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Unidirectional and Alternate Pathway Influences of Some Economic Traits in Onion (*Allium cepa*)

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ABSTRACT

Effect of eight plant characteristics on the yield was studied through correlation and path analysis. Yield showed positive genotypic and phenotypic correlation with single bulb weight, number of rings per bulb, diameter of bulb and neck, leaf weight and length. Dry matter contents depicted positive correlation with diameter of bulb and neck, and leaf length. While bulb weight was positively correlated with number of rings per bulb, diameter of bulb, and neck, number of leaves per plant and leaf length. Characters like bulb weight, diameter of bulb and leaf length showed positive effect on yield.

Key Words: Onion; Yield; Economic trait

INTRODUCTION

Onion is an important item of consumer's daily purchase list. Yield in onion is a product of several components i.e. single bulb weight, number of rings per bulb, dry matter contents, diameter of bulb, and neck, number of leaves per plant, leaf length and weight of such characters on bulb weight (Currah & Proctor, 1990; Shaha and Kale, 1999). So, it is important to know the influence of such characters on bulb weight. In two open pollinated onion varieties heritability estimates for solid matter contents was 0.64 (Wall & Cregon, 1999). Surlan *et al.* (1997) found heritability coefficients were 32.97% (number of dead leaves) to 97.74% (stem length). The mast significant influence on head weight was exerted by number of dead leaves and head diameter. Genetic correlation coefficients were higher than respective phenotypic values.

This paper describes the association of characters present in the onion plant, which could be used for selection of onion cultivars for better yield in future.

MATERIALS AND METHODS

Onion sets of desirable size (1.5-2.00 cm) in eight cultivars *viz.*, Faisal Red, Desi Red, Phulkara, Pk-10321, Red Imposta, Robina, Dark Red and Pusa Red. These cultivars were selected and stored till last week of July. These sets were disinfected by dipping in 0.2% solution of Dithane M-45 for five minutes before plantation. For experiment, RCBD was used with three replications. Plot size was kept at 7 x 1.40 m and transplanted on both sides of 70 cm apart ridges with 10 cm plant to plant distance. All agronomic and plant protection measures were taken to maintain the growth of the crop. Data of 10 guarded plants for yield per plot, dry matter contents, bulb weight, diameter of bulb, No. of rings per bulb, diameter of neck, No. of leaves, leaf length and leaf weight was recorded at maturity. Correlation and path analysis were computed according to Kwon and Torrie (1994).

RESULTS AND DISCUSSION

Yield per plant showed significant and positive correlation with single bulb weight (rg=0.8662) (rp=0.8661). Other characters positively correlating to yield were number of rings per bulb, diameter of bulb diameter of neck, leaf weight and leaf length. Dry matter contents and number of leaves per plant were negatively correlated to yield. Single bulb weight, number of rings per bulb, Number of leaves per plant and leave weight. While showed positive correlation to diameter of bulb and neck and leaf length Number of rings per bulb showed significantly positive genotypic and phenotypic correlation to number of leaves and leaf weight. While bulb Neck diameter showed significantly positive association to leaf length. Number of leaves per plant showed significantly positive correlation to leaf length (Table I).

Unidirectional and alternate influences. Study of path coefficient analysis indicated that genotypic correlation between yield and dry matter contents was negative (-0.4289) mainly due to the negative direct effect of dry matter contents (-0.5070) and indirect negative effect via diameter of neck (-0.0410). However, positive indirect effect via single bulb weight (0.0570), number of rings per bulb (0.0014), diameter of bulbs (0.0847), number of leaves per bulb (0.0248), and leaf weight (0.3390) nullified most of the negative effect. The genotypic correlation coefficient and heritability for this trait was 0.4289 and 0.99 ± 1.65, respectively.

Table I. Correlation coefficients among yield components in onion

Characters		Yield per plant	Dry matter contents	Single bulb weight	Number of rings per bulb	Diameter of bulb	Diameter of neck	Number of leaves per plant	Leaf weight	Leaf length
Yield per plant	rg	1								
	rp	1								
Dry matter	rg	-0.4289	1							
contents	rp	-0.4288	1							
Single bulb	rg	0.8662 **	-0.3104 **	1						
weight	rp	0.8661 **	-0.3104 **	1						
Number of rings	rg	0.4006	-0.4326	0.696	1					
per bulb	rp	0.3253	-0.3487	0.5655	1					
Diameter of bulb	rg	0.6023	0.0965	0.7217	0.6685	1				
	rp	0.6022	0.0965	0.7217	0.5427	1				
Diameter of neck	rg	0.6308	0.1348	0.5586	0.205	0.6252	1			
	rp	0.6307	0.1348	0.5584	0.168	0.6251	1			
Number of leaves	rg	-0.2157	-0.0245	0.1977	0.7952 *	0.3909	-0.2794	1		
per plant	rp	-0.2158	-0.0245	0.1977	0.6405	0.3909	-0.2796	1		
Leaf weight	rg	0.0921	-0.1051	-0.3973	-0.5506	-0.1635	0.0644	-0.06607	1	
	rp	0.0922	-0.1054	-0.3972	-0.4465	-0.1635	0.0642	-0.6604	1	
Leaf length	rg	0.4175	0.1454	0.6186	0.7348 *	0.7716 *	0.3835 *	0.5292	-0.4051	1
	rp	0.4174	0.1453	0.6184	0.5871	0.7715 *	0.3832	0.5292 *	-0.4048	1

Table II. Unidirectional and alternate influences on yield components in onion

Characters	Dry matter contents	Single bulb weight	Number of rings per bulb	Diameter of bulb	Diameter of neck	Number of leaves per plant	Leaf weight	Leaf length	Correlation coefficients	Heritability
Dry matter contents	-0.5070	0.0570	0.0014	0.0847	-0.0410	0.0248	0.0317	0.3390	0.4289	0.99 ± 1.65
Single bulb weight	0.1575	0.1837	-0.0023	0.6334	-0.1700	-0.2002	0.1198	0.1443	0.8664	0.99 ± 0.15
Rings per bulb	0.2195	0.1278	-0.0033	0.5867	-0.0624	-0.8054	0.1660	0.1714	0.4006	0.64 ± 0.35
Diameter of bulb	0.0489	0.1326	-0.0022	0.8777	-0.1903	-0.3958	0.0493	0.1800	0.6028	0.99 ± 8.43
Diameter of neck	0.0684	0.1026	-0.0007	0.5488	-0.3044	0.2829	-0.0194	0.0895	0.6808	0.99 ± 4.59
Leaves per plant	0.0124	0.0363	0.0026	0.3431	0.0850	-1.000	0.1992	0.1235	0.2167	0.99 ± 1.44
Leaf weight	0.0533	0.0370	0.0018	-0.1435	-0.0196	0.6691	-0.3015	-0.0945	0.0921	0.99** ± 0.11
Leaf length	0.0737	0.1136	-0.0024	0.6772	-0.1168	-0.5359	0.1222	0.2333	0.4176	0.99** ± 0.12

The genotypic correlation between yield and single bulb weight was positive (0.8662) mainly due to the positive direct effect of single bulb weight (0.1837) and indirect effect via diameter of bulb (0.6334), dry matter contents (0.1575), leaf weight (0.1198) and leaf length (0.1443). However, negative indirect effect via number of rings per bulb (-0.0023), diameter of neck (-0.1700) and number of leaves per plant (-0.2002) nullified most of the positive effect. The genotypic correlation coefficient and heritability for this trait was 0.8664 and 0.99 ± 0.15, respectively.

The genotypic correlation between yield and number of rings per bulb was positive (0.4006) mainly due to the negative direct effect of number of rings per bulb (-0.0033) and indirect negative effect via diameter of neck (-0.0624) number of leaves (-0.8054). However, positive indirect effect via dry matter contents (0.2195), single bulb weight (0.1278), Diameter of bulb (0.5867), leaf weight (0.1660) and leaf length (0.1714) nullified the negative effect. The genotypic correlation coefficient and heritability for this trait was 0.4006 and 0.99 ± 0.35, respectively.

The genotypic correlation between yield and diameter of bulb was positive (0.6023) mainly due to the positive direct effect of diameter of neck (0.8777) and indirect effect via dry matter contents (0.0489), single bulb weight (0.1326), leaf weight (0.0493) and leaf length (0.1800) whereas negative indirect effect via number of rings per bulb (-0.0022), diameter of neck (-0.1903) and number of leaves per plant (-0.3958) nullified most of the positive effect. The values of genotypic correlation coefficient and heritability for this trait were 0.6028 and 0.99 ± 8.43, respectively.

The genotypic correlation between yield and diameter of neck was positive (0.6023) mainly due to the negative direct effect of diameter of neck (-0.3044) and negative indirect effect via number of rings per bulb (-0.0007) and leaf weight per plant (-0.0194). However, positive indirect effect via dry matter contents (0.0684), single bulb weight (0.1026), diameter of bulb (0.5488), number of leaves

(0.2829) and leaf length (0.0895) nullified the negative effect. The values of genotypic correlation coefficient and heritability were 0.6808 and 0.99 ± 4.59, respectively.

The genotypic correlation between yield and leaves per plant was negative (-0.2157) mainly due to the negative direct effect of leaves per plant (-1.0000). Whereas positive indirect effect via dry matter contents (0.0124), single bulb weight (0.0363), number of rings per bulb (0.0026), diameter of bulb (0.3431), diameter of neck (0.0850), leaf weight (0.1992) and leaf weight (0.1235) nullified most of the negative effect. The values of genotypic correlation coefficient and heritability were 0.2167 and 0.99 ± 1.44, respectively.

The genotypic correlation between yield and leaf weight was positive (0.0921) mainly due to the negative direct effect (-0.3015) and negative indirect effect via diameter of bulb (-0.1435), diameter of neck (-0.0196) and leaf length (-0.0945) whereas positive indirect effect via dry matter contents (0.0533), single bulb weight (0.0370), number of rings per bulb (0.0018), and number of leaves per plant (0.6691) nullified most of the negative effect. The values of genotypic correlation coefficient and heritability were 0.0921 and 0.99 ± 0.11, respectively.

The genotypic correlation between yield and leaf length was positive (0.4175) mainly due to the positive direct effect (0.2333) and indirect effect via dry matter contents (0.0737), single bulb weight (0.1136), diameter of bulb (0.6772) and leaf weight (0.1222). However, negative indirect effect via number of rings per bulb (-0.0024), diameter of neck (-0.1168) and leaves per plant (-0.5359) nullified most of the positive effect. The values of genotypic correlation coefficient and genetic heritability were 0.4176 and 0.99 ± 0.12, respectively.

In all cases sign of phenotypic and genotypic correlation coefficient are same, which show that character improvement is easy (Table I). Single bulb weight had highly significant and positive correlation with yield. Furthermore, genotypic correlation is almost equal to phenotypic correlation. So, to improve yield of onion, direct selection of single bulb weight will be beneficial. Single bulb weight had 99% heritability, which means single bulb weight can be improved by simple selection (Chowdhry *et al*., 1991).

Number of rings per bulb also showed positive correlation with yield; and genotypic correlation was more than phenotypic correlation. So, improvement of that character and ultimately the yield is possible through simple selection, this character also had heritability value 64%.

Dry matter content and number of leave per plant had negative correlation with yield, for the improvement of yield with these two characters selection should be performed with an optimistic compromise, being a negative correlation with yield.

For yield improvement two or more components of yield, which are positively and significantly associated with each and other would be beneficial like leave length and diameter of bulb, number of leaves per plant and number of ring per bulb and leave length and number of rings per bulb.

Direct effect of single bulb weight, diameter of bulb and leave length is positive with 99% heritability value and in case of single bulb weight and leave length, genotypic correlation coefficient are more than the direct effect. So, direct selection of these characters will be effective in yield improvement (Table II). Similarly, direct effect is positive, selection of these characters would be beneficial to improve other related traits (Khan *et al*., 1991).

Direct effect of number of rings per bulb, diameter of neck, number of leaves per plant, and leave weight are negative and correlation coefficient are positive for these character. In this case, indirect effects are cause of correlation. For these characters, indirect casual factors are considered for selection to improve these characters and yield (Singh & Chaudhry, 1985; Singh, 2000).

CONCLUSIONS

For yield improvement in onion crop, major emphasis should be given to single bulb weight. In addition to that other characters like numbers of ring per bulb, diameter of bulb, and leave length should also be given attention for yield improvement. Because, these character are positively correlated with yield.

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