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VARIABILITY AND INTERRELATIONSHIP AMONG YIELD AND YIELD CONTRIBUTING CHARACTERS IN ONION (*ALLIUM CEPA* L.)

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Abstract

A study was conducted using seven varieties of onion (*Allium cepa* L.) and observations were recorded on yield and yield components in order to obtain informations on genetic variability and character association of onion. Higher genotypic coefficients of variations were recorded in number of seeds per scape (NSPS), final plant height (FPH), final scape height , fresh weight of bulb and bulb length. These characters also exhibited high heritability along with high genetic advance as percentage of mean. Phenotypic correlation coefficients showed that bulb length, bulb diameter and scape diameter were positively and significantly correlated with fresh weight of bulb. The number of seeds per scape, final scape height, final plant height and number of pseudostem branches at maximum flowering stage were also positively and significantly correlated with seed yield per scape.

Key words: Genetic variations, correlation, yield components, onion.

Introduction

Onion is one of the oldest cultivated plant species in the world among the bulbs. It is the most common and important crops among the vegetables and species in Bangladesh. It is used in almost all food preparations and is an integral part of Bangladesh diet (Hossain and Islam 1994). It is also used as delicious vegetable and salad in many countries of the world. On the account of its special characteristics of pungency, it is valued much. Onion is an important spice because of its excellent flavour, which increase the test of various types of foods and carries. Nutritionally, its bulb is rich in minerals and other nutrients, like calcium, protein, carbohydrate, vitamin C and iron and it also contains vitamin B in trace amount (Sharfuddin and Siddique 1985). Nadkarni (1927) reported various medicinal properties of onion. The juice of onion is used for treating opthalmia and earache. Bulb juice is used as smelling on hysterical fits in faintness and it is also used against flatulence, dysentery and cholera, heart disease. It plays an important role in reducing the insulin requirement for diabetic patient by regular use. Inspite of its various uses, very little research work has been under taken for its improvement in Bangladesh. Therefore, the present research work was undertaken to study the genetic and nongenetic variability and nature of interrelationship among yield and other yield contributing characters, which will be helpful in future breeding programme for the improvement of this crop.

Materials and Methods

A total of seven onion varieties, viz., Taherpuri brown, Taherpuri white, Pusa red, Pusa white, Patnaideep pink, Shitlai brown and Shamrat collected from Bangladesh Agricultural Research Institute, Joydebpur Gazipur were used in this study. The bulbs of the variety were used as the planting materials. The experiment was laid out in Randomized Complete Block Design with three replications at the experimental field of Academic Unit, Faculty of Agriculture, University of Rajshahi, Bangladesh during November, 2005 to April, 2006. The unit plot size was 3m × 1m having 35 cm distance from row to row, 45 cm distance from plot

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to plot and 50 cm distance from replication to replication. The medium sized mother bulbs were planted in each row of the plots on 17th November, 2005. Manure and fertilizers were applied at the rate of cowdung 0.5 tone, Urea 120 kg, TSP 130 kg and MP 160 kg/ha. The entire amount of cowdung, TSP, MP and 50% of Urea were applied at final land preparation. The rest 50% Urea was applied as top dressed after 40 days of planting the bulbs. Normal cultural practices were followed as routine procedure to ensure normal growth of plants. Data on days to flower initiation (DFI) was recorded as plot basis, while other various characters viz., number of leaves at maximum flowering stage (NLMFS), number of pseudostem branches at maximum flowering stage (NPMFS), final plant height (FPH) in cm, final scape height (FSH) in cm, number of flowers per scape (NFPS), number of scape per plant (NSPP), number of seeds per scape (NSPS), scape diameter (SD) in cm, fresh weight of bulb (FWB) in gm, bulb length (BL) in cm, bulb diameter (BD) in cm and seed yield per scape (SYPS) in mg were recorded from randomly selected 10 sample plants from each plot. Phenotypic and genotypic variances were estimated by using the formula given by Johnson *et al.* (1955). Phenotypic and genotypic coefficient of variability was estimated according to the formula given by Burton (1952). Heritability in broad sense was estimated according to Hanson *et al.* (1956). The genetic advance as percentage of mean and phenotypic correlation coefficients was computed using the formula suggested by Comstock and Robinson (1952) and Al-Jibouri *et al.* (1958) respectively.

Results and Discussion

Variability and Genetic parameters: Analysis of variance for all the characters under study displayed significant variations among the varieties (Table 1). Variability of a character is measured by range and genotypic coefficient of variation (GCV). In most of the cases, considerable differences between phenotypic and genotypic coefficients of variations were observed (Table 2), which indicated that environment had influenced to a certain extent in the expression of most of the characters, except FSH, FWB and BL, suggesting these characters are less influenced by environment and genetic variation existed in the expression of these characters and this genetic variability can be exploited by selection (Burton and de Vane 1953).

Table 1. Analysis of variance, range, mean with standard error and coefficient of variation of yield and yield contributing characters in onion.

SV	df	DFI	NLMFS	NPMFS	NSPP	NFPS	FPH	FSH	NSPS	SD	FWB	BL	BD	SYPS
R	2	1.91	5.98	1.02	0.098	1359.88	92.50	11.41	4830.81	0.08	1.48	0.09	0.90	0.13
V	6	132.13**	207.86**	7.40**	1.23**	3961.87**	256.80**	208.38**	19621.75**	0.23*	105.82**	1.55**	0.41**	0.48*
E	12	17.39	31.23	0.43	0.202	844.03	31.64	31.04	2513.08	0.06	0.43	0.09	0.07	0.09
Range	-	47.33	20.33	2.13	3.70	212.18	14.60	35.19	110.93	0.77	13.24	2.81	2.63	0.35
		-71.67	-48.67	-8.87	-5.00	-237.54	-58.20	-63.83	-179.57	-1.15	-16.98	-3.31	-3.16	-0.89
Mean	-	58.55	32.47	4.33	4.71	245.14	42.37	46.93	151.93	0.96	15.15	3.11	2.93	0.73
± SE		±1.15	±1.67	±0.32	±0.25	±4.48	±1.61	±1.61	±5.25	±0.19	±0.35	±0.26	±0.19	±0.17
CV%	-	5.51	12.89	15.25	9.59	9.82	6.78	6.99	22.37	20.89	4.23	8.95	10.51	24.65

SV = source of variation, df = degree of freedom, R = replication, V = variety, E= error and CV% = coefficient of variation

As genetic coefficient of variation does not indicate the amount of heritable variation. Heretability estimates in broad sense were used for the determination of the proportion of the total genetic variation. The heritability estimates was high for BL (84.48%), FSH (79.73%), FWB (79.20%), FPH (70.79%) and NSPS (70.41%), and SD exhibited lowest estimates of heritability (50.00%) (Table 2). Genetic advance as percentage of mean was maximum for SD followed by FWB and NSPS. The rest of the characters also showed high values of genetic advance as percentage of mean. The heritability estimates though provide the basis for selection on phenotypic performance, Johnson *et al.* (1955) suggested that heritability estimates and expected genetic

advance should always be considered jointly. The characters which have high heritability as well as high genetic advance are BL, FWB, FSH, FPH and NSPS indicating these are simply inherited characters, even if they are under ploygenic control and these characters could be improved through selection. Sandhu and Korla (1976) reported similar results in onion. Moderate heritability coupled with high genetic advance were found for DFI, NLMFS, NPMFS, NSPP and BD indicated that these characters were moderately heritable and both additive and nonadditive genes were involved to control these characters. Sandhu and Korla (1976) observed such additive and non-additive gene effects in onion. On the other hand, low heritability estimates along with high genetic advance for SD, SYPS, NFPS suggested that genotype-environment interaction play a significant role in the expression of these characters.

Correlation coefficients: Correlation coefficient estimation was done at phenotypic level for all 13 characters studied and the results obtained are shown in Table 3. The results of the correlation coefficients revealed that most of the characters were positively related with each other. Correlation coefficients of NLMFS with NPMFS; NPMFS with SYPS; FPH with NSPP and SYPS; FSH with NFPS and SYPS; NFPS with NSPS; SD with fresh WB, BL and BD; NSPP with NSPS and SYPS; NSPS with SYPS; FWB with BL and BD, and BL with BD were found to be highly significant and positive, which indicate that these characters were strongly and directly associated with each other. Sandhu and Korla (1976) obtained similar results in onion. Negative and significant correlation between DFI with FSH and BD; SD with NSPP, NSPS; NSPP with BL, and FWB with SYPS. Significant and negative correlation between FWB and SYPS indicate that bulb yield per plant may be decreased with increase of this character.

Table 2. Components of variance and genetic parameters of yield and yield contributing characters in onion.

Characters	σ^2p	σ^2g	PCV (%)	GCV (%)	h_b^2 (%)	GA%
DFI	55.64	38.25	95.03	65.33	68.75	18.04
NLMFS	90.10	58.88	277.49	181.33	65.35	39.35
NPMFS	3.42	2.11	78.98	48.73	61.70	54.28
NSPP	0.55	0.34	11.68	7.22	61.82	20.05
NFPS	1883.32	1039.28	768.26	423.95	55.18	20.12
FPH	106.30	75.25	250.89	177.60	70.79	35.48
FSH	74.15	59.12	158.00	125.97	79.73	30.14
NSPS	8215.97	5784.86	5407.73	3807.58	70.41	86.53
SD	0.78	0.39	81.25	40.63	50.00	94.76
FWB	68.90	54.57	454.78	360.19	79.20	89.39
BL	0.58	0.49	18.65	15.76	84.48	42.62
BD	0.18	0.11	6.14	3.75	61.11	18.23
SYPS	0.23	0.13	31.51	17.81	56.52	76.49

Table 3. Phenotypic correlation coefficients among yield and yield contributing characters in onion.

Characters	NLMFS	NPMFS	FPH	FSH	NFPS	SD	NSPP	NSPS	FWB	BL	BD	SYPS
DFI	0.479	0.133	0.098	-0.737**	0.0508	-0.199	-0.036	0.032	0.158	-0.128	-0.538*	-0.344
NLMFS		0.878**	0.324	-0.367	-0.454	0.174	-0.020	0.196	0.347	0.265	-0.038	0.285
NPMFS			0.216	-0.133	-0.406	-0.080	0.272	0.197	-0.061	-0.070	-0.231	0.533*
FPH				-0.076	0.377	0.024	0.550*	0.470	0.388	0.148	0.362	0.555*
FSH					0.587*	-0.171	0.186	0.509	-0.047	0.162	0.159	0.596*
NFPS						-0.453	0.472	0.781**	0.068	-0.043	0.136	0.422
SD							-0.726**	-0.706**	0.709**	0.822**	0.764**	-0.350
NSPP								0.801**	-0.441	-0.615*	-0.406	0.686**
NSPS									-0.147	-0.277	0.156	0.782**
FWB										0.923**	0.700**	-0.540*
BL											0.813**	-0.067
BD												0.170

* indicates significant at 5% level of probability, ** indicates significant at 1% level of probability.

Correlation coefficients revealed that BL, BD and SD are important as they exhibited significant positive correlation with FWB, which indicated that increase of the values of these characters will increase FWB. Again, number of NSPP, NSPP, FSH, FPH and NPMFS also exhibited positive correlation with SYPS suggesting increase of these traits would increase seed SYPS. Among these traits, BL, FWB, FSH, NSPS and FPH had high genotypic coefficients of variations and high heritability coupled with high genetic advance as percentage of mean which suggested that selection based on these characters would give better response for improving bulb yield as well as seed yield in onion.

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