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Correlation and Path Coefficient Analysis for Some Yield-related Traits in Onion (*Allium cepa* L.)

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Abstract: The associations among growth and yield components and their direct and indirect influence on the bulb yield of onion were investigated. For this purpose, experiments were laid out which consisted of four levels of nitrogen (0, 50, 100 and 150 kg N ha^{-1}), three levels of phosphorus (0, 17.5 and 35 kg P ha^{-1}) and four intra-row spacing (10, 15, 20 and 25 cm), laid out in a split-plot design. Correlation and path coefficient analysis in onion showed that cured bulb yield had significant positive correlation with plant height, number of leaves per plant, bulb diameter and bulb weight but had negative association with percentage-culled bulbs. Path analysis indicated that bulb diameter, plant height and number of leaves per plant were the principal component of yield.

Key words: Correlation, path coefficient analysis, onion

INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important crops among the vegetables in Nigeria. It is produced widely and has been for long an important commercial vegetable in the northern part of this country and the bulk of the crop in produced during dry season through irrigation (Amans *et al*., 1990).

A little attention has been given to improve the yield potentials of this crop. Yield could be regarded as a complex character, which is dependent on a number of agronomic characters and is influenced by many factors, which could be genetic or environmental (Udin *et al*., 1985). For this reason direct selection for yield can be misleading. Therefore, if improvement is to be made through selection, knowledge of the nature and degree of association of yield and yield contributing characters is very essential (Rahman *et al*., 2002).

Path coefficient analysis is the partitioning of total correlation into direct and indirect percentage contribution of various yield components to the final bulb yield in onion. The advantage of path-coefficient analysis is that it permits the partitioning of the correlation co-efficient into its components. In agriculture, path analysis has been used by plant breeders to assist in identifying traits that are useful as selection criteria to improve crop yield (Surek and Beser, 2003; Milligan *et al*., 1990).

In this study, attempt was made to study the direct and indirect influences of some important yield components among themselves and to yield through path analysis.

MATERIALS AND METHODS

The experiments were conducted at the Usmanu Danfodiyo University, Sokoto Teaching and Research *(fadama)* farm (13°, 01'N latitude, 05°, 15'E longitude) 300 m altitude, during 2003/2004 and 2004/2005 rainy seasons.

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The treatments consisted of four levels of nitrogen (0, 50, 100 and 150 kg N ha^{-1}), three levels of phosphorus (0, 17.5 and 35 kg P ha^{-1}) and four intra-row spacing (10, 15, 20 and 25 cm). The treatments were laid out in a split plot design and replicated three times with nitrogen in the main plot and spacing and phosphorus in the sub-plots. The unit plot size was 3×2 m^2. Transplanting was made on the I4th December in both seasons. The entire dose of phosphorus was applied as basal before transplanting. Half of the nitrogen was applied at 2 Weeks After Transplanting (WAT), while the remaining at 6WAT.

Meteorological data was obtained from the Sokoto Energy Research Center of the Usmanu Danfodiyo University, Sokoto for the two seasons. Data collected was on the number of leaves per plant. Plant height, crop growth rate, relative growth rate, bulb diameter, individual bulb weight cured bulb yield and percentage culled bulbs. These were recorded from the five randomly selected plants from each unit plot. Simple correlation coefficients were estimated using the formula of Steel and Torrie (1960) and path coefficient analysis was done according to the methods of Dewey and Lu (1959) and Snedecor and Cochran (1987), respectively. The data in 2003/2004 and 2004/2005 were analyzed separately.

RESULTS AND DISCUSSION

The analysis of variance (Table 1) revealed highly significant differences in all the parameters under investigation in both years. The correlations among all pairs of variables in 2003/2004 and 2004/2005 are shown in Table 2. The traits significantly correlated with cured bulb yield at 0.01 levels.

Table 1: Range mean values and analysis of variance for the characters in the 2003/2004 and 2004/2005

				Mean sun of squares	
Characters	Year	Mean	SE±	Entries	Error
Plant height (cm)	2003/2004	39.47	1.87	47.05**	3.52
	2004/2005	32.96	0.64	45.51**	1.41
Number of leaves/plant	2003/2004	11.61	0.52	6.12**	0.27
	2004/2005	10.09	0.40	6.01	0.22
Crop growth rate (g/m^2/day	2003/2004	0.62	0.08	0.21**	0.06
	2004/2005	0.66	0.11	0.26**	0.01
Bulb diameter (cm)	2003/2004	7.51	0.49	13.10**	0.01
	2004/2005	7.16	0.38	14.48**	0.38
Bulb weight (g)	2003/2004	180.25	21.87	9740.63**	81.29
	2004/2005	139.01	9.29	5377.76**	86.35
Cured bulb yield (t ha^{-1})	2003/2004	30.37	2.90	439.09**	8.46
	2004/2005	27.34	2.30	300.50**	2.30

** Significant at p = 0.01 level

Table 2: Phenotypic correlations among the traits in 2003/2004 and 2004/2005 dry seasons at Sokoto

Characters	Year	Cured bulb	No. of leaves/plant	Plant height	Crop groth rate	Bulb diameter	Blub weight
Number of	2003/2004	0.783**	----				
leaves/plant	2004/2005	0.884**	----				
Plant	2003/2004						
height	2004/2005	0.826**	0.753**	----			
		0.775**	0.725**	----			
Crop growth	2003/2004	0.652**	0.692**	0.599**	----		
rate	2004/2005	0.650**	0.771**	0.543**	----		
Bulb diameter	2003/2004	0.657**	0.719**	0.568**	0.584**	----	
	2004/2005	0.809**	0.879**	0.398**	0.743**	----	
Bulb weight	2003/2004	0.645**	0.650**	0.650**	0.646**	0.770**	----
	2004/2005	0.801**	0.831**	0.558**	0.767**	0.905**	----

**Significant at p = 0.01level

Table 3: Path analysis showing direct and indirect effect of traits on tread bulb yield in 2003/2004 and 2004/2005 dry seasons at Sokoto

Characters	Year	No. of leaves/plan	Plant height	Crop groth rate	Bulb weight	Bulb diameter	Correlation with cured yiek
Number of	2003/2004	0.66	0.49	0.45	0.47	0.44	0.783**
leaves/plant	2004/2005	0.49	0.35	0.38	0.43	0.43	0.884**
Plant	2003/2004	0.46	0.61	0.36	0.34	0.32	0.826**
height	2004/2005	-0.10	-0.14	-0.07	0.05	-0.05	0.775**
Crop growth	2003/2004	0.36	0.31	0.52	0.30	0.30	0.652**
rate	2004/2005	-0.21	-0.12	-0.23	-0.17	-0.17	0.650**
Bulb weight	2003/2004	0.33	0.28	0.33	0.52	0.93	0.645**
	2004/2005	0.41	0.34	0.38	0.50	0.46	0.801**
Bulb diameter	2003/2004	0.76	0.65	0.62	0.82	1.06	0.657**
	2004/2005	-0.31	-0.24	-0.26	-0.32	-0.35	0.809**

**Significant at $p = 0.01$ level

Cured bulb yield showed significantly positive association with plant height, number of leaves per plant, crop growth rate, relative growth rate, bulb diameter and individual bulb weight but negative association with percentage-culled bulbs. Number of leaves per plant exhibited strong positive correlation with plant height, bulb weight, bulb diameter and fresh bulb yield. Also crop growth rate shows positive and significant association with all the components except the percentage culled bulbs. This trend of relationship was maintained between relative growth rate, bulb diameter, individual bulb weight and other variables.

The strong correlation among these characters indicated that these characters were governed by the same genetic system; that is the characters were expected to be linked to each other. Consequently selecting plants for good characters may lead to an improvement of yield in onion. Significant positive correlations of onion yield and other yield variables such plant height, leaf number per plant, bulb diameter and bulb weight were reported by Vavidel *et al.* (1981), Pandian and Muthukrishnan (1982), Rahman and Das (1985) and Rahman *et al.* (2002).

Path analysis (Table 3) revealed that Relative Growth Rate (RGR) had very high negative direct effect (-0.39) in 2003/2004 and (-0.07) in the 2004/2005, respectively on the cured bulb yield though its correlation with the yield was positive and highly significant. This might be due to high positive indirect effect via leaf number per plant (0.36) plant height (0.27) bulb diameter (0.65) and bulb weight (0.28), respectively in the 2003/2004 season. The negative direct effect indicated that variety with low relative growth rate could be developed without sacrificing total bulb yield. Bulb diameter had the highest positive direct effect (1.06) in building up the correlation with total cured bulb yield (0.7169). Plant height, number of leaves per plant crop growth rate and individual bulb weight also showed positive direct effects. The indirect effects of number of leaves per plant via RGR, plant height via RGR, number of leaves via bulb diameter, bulb diameter via RGR were negative, even though their correlation with the bulb yield was positive and significant. The findings in this research was in agreement with that of Rahman *et al.* (2002) where they reported positive direct effects of number of leaves per plant, plant height, bulb diameter and bulb weight on the cured bulb yield of onion.

In both correlation and path coefficient analysis it may be inferred that number of leaves per plant, plant height, bulb diameter and individual bulb weight were important for total cured bulb yield in onion. Therefore any attempt to increase the yield of onion should be geared to wards encouraging these important attributes.

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