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CORRELATIONS AND PATH – COEFFICIENT ANALYSIS OF YIELD AND YIELD COMPONENT OF CASTOR (*RICINUS CUMMUNIS* L.) ACCESSIONS

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ABSTRACT

This study was conducted to demonstrate the significance of path-Coefficient analysis in determining the nature of character association in nine castor accessions in randomized complete block design. The result of phenotype correlation revealed that panicle per plant, capsule per plant, Number of panicles per plant and branches per plant had positive significant association with castor seed yield. Panicle per plant was positively and significantly correlated with capsule per plant, panicle length, Branches per plant and seed yield. Path coefficient analysis showed that panicle length per plant had maximum positive direct effect on seed yield. This present studies suggest that direct selection for greater number of panicle length per plant may increase yield of castor in the accession studied.

Keywords: Castor, path coefficient, analysis, correlations, Accessions, seed yield.

INTRODUCTION

Castor bean (*Ricinus communis* L.) belongs to the family Euphorbiacea, a family made of many vegetables that are mostly indigenous to Tropical areas (Waynes *et al*., 1999; Zade and Myandoab, 2012). It is cultivated around the world because of the commercial importance of its oil and India is the world's largest producer of castor seed-producing 8 to 8.5 lakh tones of castor seed annually; accounting for more than 60% of the entire global production (NMCE: www.nmce.com). India, China and Brazil are the major castor growing countries, accounting for 90% of the world's production.

The castor bean plant has been cultivated for centuries for the oil produced by the seeds and the Egyptians burned castor oil in their lamps more than 4000 years ago (Oplinger *et al*., 1990). Castor oil has been used in the production of aircraft lubricants, hydraulic fluids and in the manufacturing of explosives in the United States. It has been used in the manufacture of soaps, linoleum, printer ink, nylon, varnishes, enamels, paints and electrical insulations. Castor is useful in textile industry in dyeing and finishing of fabrics and leather. Furthermore, castor has great potentials for growth in Nigeria with its diverse usage in Military, Pharmaceuticals', Medicals, Textile, paint manufacturing etc. Therefore, considering its wide genetic background coupled with high yield potentials, great improvement can be achieved through breeding of this relatively new crop in Nigeria (Adeyanju *et al*., 2010)

Correlations are very important in plant breeding because of their reflection in dependence degree between two or more characters. If there is genetic correlation between traits in the case of direct selection of one trait, this can cause a change in another trait. Correlations between traits are dependent on genetic and environmental factors (Singh, 2007). Correlation studies between characters have been of great value in determination of the most effective procedures for the selection of superior genotypes (Adebisi *et al*., 2004). Ado *et al*., (1988), earlier reported that correlation studies including path analysis is a powerful tool for finding out reliable traits associations for aiding and development of superior genotypes.

Correlations express only the degree of interrelationships between traits, while path analysis shows analytically better survey of yield expression as a resultant of its components. Path coefficients divided correlation coefficients into a measure of direct and indirect effects within a system of correlated traits (Udin, 1999). Path coefficients show direct influence of independent variable upon dependent variable, but indirect influence of one independent variable through other independent variable on dependent variable describe results between simple correlation of independent variables and their separate direct influence (Zecivic *et al.*, (2004). The knowledge of phenotypic interrelationships between yield and yield component will give additional information that will make possible successful work of castor breeding. Although correlation and path analysis have been extensively studied in castor in other parts of the world, there has been little information for these crop under Nigeria condition. Therefore, this study was undertaken to estimate the phenotypic correlations and path coefficient analysis of yield and yield component in castor.

MATERIALS AND METHODS

Nine castor accessions collected from different locations of Northern and southern guinea Savannah Agro-ecological zones of Nigeria (Kaduna, Nasarawa, Benue, Enugu and Plateau States) were examined. The experiments were laid out in randomized complete block design in three replications in two locations of the Research Farm sites of University of Agriculture, Makurdi and College of Agriculture Lafia.

Three ridged row plots of 3m lengths were used and each row was seeded to 7 hills of two seeds that were thinned to one seed per hill after three weeks of planting at the two locations. The rows were 0.75 m apart and the hills were spaced 0.5m intra rows. In each plot, 5 plants from the middle row were used for observation of the following traits: plant height, leaf area, nodes to first panicle, panicle length, number of panicles per plant, number of branches per plant, number of capsule per plant, percent shattering, days to 50% flowering, days to 50% maturity, hundred seed weight, seed yield per plant and seed yield per hectare. The phenotypic correlation coefficients between pairs of characters were calculated to determine their association from the variance components by the method described by Singh (2007). The correlation coefficients were partitioned into direct and indirect effects according to Wright (1968); Dewey and Lu (1959).

RESULTS AND DISCUSSION

The correlation coefficients among thirteen characters of castors pooled across the two locations (Makurdi and Lafia) is presented in table 1. Plant height had a significant positive correlation with branches per plant (r = 0.526*), days to 50% maturity (r = 0.271*) and 100 seed weight (r = 0.292*). Significant positive association was recorded between number of capsule per plant with panicle length per plant and seed yield per plant, while there was a negative correlation between number of capsule per plant with nodes to primary panicle (r = -0.519**), days to 50% flowering (r = -0.382**), days to maturity (r = -0.623**), percentage shattering (r =-0.750**) and hundred seed weight (r = -0.504**). This result corroborates with the findings of Ahmed *et al*., (2012).

Panicle per plant exhibited highly positive and positive correlation with capsule per plant (r = 0.477**), panicle length (r = 0.303*), branches per plant (r = 0.548**) and seed yield (r = 0.625*). This indicated that cultivars with high number of panicles contributed higher to seed yield.

Significant and positive relationships observed between days to 50% flowering and days to maturity (r =0.496**) and Seed yield per plant (r = 0.318*). Significant positive and negative correlations was exhibited between days to 50% maturity and seed yield per plant (r = -0.556*).

Yield related characters that recorded very high positive correlation with seed yield per plant are panicle per plant (r = 0.625**), number of capsules per plant (r = 0.650**), panicle length per plant (r = 0.543**) and number of branches per plant (r = 0.428**). Similar results of association between such yields related characters were observed by Dhedhi *et al*., (2010) and Guler *et al.*, (2001).

Number of capsule per plant exhibited significant negative association with number of primary panicle (r = -0.519**), days to50% flowering (r = -0.382**), days to 50% maturity (r = -0.623**) and hundred seed weight (r = -0.504**). This result suggests that any positive increase in such traits will accelerate the boost in seed yield per plant.

Nodes to primary panicle had highly positive significant correlation with days to 50% flowering (r = 0.691**), days to maturity (r = 0.589**) and hundred seed weight (r = 0.386**). However, nodes to primary panicle recorded a negative significant correlation with panicle length per plant (r = -0.394**), number of branches per plant (r = -0.880**) and seed yield per plant (r = 0.377**). Also panicle length per plant showed a high negative correlation with hundred seed weight (r = -0.351**).

Branches per plant had significantly negative correlation with days to 50% flowering (r = -0.423**). This implies that the more the number of branches per plant the number of days to 50% flowering decreases. Although branches per plant had a positive significant correlation with seed yield per plant (r = 0.428**). The number of branches per plant is an important yield component as the flower bearing pedicles are produced at the branch nodes. Increase in pod yield can be selected via number of branches per plant as reported by Abimiku and Bello (2010).

PATH COEFFICIENT ANALYSIS

In order to determine the relationship between seed yield per plant and other examined characters, correlation coefficient and regression analysis were calculated. Regression of seed yield on panicle length and plant height in step wise order in table 2 revealed that yield on PLP and pH were highly significant, while the regression of other yield components with yield were not significant. These characters were combined with D50m and Sw100 which are some of the characters that showed high heritability and were used for path coefficient analysis.

The path – coefficients were partitioned into direct and indirect effects by using SYP as a dependent variable.

Fig. 1: A path coefficient diagram to seed yield of some agronomic traits of castor.

1. Panicle length per plant (PLP)
2. Plant height (pH)
3. Days to 50% maturity (D50m)
4. 100-seed weight (SW100)

(X) Residual factors.

From the path-diagram above, four simultaneous equations were derived as follows:

1. $r^{15} = p^{15} + r^{12} + p25 + r13\ p35 + r14\ p45$ .... (1)
2. $r25 = p25 + r12\ p15 + r23\ p35 + r24\ p45$ .... (2)
3. $r35 = p35 + r13\ p15 + r23 + p25 + r34\ p45$.… (3)
4. $r45 = p45 + r14\ p15 + r24 + p25 + r34 + p45$…(4)

Effects of panicle length per plant on seed yield = 0.543
Direct effects, p15 …………. = 0.3796
Indirect effect via plant height, r12 p25 …=0.006009
Indirect effect via 50% days to maturity, r12 p25= 0.23552
Indirect effect via 100-seed weight, r14 p45 = -0.07809
Total effect ………………………… =0.543

The correlation coefficient of the effect of PLP, (r12 = 0.543) on seed yield consist of four components. The relative contribution is as shown in the equation above. The character had a positive direct effect (r = 0.3796) on seed yield but below average. The indirect negative effect through sw100 had smothered the direct effect down.

Effect of plant height on seed yield ………(r25 = 0.102)
Direct effect, p25 …………………… = 0.05778
Indirect effect via PLP, r12 p15 ……… 0.03948
Indirect effect via sw100, r34 p45 …… = -0.5348
Indirect effect via sw100, r34 p45 = 0.05809
Total effects …………….. = 0.102

The direct effect on plant height after harvest on seed yield as partitioned was positive but low average. The negative indirect effect through D50m also further counter influenced the non-significant effects of the net effect in this system making the overall value between plant height and seed yield very low. The results are in line with the findings of Mohammad (1999) and Manga (2006).

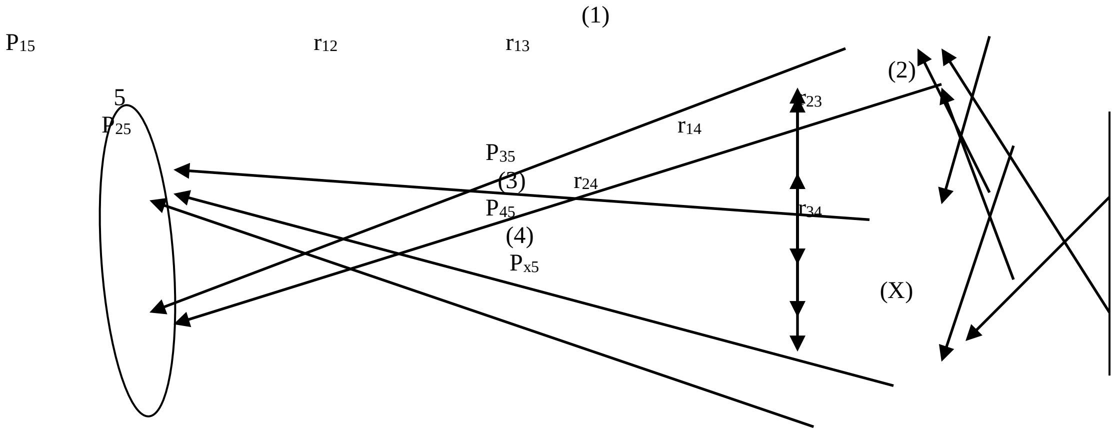

Fig. 1: A Path Coefficient diagram to seed yield of some agronomic traits of castor.

(1) Panicle length per plant
(2) Plant height
(3) Days to 50% maturity
(4) 100-seed weight
(5) Residual factors

In the path-diagram (fig. 1), the double arrowed lines indicated mutual association as measured by correlation rij. The single-arrowed lines represented direct effects as measured by path-coefficient P_{x5}.

Effect of D50m on seed yield r35 …- 0.556
Direct effect, p35……………… -0.45319
Indirect effect via PLP, r13 p15 ………… -0.19728
Indirect effect via pH, r23 p35 ……………0.00682
Indirect effect via SW100, r34 p45…… -+0.08751
Total effects …………………. -0.550

The direct effect of D50 m (r35 = -0.556) on seed yield as partitioned showed direct negative effect to be above average. However, its indirect effect through PH, SW100 were positive and below average, the negative effect through PLP has smothered the direct effect to its present status.

Effect of SW100 on seed yield, r45 …. - 0.0740
Direct effect, p45 ……………… = 0.22266
Indirect effect via PLP, r14p15 ……… -0.1313
Indirect effect via pH, r24 p25 ………0.01507
Indirect effect via D50m, r34 p45 … – 0.17810
Total effects ………………. - 0.0740

The effect of SW100 on Sy showed direct positive effect to be below average. The indirect negative effect through PLP and D50m had smothered the direct effect down. From this present research, it could be concluded that maximum positive direct effect of PLP on seed yield coupled with high value of phenotype correlation (r = 0.543**) suggested that direct selection for this trait for high yield would be effective.

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TABLE 1: CORRELATION COEFFICIENT AMONG THE TRAITS OF CASTOR STUDIED IN MAKURDI AND LAFIA.

Character	PH	LA	LLN	PP	CPP	NPP	PLP	BPP	D50FI	D50M	PS	100SW(g)	SYP(g)
PH		0.28*	0.41	0.189	-0.171	-0.76	0.104	0.526*	-0.035	0.271*	-0.014	0.292*	0.102
LA			0.310*	0.119	-0.299*	0.282*	-0.075	0.286*	0.271	0.205	0.141	0.447**	0.176
LLN				-0.171	-0.262	0.324*	-0.106	-0.049	0.132	0.275*	0.155	0.605**	-0.196
PP					0.477**	-0.361	0.303*	0.548**	-0.317*	-0.416*	-0.342*	-0.139	0.625*
CPP						-0.519**	0.722**	0.159	-0.382**	-0.623**	-0.75*	-0.504**	0.650**
NPP							-0.394**	-0.88*	0.691**	0.589**	0.061	0.386**	-0.377**
PLP								0.249	-0.402**	-0.520**	-0.106	-0.351**	0.543**
BPP									-0.423**	-0.217	-0.205	0.053	0.428**
D50FI										0.496**	0.069	0.210	0.318*
D50M											-0.042	0.393**	-0.556**
PS												0.051	-0.221
100SW(g)													-0.074
SYP (g)													

PH = Plant Height, LA = Leaf Area, LLN = Leaf Lobe Number, PP = Panicle/Plant CPP =Number of Capsule/Plant NPP=Node to Primary Panicle, PLP=Panicle Length/Plant, BPP=Number of Branch/Plant, D50FI=Days to 50% Flowering, D50M = days to 50% Maturity, PS=Percentage Shattering, 100SW=100 Seed Weight and SYP = Seed yield/plant.

** Correlation is significant at 0.01 levels.

* Correlation is significant at 0.05 levels.