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Relationships between some Quantitative Characters in Selected Cowpea Germplasm [(*Vigna unguiculata* L. (Walp)]

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Abstract

The morphotypic variations of eight local varieties ('Achishiru', 'Aloka local', 'Borno local', 'Danila', 'Danmisira', 'Danwuri', 'Kanannado' and 'Yambare') of cowpea [*Vigna unguiculata* L. (Walp)] were studied in relation to their yield in 2004 rainy season. Simple correlation coefficients among the different pairs of variables were computed using mean values for each variable. The genotypic (r_g), phenotypic (r_p) and environmental (r_e) correlation coefficients were estimated. The magnitude of the genotypic correlation coefficients were in most cases higher than their corresponding phenotypic (r_p) and environmental (r_e) correlation coefficients. High and positive r_g exists between days to 50% flowering and plant height (r_g=0.9113), days to maturity and fodder weight (r_g=0.9301), days to maturity and 100 seed weight (r_g=0.6958) and number of leaves per plant and fodder weight (r_g=0.8096). On the other hand, high but negative r_g exists between plant height and pod per plant (r_g=-0.6011). Also, the relationship between days to maturity, and number of seed per pod were all negative and moderate.

Keywords: morphotypic, cowpea, *Vigna unguiculata*, germplasm

Introduction

Cowpea [*Vigna unguiculata* (L) Walp] is considered as the most important legume in west Africa primarily grown in areas where the minimum and maximum temperatures range between 20 °C and 35 °C, respectively during the growing season. Cowpea grows in a wide range of environments covering 40⁰ N to 30⁰ S (Rachie, 1985).

Cowpea is a cheap source of protein (20-26%) and starch (50-67%) (Singh *et al.,* 1997). The leaves, stems and seeds have antimicrobial properties that frequent consumers had lower blood pressures (BP) and total serum cholesterol levels. Consequently, consumers were less likely to be diagnosed with high BP, diabetes and other heart diseases (Brazzino, 2002). In Nigeria, the varieties under cultivation are unimproved, local types which are photoperiod sensitive when planted in the normal planting (rainy) season (June-July), which coincides with long days. When planted in the dry season with irrigation they mature within 60-80 days but remain stunted in growth under low temperature conditions (Mukhtar and Singh, 2006) resulting in poor fodder yields.

Cowpea growth habit ranges from erect, semi-erect, spreading to climbing and trailing types (Steele, 1976) with plant height varying from dwarf (about 15 cm) to tall (over 100 cm). Seeds have various colours (brown, white and speckled), different seed shapes (kidney, void and rhomboid) and sizes as described by Martin *et al.* (1976).

The study of relationships among quantitative traits is important for assessing the feasibility of joint selection of two or more traits and hence for evaluating the effect of selection for secondary traits on genetic gain for the primary trait under consideration. A positive genetic correlation between two desirable traits makes selection easy for improving both traits simultaneously. A negative correlation between two desirable traits makes it impossible to achieve significant improvement in both traits. However, simple correlations do not give a better perspective into the true biological relationships of these traits with yield; being quantitative in nature, is a complex trait with low heritability and depends upon several other components with high heritability (Ezeaku and Mohammed, 2006).

In view of the above, this research is aimed at careful observations of the relationships existing between quantitative characters of the selected varieties and also pave way to find which variety is adapted to this kind of planting season. The investigation of the quantitative characters will also elucidate areas needing attention to make improvement on the growth habit and better adaptation to seasonal variation.

Materials and methods

The study was conducted at the Research Farm and Botanic Garden of the Department of Biological Science, Bayero University, Kano, Nigeria (latitude $11^0 55'$ N and

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longitude $8^{0}28^{'}$ E). The area falls within the Sudan savannah agroecological zone (Olofin, 1987) characterized by two seasons: the rainy season with long day length, usually begins from May and ends in September with heavier rainfalls in July and August. The dry season is characterized by short day length which begins in October and ends in April/May (Singh, 1992). Total mean rainfall during the period of the study was 756 mm, while the average minimum and maximum temperatures were 22 ^{0}C and 34.8 ^{0}C, respectively. The minimum and maximum relative humidity recorded in the same period were 33.1 and 56.0%, respectively. The treatments consisted of eight cowpea varieties planted in a completely randomized block design with four replications. The experimental unit was four row plot of 5 m long spaced at 0.75 m apart with a plant-to-plant spacing of 0.4 m. Seedlings were thinned to two plants per stand at 14 days after planting. Cypercott containing cypermethrin 10% EC) was sprayed at the rate of 1litre/ha at vegetative, flowering and podding stages to protect the crop against the menace of insect pests prevalent in the area.

Five plants each from the two middle rows of each plot were randomly selected for recording days to 50% flowering, plant height, number of leaves per plant, and days to maturity. The border rows were used for estimating leaf area, root length and number of root nodules per plant.

The data obtained were statistically analysed based on Steele and Torrie (1981) procedure and correlation coefficients were computed from variance and covariance components using the formula described by Singh and Chaudhary (1985) where:

$$r_{(X_1X_2)} = \frac{Cov_{(X_1X_2)}}{\sqrt{\sigma_{(X_1)} * \sigma_{(X_2)}}}$$

Where: r (X_1X_2) is the correlation between X_1 and X_2
Cov $(X_1\ X_2)$ is the covariance between X_1 and X_2
V (X_1) is the variance for X_1
V (X_2) is the variance for X_2

Results and discussion

The results of the growth and yield characters studied in this work were presented in Tab. 1. It shows that varieties like 'Kanannado' that matured late (113 DAP) tend to produced longer stem height (153.6 cm) with least pod per plant (5 pod/plant), while 'Achishiru' matured earliest (85 DAP) but produced the highest number of pods per plant (15 pod/plant) but the least fodder (31.3 g). This might be accorded to the differences in response to photosensitivity, which the varieties exhibited greatly.

The correlation coefficients were partitioned into genotypic (r_g), phenotypic (r_p) and environmental (r_e) sources between growth and yield components and presented in Tab. 2. The magnitude of genotypic correlation coefficients were in most cases higher than their corresponding phenotypic (r_p) and environmental (r_e) correlation coefficients indicating inherent relationship between most of the traits studied as suggested by Khairwal *et al.* (1999).

The implication of high positive genotypic correlation observed between days to 50% flowering and plant height (r_g=0.9113) and days to maturity and fodder weight (r_g=0.8872) is that, late flowering varieties tend to produce numerous and longer branches, mature late and produced high amount of fodder as exhibited by 'Kanannado', 'Yambare' and' Danmisira'. On the other hand, the early maturing varieties ('Achishiru' and 'Danwuri') produced few short branches, matured early and produced the least fodder. This might be due to the differences in response to photosensitivity shown by the different varieties. The longer the reproductive period, the greater the number of leaves, stem height and the higher the amount of fodder to expected from a variety (Mukhtar and Singh, 2004). High positive genotypic correlation coefficient exist between days to maturity and 100 seed weight (r_g=0.6958) implying that late maturing varieties tend to produce larger grains. This might be due to the higher photosynthetic efficiency of these varieties (Fagwalawa, 2005).

The high positive phenotypic and genotypic correlation coefficients observed between leaves per plant and fodder weight per plant (r_g=0.7815) suggested that the higher the number of leaves produced by a variety, the heavier the fodder produced by such a variety. This agreed with Littleton *et al.,* (1979) who reported that dry mat-

Tab. 1. Mean values for growth and yield parameters in cowpea.

Varieties	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of leaves plant^{-1}	Fodder weight (g)	Number of pod plant^{-1}	100 seed weight (g)
'Achishiru'	41	69	85.8	38	31.3	15	8.7
'Aloka local'	52	80	114.3	37	47.4	11	14.0
'Borno local'	60	84	96.3	122	75.6	6	11.2
'Danila'	56	84	123.3	108	91.5	12	14.9
Danmisira	68	86	121.6	125	125.2	8	18.
'Danwuri'	46	74	70.2	38	72.2	13	13.3
'Kanannado'	85	113	153.6	141	151.4	5	17.1
'Yambare'	67	89	147.9	157	102.0	16	15.3
Mean	59	84.9	114.1	95.6	87.1	10.7	10.7
C.V. (%)	4.3	12.1	19.1	6.7	10.7	11.16	5.5

Tab. 2. Genotypic, phenotypic and environmental correlation coefficients for growth and yield components in 2004 wet season

Character		Days to mature	Plant height (cm)	Leaves plant^{-1}	Leaf Area (cm^3)	Stem Girth (cm)	Reaction to virus	Pod plant^{-1}	Seed pod^{-1}	Seed weight (g)	100 seed weight (g)	Fodder weight (g)
Days to flowering	rg	0.9720	0.9113	0.8327	0.3694	0.6954	0.7253	-0.6011	-0.6159	0.1114	0.7622	0.9301
	rp	0.9454	0.6820	0.8176	0.2732	0.5816	0.6050	-0.5601	-0.5485	0.1216	0.7315	0.8979
	re	-0.0122	-0.1251	0.2310	-0.0079	0.5169	0.1788	0.0969	0.1514	0.2956	0.1262	0.1895
Days to maturity	rg		0.8945	0.7321	0.1422	0.5512	0.7993	-0.5869	-0.6756	-0.0648	0.6958	0.8872
	rp		0.6856	0.7144	0.1468	0.4311	0.6482	-0.5541	-0.6342	-0.0524	0.6771	0.8468
	re		-0.0215	-0.2196	0.0070	0.1668	-0.0253	0.0234	-0.3089	0.0396	0.2909	-0.2156
Plant height (cm)	rg			0.8479	0.0601	0.4449	0.9944	-0.1869	-0.4061	0.3378	0.7597	0.7872
	rp			0.6174	-0.0615	0.0953	0.4269	-0.1865	-0.2440	0.2063	0.5862	0.5958
	re			-0.4499	-0.2340	-0.4116	-0.5815	-0.2585	0.1946	-0.0630	0.0935	0.0054
Leaf per plant (cm^2)	rg				0.4809	0.6206	0.5968	-0.3253	-0.2528	0.4438	0.5898	0.8096
	rp				0.3888	0.4857	0.4960	-0.2996	-0.2319	0.3735	0.5599	0.7815
	re				0.3466	0.2049	0.1281	0.2377	-0.0090	-0.0980	-0.2080	-0.0062
Leaf area (cm^2)	rg					0.9902	-0.0140	-0.4802	-0.2892	0.6174	0.5311	0.5416
	rp					0.6617	0.0230	-0.3014	-0.1950	0.3764	0.4297	0.3770
	re					0.1796	0.0848	0.2343	0.0255	-0.0770	02541	-0.1362
Stem girth (cm)	rg						0.2911	-0.7062	-0.7107	0.4539	0.8125	0.8067
	rp						0.3157	-0.5104	-0.4599	0.4453	0.5780	0.5592
	re						0.3616	0.0204	0.1589	0.4489	-0.1311	-0.2583
Root length (cm)	rg						0.3928	-0.2224	-0.3425	0.8558	0.4803	0.5471
	rp						0.2933	0.0990	-0.2020	0.5776	0.3330	0.3248
	re						0.1540	0.2653	0.0953	-0.1531	-0.0098	-0.3630
Reaction to virus	rg							-0.3855	-0.5286	0.0909	0.7132	0.7288
	rp							-0.3268	-0.3338	0.1029	0.5776	0.5673
	re							-0.1422	0.3075	0.1335	0.0683	-0.1203
Pod per plant	rg								0.5837	0.2130	-0.3018	-0.4910

ter production is dependent on leaf area with large number of produced when plants maintain relatively large and healthy leaf areas for long time. The negative and low association between leaf area and fodder weight with respect to the environment (r_e=0.0062) further implied that the environment has less effect in the expression of these traits. Similarly, high but negative genotypic correlation coefficient existing between plant height and number of pod per plant (r_g=0.6011) indicated that the variety with profuse vegetative growth habit e.g. 'Kanannado' produced less number of pods as earlier reported by Hadley *et al.* (1983). The moderate negative genotypic correlation coefficient (r=0.5869) and phenotypic correlation coefficient (r_p=0.5541) observed between days to maturity and number of pod per plant, could be attributed to the poor performance of late maturing varieties included in the experiment (Rao, 1981).

Conclusions

Conclusively, the magnitude of genotypic correlation coefficients were in most cases higher than their corresponding phenotypic and environmental correlation coefficients. This showed that relationship between most of the traits studied where inherent and can be exploited in hybridization programmes to develop and select hybrids with superior characteristics.

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