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Character association and their direct and indirect effects on bulb yield in Onion

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Abstract: *Twenty one genotypes of onion were evaluated for nine characters to estimate the extent of association between yield and its component traits and partition it into direct and indirect effects using path coefficient analysis.Genetic correlation coefficients recorded higher magnitude than the phenotypic correlation coefficients for all the traits except for bulb weight.Yield per plot was positively and significantly associated with plant height, days to harvest, neck thickness, bulb diameter, bulb weight and TSS.The magnitude of association ranged from low (r = 0.296) for total soluble solids to high (r = 0.924) for bulb weight.Bulb weight (1.006) had maximum positive direct effect on bulb yield.*

Keywords: *Bulb yield,Character association, Correlation, Onion.*

INTRODUCTION

Onion is one of the most important crops grown in India which serves as spice as well as vegetable. Globally for onion India ranks first in total area (10.51 lakh hectare) and second in production (168.13 lakh tonnes) after China (1). It is an indispensible item in every kitchen as vegetable and as condiment used to flavour many of the food stuffs. Nowadays it is used by processing industry for dehydration in the form of onion flakes and powder which are in great demand in the world market. High yielding onion cultivars with high soluble solid content could provide good incentive to increase production for processing and storage such as dehydration so as to minimize onion loss due to poor storage by farmers and marketers. The soluble solids are known to comprise the bulk of onion dry mass and that dehydrator cultivars are developed from breeding populations that have high dry mass content (11). However, onion yield is highly complex quantitatively controlled trait influenced by its component traits, direct selection for genetic improvement in yield often mislead the breeder. The product moment coefficient between yield and its component traits often exhibit a complex chain of interacting characters relationships. Path coefficient analysis furnishes information of influence of each contributing character to yield directly as well as indirectly and also enables breeder to rank the genetic attributes according to their contributions. The present investigation therefore, was carried out with the aim to assess the extent of association between yield and its component traits and partition it into direct and indirect effects using path coefficient analysis.

MATERIAL AND METHOD

A field experiment was conducted with twenty one genotypes in RBD with three replications at College of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during rabi season of 2012-2013. Eight week old healthy seedlings of each genotype were transplanted on flat beds at a spacing of 15 cm x 10 cm. Recommended package of practices were adopted to raise a successful crop. Ten plants were selected at random in each plot to record the observations on plant height (cm), number of leaves, number of days to maturity, neck thickness (cm), bulb diameter (cm), bulb weight (g), number of marketable bulbs per plot, total soluble solids (%)

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and bulb yield per plot (kg). The analysis of variance for different characters was done on the basis of the model described by Panse and Sukhatme(8). Path coefficient was analysed following method proposed by Dewey and Lu (2).

RESULT AND DISCUSSION

The analysis of variance showed that the mean square due to genotypes were significant (P< 0.05) for all quantitative character studied indicating that genotypes differed among themselves. In the present investigation, genetic correlation coefficients recorded higher magnitude than the phenotypic correlation coefficients for all the traits except for bulb weight (Table 1). This indicated that even though there was inherent association between the characters studied, the relationship between the traits was under the influence of environment and genotype-environment interaction.Rahman (9), Gurjar*et al.* (3) and Ram *et al.* (10) also revealed that the genotypic correlation coefficient were of higher magnitude than their corresponding phenotypic correlation coefficients.

The correlation coefficient analysis between yield per plot and its component traits indicated that yield per plot was found to be positively and significantly associated with plant height, days to harvest, neck thickness, bulb diameter, bulb weight and TSS. Characters viz., number of leaves and number of marketable bulbs per plot were positively but non-significantly correlated to yield per plot. The magnitude of association ranged from low (r = 0.296) for total soluble solids to high (r = 0.924) for bulb weight. Strong positive association ship of bulb yield with plant height was observed by Mohanty (7) and Rahman *et al.* (9). Contradictory to present findings positive and significant correlation of bulb yield with number of leaves per plant was reported by Marey *et al.* (6).

Bulb yield is a polygenic trait. It is influenced by many other traits, hence; direct selection for this character may often be misleading. Since the correlation studies alone are not sufficient to make the picture of association analysis very clear so assessment of real contribution of individual character towards the bulb yield become essential. It has also been suggested that yield components have either a direct or indirect effect on bulb yield or both. Therefore, it was essential to determine the effect of yield components on bulb yield. Consequently path coefficient analysis provides a clear and more realistic picture of a complex situation that exists at correlation level. It measures the direct as well as indirect effects of one variable on the dependent variable through the other traits. Thus, it is possible to calculate both direct and indirect effects of yield components on bulb yield (table 2).In the present study bulb weight (1.006) had maximum positive direct effect on bulb yield followed by number of marketable bulbs per plot (0.403) and number of leaves (0.025). Whereas Hosamani *et al.* (5) observed maximum positive direct effect of neck thickness on bulb yield followed by bulb length and TSS. Hyder *et al.* (4) reported that plant height, bulb length, bulb diameter and days to harvest were the most important yield contributing factors.Bulb weight also had highest positive indirect effect on bulb yield and this was in accordance with the findings of Gurjar *et al.* (3).

Positive direct effect of plant height (0.007), number of leaves per plant (0.025), bulb diameter (0.018), bulb weight (1.006), number of marketable bulbs per plot (0.403) and total soluble solid (0.011) on yield per plot were observed. Days to harvest had negative direct effect (-0.011) however it had positive effect on yield per plot mainly through bulb

Table 2
Direct and indirect effects on bulb yield of its components and other yield contributing traits in onion

Character	*Plant height*	*No of leaves*	*Days to harvest*	*Neck thickness*	*Bulb diameter*	*Bulb weight*	*No. of Mrk. Bulb per plot*	*TSS*	*Yield/plot*
Plant height	0.007	0.009	–0.002	–0.006	0.009	0.748	–0.186	0.001	0.580
No of leaves	0.003	0.025	0.000	–0.008	0.000	0.404	–0.207	0.004	0.222
Days to harvest	0.001	–0.001	–0.011	–0.002	0.009	0.439	0.012	0.003	0.451
Neck thickness	0.003	0.012	–0.002	–0.015	0.006	0.619	–0.129	0.001	0.494
Bulb diameter	0.004	0.000	–0.005	–0.005	0.018	0.640	–0.004	0.002	0.648
Bulb weight	0.005	0.010	–0.004	–0.009	0.011	1.006	–0.098	0.005	0.924
No. of Mrk. Bulb per plot	–0.003	–0.013	–0.000	0.005	–0.000	–0.246	0.403	–0.003	0.140
TSS	0.0008	0.008	–0.003	–0.002	0.002	0.408	–0.130	0.011	0.296

Residual effect = 0.843; The main diagonal (bold) is direct effects. Mrk.– Marketable.

Table 1
Phenotypic and Genotypic correlation coefficient among nine quantitative traits in onion

Character	*Plant height*		*No of leaves*	*Days to harvest*	*Neck thickness*	*Bulb dia.*	*Bulb weight*	*No. of Mrk. Bulb per plot*	*TSS*	*Yield/plot*
Plant height (cm)	G	1	0.386**	0.179	0.404**	0.504**	0.743**	–0.463**	0.126	0.580**
	P	1	0.370**	0.137	0.394**	0.389**	0.587**	–0.345**	0.120	0.461**
No. of leaves / plant	G		1	–0.040	0.482**	1.615**	0.401**	–0.514**	0.323*	0.222
	P		1	–0.252*	0.466**	–1.853**	0.253*	–0.390**	0.230	0.119
Days to harvest	G			1	0.181	0.486**	0.437**	0.031	0.293*	0.451**
	P			1	0.173	0.375**	0.364**	0.040	0.264*	0.373**
Neck thickness (cm)	G				1	0.333**	0.615**	–0.321*	0.121	0.494**
	P				1	0.330**	0.558**	–0.164	0.068	0.493**
Bulb dia. (cm)	G					1	0.635**	–1.108**	0.148	0.648**
	P					1	0.619**	0.043	0.102	0.636**
Bulb weight (g)	G						1	–0.245	0.406**	0.924**
	P						1	–0.168	0.329**	0.936**
No. of Mrk. Bulb per plot	G							1	–0.323*	0.140
	P							1	–0.267*	0.184
TSS	G								1	0.296*
	P								1	0.236*
Yield/plot (kg)	G									1
	P									1

* –significance at 5% (0.250), ** –significance at 1% (0.325). Mrk. – Marketable

weight (0.439). Neck thickness also had negative direct effect but it had positive contribution on yield through bulb weight (0.619). The study suggested that bulb diameter with high indirect effect via bulb weight while bulb weight and number of marketable bulbs per plot with highest direct effects on yield were the most influencing character and hence, should form prominent component of selection index for enhancing bulb yield.

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