.21	11.73	32.60	25.00	27.26	29.37	15.65	33.45	13.34	9.33	28.24	532.50
NRCOG-594	49.75	9.60	5.31	5.22	0.68	13.62	67.88	12.99	40.74	20.20	19.69	29.97	17.28	38.34	0.01	10.08	36.51	330.00
NRCOG-596	47.90	10.87	4.68	5.31	0.77	15.17	69.61	10.07	36.57	23.03	20.15	37.51	0.01	36.24	13.18	0.01	33.05	392.50
NRCOG-598	53.60	9.35	5.03	5.48	1.02	14.00	61.11	12.58	31.62	21.19	22.84	35.10	17.80	40.22	0.01	7.42	39.25	305.00
NRCOG-599	52.90	8.50	4.96	5.20	1.00	13.45	54.03	12.19	37.45	24.30	23.72	23.03	21.14	39.24	20.89	11.52	32.08	315.00
Hy-3667	50.19	8.45	6.35	5.34	0.68	9.92	94.19	8.87	45.05	35.92	13.37	18.29	0.01	58.69	20.46	38.30	33.06	462.50
DPS-1029	48.00	8.60	6.74	5.17	1.01	9.00	76.02	10.37	36.11	35.94	15.25	28.60	0.01	72.56	45.52	0.01	39.25	375.00
Baswant-780	55.19	9.05	5.36	6.26	0.77	13.06	93.29	10.99	54.74	25.00	14.34	11.54	12.35	40.80	19.00	0.01	34.46	487.50
N-2-4-1	55.05	7.80	5.21	5.29	1.11	13.41	76.02	13.60	35.49	21.56	25.69	28.79	18.60	31.93	16.41	14.18	21.96	462.00
General mean	52.33	8.59	4.99	5.31	0.80	13.43	68.89	11.81	35.71	26.78	22.02	25.53	10.99	40.90	18.94	8.12	30.06	362.48
'F' Test	-	-	**	-	*	**	*	-	*	-	-	-	-	**	**	**	**	*
Sem±	3.46	1.21	0.21	0.29	0.09	0.48	8.67	1.12	5.51	6.00	5.48	0.33	6.05	5.75	1.95	0.91	1.59	42.33
CV	10.06	3.53	0.62	0.85	0.29	1.62	25.17	3.66	16.03	17.42	15.92	22.73	17.57	16.69	5.62	2.67	4.47	122.85

structure. Further the results indicated that NRCOG-581 recorded lowest storage losses (25.25%) with a yield of 18.0t/ha followed by NRCOG- 563 (27.42% / 20.0 t/ha), NRCOG-539 (30.00% /14.5 t/ha), NRCOG-593 (30.37%/36.2t/ha) and NRCOG-574 (31.20%/41.15 t/ha). Losses due to rotting ranged from 0.00 (NRCOG 594) to 50.86 (DPS-1029) of check hybrid. Further results indicated that the check variety B-780 recorded the maximum yield with storage loss of 42.68% followed by Hy- 3667 (42.2 t/ha / 73.08%), NRCOG-574 (41.5 t/ha/31.20%), NRCOG 593 (36.2 t/ha / 30.37%) and check variety N-2-4-1 (30.7t/ha / 28.00%). Post harvest losses were

minimum in NRCOG-581 (25.25%) with an yield of (18.00 t/h) followed by NRCOG-563 (27.42%/20.00 t/h), NRCOG-539 (30.00%/14.5 t/h) and NRCOG-574 (31.20%/41.5 t/h). Exotic collection and variety recorded higher storage losses i.e. DPS-1029 (90.86%) and Hy-3667 (73.08%), inspite of the fact they registered high yield potential. Ten genotypes in sprouting losses, nine in physical loss of weight were found less than general mean. Six genotypes namely, NRCOG-547, 563, 574, 581, 599 and N-2-4-1 recorded higher percent of reducing sugars.

Table - 2 Correlation studies on morphological and storage characters in Onion

Characters	Plant height (cms)	Number of Leaves	Polar diameter (cms)	Equatorial diameter (cms)	Neck thickness	T.S.S.	Average weight Bulb	Dry matter of bulbs	'A' grade bulbs (%)	'B' grade bulbs (%)	'C' grade bulbs (%)	Doubles	Bolter	Total loss	Rotting losses	Sprouting losses	Physical loss of weight	ELD / Ha	
Plant height	1.000																		
Number of Leaves	-0.057	1.000																	
Polar diameter	-0.162	0.026	1.000																
Equatorial diameter	-0.011	-0.112	0.246	1.000															
Neck thickness	0.151	0.205	0.234	-0.322	1.000														
T.S.S	0.248	0.139	-0.841*	-0.143	-0.051	1.000													
Ave. weight Bulb	-0.210	-0.287	0.471*	0.651*	-0.452*	-0.487*	1.000												
Dry matter of bulbs	0.244	-0.138	-0.474*	-0.458*	0.251	0.547*	-0.469*	1.000											
A' grade bulbs (%)	-0.084	-0.029	0.405*	0.711*	-0.384*	-0.323	0.752*	-0.433*	1.000										
B' grade bulbs (%)	0.107	-0.342	0.203	-0.296	-0.266	-0.335	0.083	-0.161	-0.150	1.000									
C' grade bulbs (%)	0.276	0.028	-0.392*	-0.304	0.325	0.420*	-0.454*	0.524*	-0.581*	-0.168	1.000								
Doubles	-0.243	0.248	-0.279	-0.424*	0.340	0.210	-0.579*	0.104	-0.677*	-0.270	0.064	1.000							
Bolters	0.214	-0.052	-0.401*	-0.146	0.051	0.508*	-0.274	0.733*	-0.190	-0.136	0.406*	-0.211	1.000						
Total losses	-0.447*	0.066	0.665*	0.062	-0.029	-0.699*	0.236	-0.501*	0.073	0.487*	-0.397*	-0.030	-0.306	1.000					
Rotting losses	-0.320	-0.100	0.183	-0.141	0.017	-0.353	-0.022	-0.295	-0.084	0.481*	-0.258	0.043	-0.185	0.669*	1.000				
Sprouting Losses	0.204	-0.170	0.358	0.158	-0.268	-0.322	0.400	-0.186	0.177	0.262	0.018	-0.377*	0.010	0.180	-0.252	1.000			
Physical loss of weight	-0.452	0.156	0.525*	0.332	0.049	-0.368*	0.200	-0.304	0.200	-0.065	-0.280	0.010	-0.173	0.523*	-0.098	0.025	1.000		
Yield	-0.060	-0.263	0.273	0.526*	-0.271	-0.354	0.794*	-0.388*	0.462*	-0.011	-0.372*	-0.231	-0.281	0.017	-0.052	0.306	-0.078	1.000	

At the same time ten genotypes (NRCOG- 539, 547, 563, 568, 577, 581, 593, DPS-1029 and N-2-4-1) have registered higher percentage of non-reducing sugars. Further, among the genotypes tested NRCOG- 574 showed supremacy in yield (41.5 t/ha) with a storage loss of 31.20% followed by NRCOG-593 (36.2 t/ha, 30.37%). However the check variety B-780 recorded bulb yield 44.5 t/ha with loss of 42.68% followed by N-2-4-1 30.7 t/ha and 28.00% storage loss.

On perusal of results in Table-1 indicated that only two genotypes (NRCOG-593 and 574) were superior in terms of yield to the tune of 53.2 and 44.70 t/ha respectively. Three genotypes NRCOG-581, 580 and 539 recorded maximum plant height. Three (NRCOG-596, 580 and 567) for number of leaves, two (NRCOG-567 and 590) for dry matter of leaves, five (NRCOG-594, Hy-3667, DPS-1029, B-780 and N-2-4-1) in polar bulb diameter, three (NRCOG-588, 593 and B-780) in equatorial diameter, six (NRCOG-539, 551, 598, 599, DPS-1029 and N-2-4-1) for neck thickness, eight (NRCOG-542, 547, 551, 567, 580, 590, 596 and 598) for TSS five (NRCOG-574, 588, 593, Hy-3667 and B-780) for bulb weight, three (NRCOG-551, 581 and N-2-4-1) for dry matter of bulb, four (NRCOG-574, 588, Hy-3667 and B-780) for percent of A grade and B grade bulbs, three (NRCOG-551, 568 and 577) for C grade bulb, five (NRCOG-574, 577, 588, Hy-3667 and B-780) for marketable yield showed supremacy in respective attributes studied. Bulb weight and percent of A grade bulbs. Selection pressure can be profitably exercised on these attributes. The marketable yield was positively correlated with polar diameter, equatorial diameter, average weight of bulb, "A" grade bulb and sprouting losses, however it was negatively

correlated with neck thickness of bulb, T.S.S. (%), dry matter of bulb, "C" grade bulb and doubles bulbs.

The correlation studies were carried out for the different morphological and post harvest characters in onion. The results are given in Table - 2.

The average weight of bulb was positively correlated with polar and equatorial diameter and marketable yield, while it was negatively correlated with neck thickness and TSS (%) of the bulbs. The polar diameter of the bulb was positively correlated with total losses, physical losses of weight and yields and negatively correlated with TSS, dry matter of bulb and bolters. While the equatorial bulb diameter was positively correlated with average weight of bulb, "A" grade bulb and yield, it was negatively correlated with dry matter and doubles of bulb.

The percentage of total soluble solids was positively correlated with dry matter of bulb; "C" grade bulb and bolters while it was negatively correlated with average weight of bulb, total losses (%) and polar diameter. The physical loss of weight was positively correlated with polar diameter and total losses, while negatively correlated with plant height and TSS. The rotting losses of the bulb were positively correlated with "B" grade bulb and total losses while it was negatively correlated with TSS.

Total losses were positively and significantly associated with losses due to rotting and polar bulb diameter. However, it was negatively associated with dry matter of bulb, TSS. Hence minimization of losses due to rotting and reduction in polar bulb diameter will definitely reduce the total losses. However,

high TSS, high dry matter will contribute to reduce the total losses of onion bulbs [2].

Bulb yield had a positive significant association with plant height, equatorial diameter, bulb weight, percentage of 'A' grade bulbs and yield. These results have confirmed that any improvement in these characters will have direct effect on bulb yield. Hence, exercising the selection pressure on these traits will be more effective and helpful.

It is a fact that significant association of growth attributes such as plant height, dry matter and yield attributes like equatorial diameter and bulb weight, A grade bulb and marketable yield increases the yield potential. Any improvement in these characters will directly increase the yield potential of the genotypes. Hence, successful exploitation of selection pressure on these attributes will help in improving the genotypes. [3],[4]. While exercising the selection pressure for the above attributes, which are significantly and positively associated with the yield, must be taken into consideration for exercising selection pressure.

Polar diameter was positively associated with average weight of bulb (0.65*), A grade bulbs (0.71*) and yield (0.62*). These results indicated that increased bulb size, and A grade bulbs will contribute for increasing the yield. [5]

Similarly polar diameter had a significant positively association with bulb weight (0.47*), 'A' grade bulb (0.41*) and yield (0.43*). It was also same for equatorial diameter. Bulb weight had positive significant association with 'A' grade bulbs and yield [6].

On perusal of above results it was seen that yield improvement could be possible by increasing equatorial diameter and polar diameter of bulb, bulb weight and percent of 'A' grade bulb.[7]

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NOTE: This information may be kindly circulated among your colleagues.