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Correlation and Path Coefficient Analysis for Some Yield and Related Traits in onion (*Allium cepa* L.) Genotypes

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ABSTRACT

Correlation coefficient and path coefficient were studied in onion involving 29 genotypes. The associations among growth and yield components and their direct and indirect influence on the bulb yield of onion were investigated. Correlation coefficient analysis revealed that total bulb yield had positive significant correlation with plant height, Neck thickness, Number of rings, polar and equatorial diameter of bulb, average bulb weight and bulb yield per plot. Path coefficient analysis revealed that plant height, Neck thickness, Total sugars, polar and equatorial diameter of bulb, average bulb weight and bulb yield per plot exhibited positive direct effect on total bulb yield. In addition to this Number of leaves, Ascorbic acid, thrips and Reducing sugars showed negative direct effect on total bulb yield at phenotypic and genotypic levels and could be utilized as selection criteria in onion improvement programe for Rayalaseema zone.

Key words: *Correlation, Path coefficient analysis; Onion.*

INTRODUCTION

Onion (*Allium cepa* L.) is one of the important vegetable and spice crops of India and is commonly used for salad and culinary purposes. The green leaves, immature and mature bulbs are used for vegetables and spice purposes. It is an important bulb crop throughout the world and is commercially cultivated in more than hundred countries. Mature bulbs are used as vegetable, spice, pickles in brine/vinegar, soups and sauces purposes and also dehydrated and used as powder for seasoning other dishes. The green leaves and immature/mature bulbs are eaten as raw or used in preparation of vegetables. Besides, onion has been known for its high medicinal properties for centuries. Yield is a complex character and it depends on a number of characters, thus yield can be improved by direct as well as indirect selection. To identify component character, correlation is considered as an important tool. In order to collect information on association of different characters and their direct and indirect influence on bulb yield as the basic requirement for improvement, the present investigation was undertaken.

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MATERIAL AND METHODS

Experimental site is situated at Citrus Research Station, Dr. YSR Horticultural University, Tirupati, which comes under Rayalaseema region of Andhra Pradesh state, located at 13^0 65^1 North latitude and 79^0 42^1 East longitude, with an altitude of 162 meters above mean sea level.

The climate of the research station is tropical with maximum temperature ranging from 36-42°C during *rabi* season, average temperature25.6°C during crop growing period. The relative humidity generally fluctuates between 63 percent with a rainfall of 51 mm. The soil of the experimental site was red sandy loam. The experiment was laid out in Randomized Block Design and replicated thrice. Plants were spaced 15 cm between row to row and 10 cm between plants to plant. Recommended Fertilizer Dose: 120: 50: 100: 40 @ N: P2O5: K2O: S, kg ha-1. Farm Yard Manure (FYM): 20 tons ha-1. Observations on growth parameters were taken from randomly selected ten plants per replication at 30, 60 and 90 days after transplanting. Bulb characters and yield were recorded from randomly selected ten bulbs after harvest. The mean values obtained from the ten competitive plants selected at random from each genotype in each replication for different horticulture traits. Twenty nine genotypes of onion were collected from different locations. Simple correlation coefficients were estimated using the formula of Steel and Torrie[15] and Path coefficient analysis was done according to the methods of Dewey and Lu[4] and Snedecor and Cochran[14], respectively.

Scale for path coefficients

Values of direct (or) indirect effects	Rate (or) scale
0.00 to 0.09	Negligible
0.10 to 0.19	Low
0.20 to .29	Moderate
0.30 to 0.99	High
>1.00	Very high

RESULTS AND DISCUSSION

CORRELATION STUDIES

The phenotypic and genotypic correlation coefficients were determined to know the nature of relationship existing between yield and its component characters as well as the association among component characters themselves. The degree of association of morphological and bulb character with bulb yield and also among themselves at genotypic and phenotypic level are depicted in Table 1 and 2.

Character association

The correlation co-efficient was determined to know the nature of relationship between yield and its component characters as well as the association between component characters themselves. The degree of association between morphological characters and bulb characters with bulb yield was studied.

Association of different characters with bulb yield

Bulb yield was found to be positive and highly significant correlated with plant height (rg 0.243 and rp 0.213), neck thickness (rg 0.536 and rp 0.454), number of rings (rg 0.582 and rp 0.574), days to maturity (rg 0.531 and rp 0.524), polar bulb diameter (rg 0.747 and rp 0.719), equatorial bulb diameter (rg 0.880 and rp 0.577), and bulb weight (rg 0.828 and rp 0.740) for both genotypic and phenotypic correlation co-efficient level. While, bulb doubling or splitting (rg - 0.542 and rp -0.535) was found to be significant but negatively correlated with bulb yield. The number of leaves (-0.096 & -0.083), thrips infestation (-0.112 & - 0.108) and purple blotch disease (-0.054 & -0.052) were found to be non significant but negatively correlated both at genotypic and phenotypic levels. Quality parameters ascorbic acid (0.138 & 0.131), total sugars (0.041 & 0.046) and reducing sugars (0.205 & 0.196) were found to be positively correlated with bulb yield. Positive association

make simultaneous improvement in two or more attributes possible, whereas, negative association indicates the need compromise between desirable characters. Gurjar and singhania[6] reported that the bulb yield was significantly and positively associated with plant height, number of leaves per plant, equatorial and polar bulb diameter. Patil[13] reported significantly negative association of doubles or bulb splitting, thrips and purple blotch with bulb yield.

In the present investigation, the genotypic correlation is higher than phenotypic correlation for all characters indicating little influence of environment and presence of inherent association between various characters. Patil[13] observed that equatorial and polar bulb diameter showed positive significant correlation with bulb yield. Netrapal *et al.*[12], Mohanty[10], Mohanty[11], and Mahanthesh *et al*.[9], reported the positive association between number of leaves and bulb yield. Dhotre *et al.*[5] also observed positive significant correlation of bulb yield with equatorial bulb diameter.Whereas, Hosamani *et al.*[7] reported the positive correlation of bulb diameter and average bulb weight with bulb yield. The results indicated that higher plant height with maximum number of leaves, number of rings, along with equatorial and polar diameter would result in high bulb yield. Selection for these traits results in high bulb yield.

PATH ANALYSIS

Path coefficient analysis was performed to assess the direct and indirect effects of different characters on yield. Even though the correlation analysis can identify the degree of association between two characters, it does not provide reasons such an association. The simple linear correlation coefficient is designed to detect presence of a linear association between two variables. It cannot detect any other of variable association. Thus, a non significant correlation co-efficient value cannot be taken to imply the absence of any functional relationship between the variables. Path coefficient analysis reveals this mystery by breaking the total correlation coefficient into components of direct and indirect effects. Genotypic and phenotypic path coefficients for total yield per plant with fifteen parameters are presented in Table 3 and 4 respectively.

The correlations among various characters were subjected to genotypic path coefficient analysis for partitioning the correlation coefficient values into direct and indirect effects by considering bulb yield as the dependent variable and other characters as independent variables. Genotypic Path analysis revealed that bulb weight exhibited high positive direct effect on bulb yield (1.2262) followed by neck thickness (0.2871), doubles (0.2416), purple blotch incidence (0.1721), total sugars (0.1029), polar bulb diameter (0.0524), number of rings (0.0059) and plant height (0.0038).However, negative direct effect of number of leaves (-0.1207), days to maturity (-0.0266), equatorial bulb diameter (-0.2847), bulb shape index (-0.1479), ascorbic acid (- 0.2642), reducing sugars (-0.1334) and thrips infestation (-0.1220) were observed on bulb yield. The bulb weight is an important attribute of bulb yield as it has relatively high positive direct effect. These results are in confirmation with the findings of and Patil[13], Balareddy[2] and Gurjar and Singhania[6] who recorded high direct effect of bulb weight on yield. Phenotypic path analysis revealed that bulb weight exhibited high positive direct effect on bulb yield (1.2262) followed by neck thicken (0.2871), total sugars (0.1029) and polar bulb diameter (0.0524). However, negative direct of number of leaves (-0.1207), days to maturity (-0.0266), equatorial diameter (-0.2847), bulb shape index (-0.1479), ascorbic acid (-0.2642) and thrips infestation (-0.1220). positive direct effect of bulb weight was reported by Hyder *et al*.[8] and Hosamani *et al*.[7]. Patil[13] and Balareddy[2] recorded high direct effect of bulb weight on yield Gurjar and singhania[6] reported negative direct effect of equatorial bulb diameter on bulb yield. Mohanty[11] observed positive effect on bulb yield. Yousefi *et al*.[16] observed the thrips effect on bulb yield. Similar results have been reported by Cardona *et al*.[3] and Feri *et al*. Genotypes having glossy foliage were resistant to thrips[1]. In general, it

could be inferred that equatorial and polar bulb diameter, bulb weight, days to maturity, number of rings and neck thickness should be given more importance for selecting genotypes. Therefore, these characters can be considered for selection of high yielding variety in onion.

Table 1. Genotypic correlation coefficients among growth and yield characters in onion

Character	Yield (t/ha)	Plant height (cm)	Number of leaves	Neck thickness (mm)	Days to maturity	Polar bulb diameter (mm)	Equatorial bulb diameter (mm)	Bulb shape index	Number of rings	Doubles (%)	Bulb weight (gm)	Ascorbic acid (mg/100gm)	Total sugars (%)	Reducing sugars (%)	Thrips infestation (%)	Purple blotch (%)
Yield (t/ha)	**1.000**															
Plant height (cm)	0.243*	**1.000**														
Number of leaves	-0.096	0.780**	**1.000**													
Neck thickness (mm)	0.536**	0.668**	0.367**	**1.000**												
Days to maturity	0.531**	0.074	-0.176	0.409**	**1.000**											
Polar bulb diameter (mm)	0.747**	0.237*	-0.080	0.698**	0.517**	**1.000**										
Equatorial bulb diameter (mm)	0.880**	0.231*	-0.164	0.733**	0.654**	0.985**	**1.000**									
Bulb shape index	0.018	-0.427**	-0.601**	-0.201	-0.289**	-0.551**	-0.843**	**1.000**								
Number of rings	0.582**	0.265*	-0.142	0.575**	0.516**	0.646**	0.775**	0.091	**1.000**							
Doubles (%)	-0.542**	0.075	0.342**	-0.434**	-0.534**	-0.625**	-0.764**	-0.098	-0.673**	**1.000**						
Bulb weight (gm)	0.828**	0.058	-0.266*	0.525**	0.648**	0.863**	0.957**	-0.036	0.725**	-0.790**	**1.000**					
Ascorbic acid (mg/100gm)	0.138	-0.048	-0.226*	0.235*	0.235*	0.259*	0.260*	0.303**	0.331**	-0.180	0.282**	**1.000**				
Total sugars (%)	0.041	-0.199	-0.189	0.103	0.168	0.159	0.161	-0.451**	0.160	-0.008	0.164	0.440**	**1.000**			
Reducing sugars (%)	0.205	-0.357**	-0.461**	0.108	0.428**	0.257*	0.332**	-0.316**	0.260*	-0.218*	0.367**	0.351**	0.588**	**1.000**		
Thrips infestation (%)	-0.112	0.332**	0.523**	0.159	0.002	-0.069	-0.096	-0.264*	-0.310**	0.341**	-0.129	-0.056	0.076	0.126	**1.000**	
Purple blotch (%)	-0.054	0.432**	0.608**	0.293**	-0.057	-0.023	-0.048	-0.291**	-0.224*	0.272*	-0.139	-0.147	-0.020	-0.034	0.927**	**1.000**

Table 2. Phenotypic correlation coefficients among growth and yield characters in onion

Character	Yield (t/ha)	Plant height (cm)	Number of leaves	Neck thickness (mm)	Days to maturity	Polar bulb diameter (mm)	Equatorial bulb diameter (mm)	Bulb shape index	Number of rings	Doubles (%)	Bulb weight (gm)	Ascorbic acid (mg/100gm)	Total sugars (%)	Reducing sugars (%)	Thrips infestation (%)	Purple blotch (%)
Yield (t/ha)	**1.000**															
Plant height (cm)	0.213*	**1.000**														
Number of leaves	-0.083	0.682**	**1.000**													
Neck thickness (mm)	0.454**	0.527**	0.281**	**1.000**												
Days to maturity	0.524**	0.065	-0.153	0.355**	**1.000**											
Polar bulb diameter (mm)	0.719**	0.220*	-0.052	0.607**	0.509**	**1.000**										
Equatorial bulb diameter (mm)	0.577**	0.152	-0.044	0.518**	0.456**	0.869**	**1.000**									
Bulb shape index	-0.013	-0.090	-0.108	-0.011	-0.076	-0.129	-0.037	**1.000**								
Number of rings	0.574**	0.241*	-0.127	0.499**	0.513**	0.634**	0.540**	0.015	**1.000**							
Doubles (%)	-0.535**	0.068	0.300**	-0.374**	-0.533**	-0.614**	-0.530**	-0.029	-0.671**	**1.000**						
Bulb weight (gm)	0.740**	0.053	-0.170	0.445**	0.602**	0.822**	0.787**	0.047	0.665**	-0.728**	**1.000**					
Ascorbic acid (mg/100gm)	0.131	-0.045	-0.201	0.224*	0.226*	0.252*	0.209*	0.095	0.316**	-0.172	0.277**	**1.000**				

Total sugars (%)	0.046	-0.193	-0.131	0.103	0.160	0.156	0.145	-0.062	0.153	-0.007	0.144	0.390**	**1.000**			
Reducing sugars (%)	0.196	0.318**	0.402**	0.096	0.422**	0.256*	0.254*	0.115	0.258*	0.216*	0.340**	0.339**	0.544**	**1.000**		
Thrips infestation (%)	-0.108	0.301**	0.453**	0.133	0.002	-0.068	-0.069	-0.087	-0.308**	0.340**	-0.121	-0.054	0.071	0.123	**1.000**	
Purple blotch (%)	-0.052	0.386**	0.520**	0.252*	-0.057	-0.022	-0.032	-0.099	-0.221*	0.270*	-0.130	-0.135	-0.013	-0.032	0.922**	**1.000**

Table 3. Genotypic path among growth and yield characters in onion

Character	Plant height (cm)	Number of leaves	Neck thickness (mm)	Days to maturity	Polar bulb diameter (mm)	Equatorial bulb diameter (mm)	Bulb shape index	Number of rings	Doubles (%)	Bulb weight (gm)	Ascorbic acid (mg/100gm)	Total sugars (%)	Reducing sugars (%)	Thrips infestation (%)	Purple blotch (%)	Yield (t/ha)
Plant height (cm)	0.0038	0.0942	-0.1918	0.0038	0.0124	-0.0656	0.0632	-0.0016	0.0181	0.0714	0.0128	-0.0205	0.0477	-0.0405	0.0744	0.243*
Number of leaves	0.0030	-0.1207	-0.1054	0.0093	-0.0042	0.0468	0.0888	0.0008	0.0826	-0.3257	0.0597	-0.0194	0.0615	-0.0638	0.1047	-0.096
Neck thickness (mm)	0.0025	0.0443	0.2871	-0.0068	0.0366	-0.2086	0.0298	-0.0034	-0.1047	0.6433	-0.0622	0.0106	-0.0145	-0.0193	0.0503	0.536**
Days to maturity	-0.0005	-0.0423	-0.0737	-0.0266	0.0255	-0.1678	0.0262	-0.0039	-0.1539	0.7856	-0.0791	0.0156	-0.0483	0.0367	-0.0606	0.531**
Polar bulb diameter (mm)	0.0009	-0.0097	-0.2003	-0.0130	0.0524	-0.3117	0.0815	-0.0038	-0.1509	1.0000	-0.0684	0.0164	-0.0342	0.0085	-0.0039	0.747**
Equatorial bulb diameter (mm)	0.0009	-0.0199	-0.2103	-0.0157	0.0574	-0.2847	0.1247	-0.0046	-0.1846	1.0000	-0.0688	0.0166	-0.0442	0.0118	-0.0082	0.880**
Bulb shape index	-0.0016	-0.0725	0.0578	0.0047	-0.0289	0.2401	-0.1479	-0.0005	-0.0236	-0.0438	-0.0801	-0.0464	0.0422	0.0322	-0.0500	0.018
Number of rings	0.0010	-0.0172	-0.1650	-0.0175	0.0338	-0.2207	-0.0135	0.0059	-0.1627	0.8885	-0.0876	0.0165	-0.0347	0.0378	-0.0386	0.582**
Doubles (%)	0.0003	0.0413	0.1245	0.0170	-0.0327	0.2176	0.0144	0.0040	0.2416	-0.9688	0.0476	-0.0008	0.0291	-0.0416	0.0467	-0.542**
Bulb weight (gm)	0.0002	-0.0321	-0.1506	-0.0171	0.0452	-0.2724	0.0053	-0.0043	-0.1909	1.2262	-0.0745	0.0169	-0.0490	0.0157	-0.0239	0.828**
Ascorbic acid (mg/100gm)	-0.0002	-0.0273	-0.0676	-0.0080	0.0136	-0.0741	-0.0448	-0.0019	-0.0436	0.3460	-0.2642	0.0453	-0.0468	0.0068	-0.0252	0.138
Total sugars (%)	-0.0008	-0.0228	-0.0296	-0.0041	0.0083	-0.0459	0.0667	-0.0009	-0.0020	0.2008	-0.1163	0.1029	-0.0785	-0.0093	-0.0034	0.041
Reducing sugars (%)	-0.0014	-0.0557	-0.0311	-0.0096	0.0135	-0.0944	0.0468	-0.0015	-0.0527	0.4501	-0.0928	0.0605	-0.1334	-0.0153	-0.0058	0.205
Thrips infestation (%)	0.0013	0.0631	-0.0455	0.0080	-0.0036	0.0275	0.0391	0.0018	0.0824	-0.1581	0.0148	0.0079	-0.0167	-0.1220	0.1595	-0.112
Purple blotch (%)	0.0016	0.0735	-0.0840	0.0094	-0.0012	0.0136	0.0430	0.0013	0.0656	-0.1705	0.0388	-0.0020	0.0045	-0.1131	0.1721	-0.054

Table 4. Phenotypic path among growth and yield characters in onion

Character	Plant height (cm)	Number of leaves	Neck thickness (mm)	Days to maturity	Polar bulb diameter (mm)	Equatorial bulb diameter (mm)	Bulb shape index	Number of rings	Doubles (%)	Bulb weight (gm)	Ascorbic acid (mg/100gm)	Total sugars (%)	Reducing sugars (%)	Thrips infestation (%)	Purple blotch (%)	Yield (t/ha)
Plant height (cm)	**0.0036**	-0.0040	0.0391	-0.0037	0.0223	0.0355	0.0031	0.0450	0.0281	0.1714	0.0127	-0.0205	0.0477	0.0402	0.0241	0.213*
Number of leaves	0.0280	**-0.1205**	0.0534	-0.0093	0.0141	-0.0167	0.0002	-0.0007	0.0268	0.0957	0.0597	-0.0194	0.0616	0.0363	0.0093	-0.083
Neck thickness (mm)	0.0241	-0.0082	**0.1867**	-0.0068	0.0361	0.0083	0.0012	0.0022	0.0286	0.2433	-0.0622	0.0106	-0.0145	0.0492	0.0101	0.454**
Days to maturity	0.0225	-0.0021	0.0153	**-0.1268**	0.0252	0.0150	0.0014	0.0026	0.0153	0.1856	-0.0790	0.0156	-0.0484	0.0164	0.0010	0.524**
Polar bulb diameter (mm)	0.0283	-0.0096	0.0169	-0.0330	**0.1051**	0.0567	0.0001	0.0640	0.0225	0.2180	-0.0683	0.0163	-0.0343	0.0041	0.0058	0.719**
Equatorial bulb diameter (mm)	0.0284	0.0198	-0.0101	-0.0357	0.0657	**0.0843**	-0.0002	0.0643	0.0017	1.1731	-0.0687	0.0166	-0.0433	0.0116	0.0028	0.577**
Bulb shape index	0.0035	-0.0023	0.0277	-0.0097	0.0285	-0.0196	**0.0002**	0.0005	-0.0053	0.0437	-0.0800	-0.0463	0.0422	0.0582	0.0098	-0.013
Number of rings	0.0232	0.0171	0.0164	-0.0176	0.0334	0.0453	0.0001	**0.1405**	0.0420	0.1885	-0.0875	0.0165	-0.0348	0.0375	0.0084	0.574**
Doubles (%)	-0.0012	0.0041	-0.0124	0.0070	-0.0124	-0.0003	0.0001	-0.0037	**-0.1457**	-0.1689	0.0476	-0.0008	0.0291	-0.0641	-0.0115	-0.535**
Bulb weight (gm)	0.0421	-0.0320	0.0504	-0.0371	0.0647	0.0420	0.0002	0.0497	0.0590	**0.4262**	-0.0745	0.0168	-0.0490	0.0561	0.0082	0.740**
Ascorbic acid (mg/100gm)	-0.0001	-0.0272	-0.0675	-0.0080	0.0134	-0.0740	-0.0001	-0.0018	-0.0436	0.3459	**-0.2642**	0.0453	-0.0469	0.0067	-0.0251	0.131
Total	-	-0.0227	-0.0296	-0.0040	0.0082	-0.0458	0.0002	-0.0008	-0.0019	0.2008	-0.1163	**0.1029**	-0.0786	-0.0092	-	0.046

sugars (%)	0.0007														0.0033	
Reducing sugars (%)	-0.0012	-0.0556	-0.0311	-0.0097	0.0133	-0.0942	0.0001	-0.0014	-0.0527	0.4501	-0.0927	0.0605	**-0.1337**	-0.0152	-0.0057	0.196
Thrips infestation (%)	-0.0129	0.0026	-0.0275	0.0080	-0.0193	-0.0074	-0.0002	-0.0271	-0.0482	-0.0980	0.0147	0.0078	-0.0167	**-0.2121**	0.0359	-0.108
Purple blotch (%)	-0.0025	0.0037	-0.0238	0.0049	-0.0171	-0.0061	-0.0001	-0.0192	-0.0456	-0.0745	0.0387	-0.0020	0.0045	-0.1124	**-0.0471**	-0.052

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