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CORRELATION ANALYSIS OF SOME GROWTH, YIELD AND PROTEIN COMPONENTS OF PIGEON PEA [*CAJANUS CAJAN* (L.) MILLSP.] TREATED WITH SODIUM AZIDE AND GAMMA RADIATION

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ABSTRACT

The aim of this study was to determine the correlation between seed yield and some quantitative traits. This was performed by exposing the seeds of landraces pigeon pea to gamma radiation at Centre for Radiotherapy and Oncology Department, ABUTH, Zaria at doses of 0(control), 50, 100, 150 and 200Gy. These seeds were further treated with sodium azide (NaN_3) concentrations at 0.00, 0.01, 0.02, 0.03 and 0.04% SA, giving a total of 25 treatments. The growth parameters were recorded at 4, 8, 12, 16 and 20 Weeks after Planting (WAP). A positive correlation was observed between seed yield and many other quantitative traits like number of pods per plants, mean number of seeds per pod, and protein content.

Keywords: Correlation, Pigeon Pea, Yield Components, Sodium Azide, Gamma Radiation

INTRODUCTION

Pigeon pea belongs to Family Fabaceae, genus *Cajanus*, species *cajan* (L.) Millspaugh, which also contain soybean (*Glycine max* (L) and Field bean *(Phaseolus vulgaris* (L), (Varshney *et al.*, 2012). Pigeon pea originated in India, where the largest diversity exists and is one of the major grain legume (pulse) crops cultivated in many countries in the Tropics and subtropics. Grain legumes are cherished for their opulence in protein which makes them indispensable along with cereals in daily human diet, fuel wood and fodder for small scale farmers in subsistence agriculture (Van der Maesen, 1990). Pigeon pea is an erect perennial legume shrub

often grown as an annual, reaching 91- 366cm in height. Pigeon pea is heat-tolerant, prefers hot moist conditions. It grows in temperature between 18^0C and 30°C and the optimum rainfall required for pigeon pea is 600-1000 mm/year. A rain at flowering time has very adverse effect on the seed yield (Edwards, 1981). Pigeon pea does well in low fertility soils with reasonable water-holding capacity and pH 5-7 is favourable for its growth. Pigeon pea does not tolerate shallow soils or water logging. It tolerates a wide range of soils, from sandy to heavy black clays. It is sensitive to salt spray and high salinity. It is a short day plant, flowering is triggered by short days, whilst with long days plant grows vegetatively and the leaves have three leaflets that are green and pubescent above and silvery greyish – green with longer hairs on the underside. The flowers are yellow with red to reddish-brown lines or red outside (Centre for New Crops and Plants Products, 2002).

MATERIALS AND METHODS

The seeds of pigeon pea (*Cajanus cajan* (L.) Millsp) was obtained from local farmers in Ankpa Local Government Area, latitude 7° 38'E and longitude, 7° 22'N (163m elevation above sea level), Kogi state, Nigeria (Garmin eTrex Venture HC Handheld GPS). The Gamma radiation source (Cirus Cobalt 60 Teletherapy) used for seed treatment was located at the Radiotherapy and Oncology Department, Ahmadu Bello University Teaching Hospital Shika, Zaria. The Sodium azide (SA) used for this research work was manufactured by KEM Light Laboratories P.V.T. Ltd. This research was conducted both in the laboratory and in the Biological Garden of the Department of Biological Sciences, Ahmadu Bello University, Samaru, Zaria (Longitude 07° 39'E and latitude 11° 09'N, 2148 above sea level), Nigeria. (Garmin eTrex Venture HC Handheld GPS). Samaru lies in the Northern Guinea savannah agro-ecological zone of Nigeria with mean annual rainfall of about 1100m. Rainfall in this region is essentially between May and September and dry season between October and April. Hottest months of the year are March and April and the region is with a mean daily temperature of 27°C. The coldest months are November – January (Osuhor *et al.,* 2004)

Exposure of Seeds to Gamma Radiation

Uniform healthy dry seeds of *Cajanus cajan* (L.) Millspaugh were exposed to different doses of gamma rays (control 0, 50, 100, 150 and 200Gy), derived from Cobalt-60 (^{60}CO) source with a measured dose rate of 124.5Gy/min which lasted

for 8hrs 52mins at the Oncology Department, Ahmadu Bello University Teaching Hospital, Zaria.

Seeds Treated with Sodium Azide

The radiated healthy and dry (10-12% moisture) seeds of *Cajanus cajan* (L.) Millspaugh were pre- soaked in a phosphate buffer (pH 3.0) to maintain the osmotic content of the cell for six (6) hours and later subjected to the four (4) concentrations (0.01%, 0.02%, 0.03% and 0.04%) of sodium azide [SA] (NaN_3) solutions at room temperature (25°C) for six (6) hours. The seeds were washed thoroughly to remove the residual amount of mutagens and sown immediately.

Pot Preparation and Seed Planting

Top soil was used to fill six hundred and fifty (650) polythene bags and four (4) treated seeds were sown inside each polythene bag during rainy season. The polythene bags were arranged in a complete randomized design (CRD).

Correlation Analysis

Correlation analyses carried out in respect of the traits studied were between the growth and yield parameters are presented in table 1. The germination percentage correlates positively with days to 50% flowering, number of seed per pod, number of pod per plants 100- seed weight and protein content. However, the correlations were not significant ($p > 0.05$). The leaf number had significant correlations with number of branches ($p < 0.01$) and plant height ($p < 0.05$). The positive correlations were with number of branches, root length, plant height, number of seed per pod, pod weight, 100-seed and protein percentage, while the negative correlations were with germination percentage, day to 50% flowering, number of pod per plant total grain yield. Among the correlations, only the number of branches was strongly correlated.

The branch number had a weak, positive and significant ($p < 0.01$) relationships with leaf number and plant height. While, the correlations with other parameters were weak, the positive correlations were with root length, number of pods, pod weight, 100 - seed weight and protein percentage. The negative correlations were with germination percentage, days to 50% flowering, number of seed per pod and total grain yield. The correlation with germination was non-significant ($p > 0.05$). The plant height correlated positively and significantly with leaf number at ($p < 0.05$), branch number and protein percentage ($p < 0.01$). It also correlates significantly

but negatively with day to 50% flowering at ($p < 0.01$). The negative correlations were with germination percentage, root length, days to 50% flowering and number of seed per pod, while plant height correlates positively with leaf number, branch number, number of pod, pod weight, total grain yield and protein percentage. However, branch number and protein percentage were significantly correlated individually with plant height. There was a positively significant relationship between root lengths and days to 50% flowering, and protein percentage, leaf number, number of seed per pod, 100- seed weight and total grain yield at $p < 0.05$ even though they were weak relationships. Meanwhile, correlations with other parameters were also weak. The negative correlations were with germination percentage, plant height, number of pods per plant and pod weight. All the correlations with days to 50% flowering were weak. However, the relationships with root length were positive and significant ($p < 0.05$), while that with plant height was negative and significant ($p < 0.01$). Other positive correlations were with number of seeds per pod, number of pods per plant and total grain yield, while the negative correlations were with root length, number of seeds per pod, pod weight, 100- seed weight and protein percentage. The plant height, root length, germination percentage, days to 50% flowering , number of pods per plant, pod weight, total grain yield and protein percentage correlates positively with number of seeds per pod, branch number, plant height and 100 – seed weight correlates negatively. The correlation of number of seeds per pod was strong, positive and significant at $p < 0.01$.

The number of pods correlates strongly, positively and significantly with pod weight and total grain yield ($p < 0.01$). Other positive correlations were with branch number, plant height, germination percentage, days to 50% flowering and number of seed per pod. Though, the correlations between number of pods per plant and 100- seed weight was negatively significant ($p < 0.05$), other negative correlations were with leaf number, root length and total protein percentage. The pod weight correlates positively and significantly with number of pod per plant and total grain yield ($p < 0.01$). Other positive but weak correlations were with leaf number, branch number, plant height, number of seed per pod and protein percentage ($p < 0.01$). Though, correlation with protein percentage was at ($p < 0.05$). Pod weight correlates negatively with root length, germination percentage, days to 50% flowering and 100 - seed weight. The 100 - seed weight correlates negatively and significantly with number of pod per plant ($p < 0.05$). All the correlations with 100 – seed weight were weak, however, the positive correlations with leaf number,

branch number ,root length, plant height and protein percentage, while the germination percentage, days to 50% flowering, number of seed per pod, number of pod per plant, pod weight correlates negatively.

The total grain yield correlates strongly, positively and significantly with number of seed per pod, number of pod per plant and pod weight ($p < 0.01$). Other positive correlations were with root length, plant height, germination percentage and days to 50% flowering. The leaf number, branch number 100 - seed weight and protein percentage correlates negatively. Protein percentage had a strong, positive and significant correlations with plant height, at $p < 0.01$ and weak, positive significant correlations with root length and pod weight at $p < 0.05$. The leaf number, branch number, number of seed per pod and 100 – seed weight were also positively correlated, while germination percentage, days to 50% flowering, number of pod per plant and total grain yield correlates negatively.

Table 1: Correlation Analyses of some Growth and Yield Components of Pigeon Pea

Variables	LN	BN	RLT	PLH	GP	DFF	NSP	NPP	PWT	HSWT	TGY
LN	1.000n.s										
BN	0.304**	1.000n.s									
RLT	0.089n.s	0.096n.s	1.000n.s								
PLH	0.240*	0.320**	-0.165n.s	1.000n.s							
GP	-0.091n.s	-0.227*	-0.060n.s	-0.026n.s	1.000n.s						
DFF	-0.101n.s	-0.118n.s	0.227*	-0.287**	0.131n.s	1.000n.s					
NSP	0.085n.s	-0.116n.s	0.150n.s	-0.005n.s	0.205n.s	0.016n.s	1.000n.s				
NPP	-0.077n.s	0.060n.s	-0.021n.s	0.209n.s	0.096n.s	0.050n.s	0.027n.	1.000n.s			
PWT	0.184n.s	0.093n.s	-0.011n.s	0.193n.s	-0.135n.s	-0.137n.s	0.068n.s	0.495**	1.000n.s		
HSWT	0.048n.s	0.115n.s	0.024n.s	0.069n.s	-0.169n.s	-0.005n.s	-0.004n.s	-0.226*	-0.098n.s	1.000n.s	
TGY	-0.026n.s	-0.021n.s	0.057n.s	0.177n.s	0.128n.s	0.026n.s	0.471**	0.858**	0.474**	-0.011n.s	1.000n.s
CP	0.132n.s	0.196n.	0.272*	0.345**	-0.077n.s	-0.092n.s	0.115n.s	-0.179n.s	0.265*	0.193n.s	-0.052n.s

* =significant at 0.05

**= p<0.01

ns = not significant

DFF = Days to 50% Flowering, NSP = Number of Seeds per Pod, NPP = Number of Pods per Plant, PWT = Pod Weight per Treatment, HSWT = Hundred Seed Weight per Treatment, TGY =Total Grain Yield, CP = Crude Protein, N = Number of Observations GP =Germination percentage, LN =Leaf Number, BN =Branch Number, RLT =Root Length, PLH =Plant Height

Correlation coefficient among most of the yield traits was statistically significant. Grain yield was positively correlated with number of pods per plant, number of seeds per plant, 100-grain weight. Pod weight was also positively correlated total grain yield and crude protein. Moreover root length also exhibited a significant positive association with grain yield which indicated efficient translocation of photosynthesis from source to sink. These results were in agreement with Kumar *et al.,* (2000); Singh *et al.,* (2006) and Bilgi (2006).

CONCLUSION AND RECOMMENDATION

This study revealed that the correlation coefficient between a causal factor and the effect (i.e. grain yield) is almost equal to its direct effect and then the correlation explains the true relationship and direct selection through this trait were effective. Mutants isolated in this investigation should be utilized in cultivation of pigeon pea to ensure food security.

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