



CORRELATION AND PATH COEFFICIENT ANALYSIS OF SOME GROWTH AND YIELD CONTRIBUTING TRAITS IN COWPEA (*VIGNA UNGUICULATA* (L) WALP.) EXPOSED TO ALPHA-SPIN NANO PARTICLES.

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Manuscript received: 27/11/2018

Accepted: 11/06/2019

Published: June 2019

ABSTRACT

A field experiment was conducted in the Research and Experimental Fields of the Botanical Garden of Federal University Lafia, Nasarawa State to estimate correlation and path co-efficient analysis on growth and yield traits in cowpea exposed to alpha spin nanoparticles. Nine advanced cowpea lines sourced from Institute of Agricultural Research, Samaru, Zaria and one from Nasarawa State Agricultural Programme, Lafia, were sown in a Randomized Complete Block Design in three replications and evaluated for nine morphological and reproductive traits namely vine length, number of leaves, leave area, number of branches, number of pods per plant, pod length, number of seeds per pod, 100 seed weight and seed yield per plant. Among the studied yield contributing traits, number of pod per plant (0.618), number of seed per pod (0.443), pod length (0.698), 100 seed weight (0.818) and number of branches (0.403) showed significant correlation coefficient to yield per plant. 100 seed weight showed highest direct effect ($p=0.850$) to yield followed by number of seed per pod ($p=0.807$). The number of leaves showed highest indirect effect to yield through number of branches ($p=0.147$), followed by vine length through number of leaves ($p=0.116$). The first three Principal Components (PCs) accounted for 81.1% of the total variation implying their high selection stability. This character association study helps to know the contribution of the different characters to total yield; this information helps breeders to improve the yield directly or indirectly by improving yield contributing traits.

Key words: *Vigna unguiculata*, Correlation coefficient, Path coefficient, alpha spin nanoparticles, Yield, Traits

INTRODUCTION

Cowpea is an important grain legume contributing the major protein intake in the resource poor people of the tropical and subtropical regions of the world. It is also a valuable component of farming system in areas where soil fertility is limiting due to its high potentials at fixing nitrogen in soil (Abdu Razakou, 2013; Ajayi and Adesoye, 2013) and its ability to tolerate a wide range of soil pH compared to other grain legumes (Abdu Razakou, 2013).

Direct selection for yield is not much effective as quantitative characters are controlled by polygenes. Hence, the knowledge about association of characters which will directly or indirectly contribute to yield is important. Correlation is the degree of association between traits, which can be strong or weak, positive or negative (Hayes *et al.*, 1955; Ekeobil *et al.*, 1977). Correlation studies between yield and yield components are pre-requisite to plan a meaningful breeding programme (Rafique *et al.*, 2014). It explains the degree of association among the characters.

However, it is difficult to explain a system of correlation when the association between the characters increases. The method of path coefficient analysis developed by Wright (1921) is helpful in partitioning total correlation coefficients into direct and indirect effects, according to findings by several researchers, as more variables are considered in the correlations estimates, the inherent association becomes more complex, less obvious and confusing. At this point, path analysis therefore provides an effective means of untangling direct and indirect causes of associations. Ado *et al.*, (1988) reported that correlation study including path coefficient analysis is a powerful tool for finding out reliable traits association for aiding selection and development of superior genotypes of a crop.

Principal component analysis (PCA) is an example of multivariate methods, and very efficient at examining the relative contribution of individual trait (Vijayan, 2005) under a prevailing condition for diversity in crop species. The method identifies a small set of variables that account for a large proportion of the total variance in the original variable.

PCA and correlation analysis have been used to select both drought tolerant traits and genotypes of cowpea and other crop plant by some workers. Abdou Razakou *et al.*, (2013) employed PCA to screen for drought tolerant and drought susceptible traits in cowpea. However, there is limited information on the use of correlation analysis and PCA for selection of cowpea traits exposed to alpha spin nano particles.

MATERIALS AND METHODS

The work was carried out in the Research and Experimental Fields of the Botanical garden of Federal University Lafia. Nine cowpea genotypes were obtained from the Institute of Agricultural Research (IAR) Samaru, Zaria and one from Nasarawa Agricultural Development Program (NADP), Lafia. These were exposed to alpha spin nanoparticles and were evaluated on the field in a Randomized Complete Block Design in three (3) replications. The cowpeas were Sampea 12, Sampea 11, Sampea 10, Sampea 7, IAR 33, Sampea 6, Sampea 8, Sampea 16, Sampea 17, Sampea 5. Each plot size measuring 3m x 3m (9m²) was manually cleared and ridges were made using hoe. Two seeds each of the selected cowpea varieties were sown per hole with a planting depth of 2cm, with an inter-row spacing of 75cm and intra-row spacing of 50cm respectively. Manual hoe weeding was carried out at two weeks after planting and six weeks after planting respectively. Data were collected on vine length, number of leaves, number of branches, leave area; pod length, number of seed/plant, number of pods per plant and 100 seeds weight were recorded.

RESULTS AND DISCUSSION

Table 1 shows the correlation matrix involving eight (8) attributes and the total grain yield of cowpea as exposed to Alpha-spin Nanoparticles. Significant positive correlation were found between grain yield and 100 seed weight ($r = 0.818^{**}$), Pod Length ($P = 0.698^*$), number of pods per plant and number of seeds per pod ($r = 0.443$). Conversely, grain yield was negatively correlated with vine length ($r = -0.672^*$), number of leaves ($r = -0.576^*$) and leave area ($r = -0.484$). Vine length recorded a negative relationship with number of seed per pod ($r = -0.870$) and 100 seed weight ($r = -0.800$) Negative and significant correlation also existed between number of leaves and number of seed per pod ($r = -0.952$), 100 seed weight ($r = -0.932$) and grain yield ($r = -0.576$). Negative and significant correlations between the morphological traits and some production traits and yield infer that plants with higher vegetative growth (longer vine length and number of leaves) are not necessarily those with highest grain yield and this may be related to greater translocation of photo assimilates for attending to these drains (stems and leaves), to the detriment of the pods and grains. Vine length however, had significant positive correlations with number of leaves ($r = 0.788^*$).

Number of Pod per plant positively correlated with number of seed per Pod ($r = 0.437$), pod length ($r = 0.626$), 100 seed weight ($r = 0.439$), number of

branches (0.891) leave area. The significant positive association between number of pods per plant with seed yield is in par with observations of various workers like Anbumalarmathi *et al.*, (2005), Kumawat and Raje (2005), and Lingara, (2009). The correlation coefficient measures the sum total effects (direct or indirect) of all characters to which it is correlated positively or negatively with and hence, selection based on this value alone will be some time misleading unless the direct effect is very high and operate in the same direction.

Path Coefficient analysis

Path diagrams showing cause and effect relationships of grain yield and its components presented in figure 1. The direct, indirect vegetative and reproductive traits on grain yield are presented in table 2. Path analysis showed the highest positive direct effect of 100 seed weight ($p=0.85$). This character was followed by number of seeds per plant ($p=0.807$), Vine length ($p=0.130$). Number of leaves ($p=-0.317$), Pod length ($p=-0.132$) and leave area ($p=-0.0239$) contributed negative direct effects on grain yield (Table 2). Despite the high negative direct effect of number of leaves to yield, its indirect effects via 100 seed weight, pod length and leave area were positive. The number of pods per plant and 100 seed weight showed positive and direct effect on yield, this was also reported by (Tikka *et al.*, 1978, Chikkadevaiah, 1985). These traits could be used as an index trait while selecting for grain yield.

The highest indirect effect was obtained from number of leaves via number of branches ($p=0.147$) followed by vine length via number of leaves ($p=0.116$) then number of leaves via number of pod/plant (0.082). The seed yield can be improved through increasing number of branches because it exhibited an indirect positive association with number of leaves.

The PCA conducted on the data generated 9 component axes with eigen values ranging from 0.351 to 3.155. The first three principal components (Table 3) with eigen value greater than 0.35 together accounted for about 81.1% of total variation. The first principal component (PC1) contributed approximately 35.5% which 100 seed weight and yield were the major contributors of observed variation in PC1. The

second principal component (PC2) contributed about 28.5 % of the variation mainly observed through the mean number of seeds per pod and mean leaf area. The third (PC3) accounted for another additional approximately 17.5 % of total variation in which vine length was the major contributor. The PCA showed that mean vine length and number of seeds per pod contributed the largest variability suggesting that they can be the main morphological traits to consider for good yield.

The selection directly based on this complex trait (yield) is usually not useful, but the one based on its component traits could be more effective. The basic information on major contributing characters and their inter-relationships is essential to the plant breeder to ensure efficient selection involving two or more characters. Grafius, (1959) reported that there may not be any single gene for yield as such, but operates only through its components. Correlation analysis helps the breeder to work out the selection strategy effectively for seed yield which is regulated by many genes, which is highly complex. This character association study helps to know the contribution of different characters to total yield; this information helps breeders to improve the yield through direct or indirect yield contributing traits.

CONCLUSION

The correlation analysis showed that Number of pod per plant, Number of seeds per pod, 100 Seed weight, pod length and Number of branches are major component that influence yield in the Cowpea varieties treated with alpha-spin nanoparticles. The path analysis study revealed that 100 seed weight and number of seeds per pod exerted higher direct influence on total grain yield while Number of leaves per plant exerted a higher indirect influence on total grain yield through Number of branches. Also, 100 seed weight, mean number of seeds per pod, mean leaf area and vine length accounted for the observed variation among the cowpea varieties used and this could suggest their effective utilization by breeders for selecting and improving cowpea varieties using alpha spin nanoparticles.

Table 1: Correlation matrix involving eight (8) Attributes and Total grain yield in Cowpea as exposed to Alpha Spin Nanoparticles

	PLANT HEIGHT	NUMBER OF LEAVES	NUMBER OF POD/ PLANT	NUMB OF SEED PER POD	POD LENGTH	100 SEED WEIGHT	NUMBER OF BRANCHES PER PLANT	LEAF AREA	YIELD
PLANT HEIGHT	1								
NUMBER OF LEAVES	0.788	1							
NUMBER OF POD PER PLANT	0.024	-0.592	1						
NUMBER OF SEED PER POD	-0.870	-0.952	0.437	1					
POD LENGTH	0.190	-0.174	0.626	0.260	1				
100 SEED WEIGHT	-0.800	-0.939	0.439	0.834	0.161	1			
NUMBER OF BRANCHES PER PLANT	0.086	-0.509	0.891	0.250	0.228	0.513	1		
LEAVE AREA	0.197	-0.340	0.871	0.310	0.925	0.062	0.581	1	
YIELD	-0.672	-0.576	0.618	0.443	0.698	0.818	0.262	-0.484	1

Cell Contents: Pearson correlation
P-Value

Table 2: Direct and Indirect contributions of some growth and yield traits to grain yield of cowpea as exposed to Alpha Spin Nanoparticles.

	PLANT HEIGHT	NUMBER OF LEAVES	MEAN OF POD	MEAN OF SEED PER POD	POD LENGTH	NUMBER 100 SEED WEIGHT	MEAN NUMBER OF BRANCHES	LEAF AREA	CORRELATION
PLANT HEIGHT	0.1300	-0.2827	0.0298	0.0050	0.0392	-0.2490	-0.0036	0.0102	-0.3220
NUMBER OF LEAVES	0.1160	-0.3170	0.0234	-0.0113	0.0249	-0.3940	-0.0001	0.0472	-0.5110
NUMBER OF POD PER PLANT	-0.0430	0.0825	0.0900	-0.0463	-0.0290	0.0960	-0.0124	0.0905	0.0480
NUMBER OF SEED PER POD	-0.0071	-0.0412	-0.0479	0.0870	-0.0460	-0.2190	-0.0118	0.1614	-0.2990
POD LENGTH	-0.0386	0.0600	-0.0201	-0.0306	-0.1320	0.2180	-0.0022	0.0705	0.1250
100 SEED WEIGHT	-0.0381	0.1470	-0.0102	0.0225	-0.0339	0.8500	-0.0097	0.0386	0.9660
NUMBER OF BRANCHES	-0.0202	0.0013	0.0486	0.0446	0.0127	-0.3596	0.0230	-0.1534	-0.4030
LEAVE AREA	-0.0056	0.0625	0.0341	0.0588	0.0390	-0.1374	0.0148	-0.2389	-0.1730

Where: values bold are the direct effects to yield (path coefficient)
Other values are indirect effects via different pathways.

TABLE 3: Principal Component Analysis And Mean Eigenvalues Of The Correlation Matrix Of Cowpea Varieties Exposed To Alpha Spin Nano Particles

Eigenvalue	3.1552	2.5681	1.5752	0.8883	0.4576	0.2488	0.0810	0.0169	0.0090
Proportion	0.351	0.285	0.175	0.099	0.051	0.028	0.009	0.002	0.001
Cumulative	0.351	0.636	0.811	0.910	0.960	0.988	0.997	0.999	1.000
Variable	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9
PLANT HEIGHT	-0.324	-0.274	0.510	0.069	0.329	0.146	0.171	0.471	0.418
MEAN OF LEAVES	-0.348	-0.372	0.333	0.193	0.125	-0.354	-0.427	-0.275	-0.441
MEAN OF POD	0.336	-0.258	-0.260	-0.437	0.554	-0.472	-0.042	0.170	0.035
MEAN OF SEED PER POD	0.182	0.519	-0.261	0.021	-0.226	0.420	-0.574	0.246	0.105
POD LENGTH	0.269	-0.091	-0.248	0.809	0.387	0.065	0.194	0.019	-0.110
MEAN 1000 SEED WEIGHT	0.421	0.260	0.376	0.128	0.130	-0.067	-0.427	-0.357	0.515
MEAN NUMBER OF BRANCHES	-0.360	0.324	-0.339	0.267	-0.146	-0.478	-0.320	0.382	0.286
LEAVE AREA	-0.286	0.431	-0.148	-0.155	0.564	0.462	-0.339	0.000	-0.200
YIELD	0.408	0.291	0.392	0.031	-0.111	-0.055	-0.143	0.583	-0.468

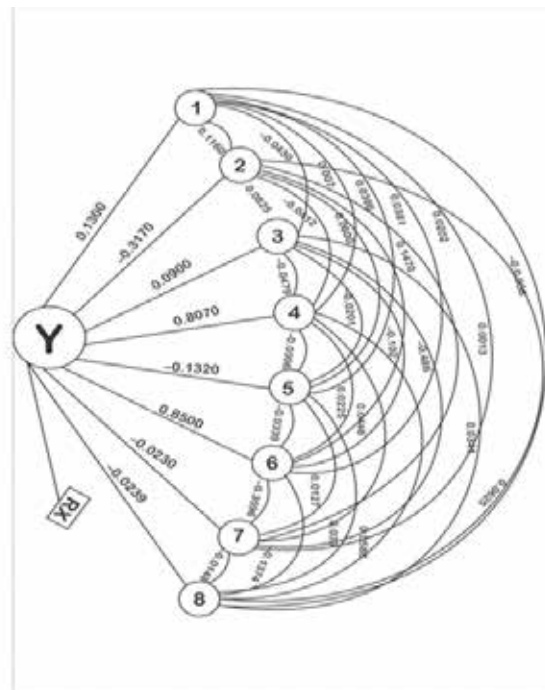


Figure 1: Path diagram showing the direct and indirect effects of eight (8) Attributes on Total yield. 1= Vine Length, 2 = Mean Number of Leaf, 3 = Mean Number of Pod, 4 = Mean Number of Seed, 5 = Mean Pod Length, 6 = Mean 100 Seed Weight, 7 = Mean Number of Branches, 8 = Leave Area

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