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**Research Article**

# Qualitative and Quantitative Characterization of the Seeds of Selected Accessions of Nigeria Pigeon Pea [*Cajanus cajan* ( L) Millspaugh]

Daudu O.A.Y.*, Falusi O.A., Abubakar A., Dangana M.C., Kolo J.T. and Kolo, J

[1]Department of Plant Biology, Federal University of Technology, Minna, Nigeria

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**Abstract:** *Cajanus cajan* is known as pigeon pea, pigeon peas are legume. It belongs to the Fabaceae family. Eight accessions of *Cajanus cajan* were obtained from National center for genetic resources and biotechnology (NACGRAB) Ibadan, they were accessed for some phenotypic characters of the seed. The result of the parameters and relationship between the different accessions was presented in charts and tables. Principal component analysis (PCA) was used to determine the relationship among the accessions. The seed colour patterns of the pigeon pea accessions shows that mottled colour pattern is the highest (63 %), this is followed by speckled pattern (25 %) and the lowest is plain with 13 %.This indicate that there are variations in terms of seed colour pattern in the crop. The base seed colour of the pigeon pea accession indicate that light-brown had the highest percentage (50%) whereas the least (25%) was obtained in both cream and brown. This shows that the accession varies in base seed colour. The seed eye colour also indicates that the highest, being 38%, was obtained from cream and light brown and the lowest (12%) from light and dark brown. The result of the seed parameters indicates that there was a significant difference ($P<0.05$) among the accessions of the pigeon pea collected. However, there were no significant difference ($P>0.05$) among mottled, reddish-brown, and oval with percentage of 25%. The pigeon pea accessions were divided into five (5) clusters based on the morphological characteristics of the seed. Accession NG/021/02 and NG/09/149 might be the best accessions required for maximum production because they show distinct variation from the other accessions. It revealed that the variations in the seed morphology of the pigeon pea accessions could determine consumers' preference and could be exploited for selection of crop.

**Keywords:** Pigeon pea, Variation, Phenotypic characters, Seed colour, Eye colour.



## INTRODUCTION

Pigeon peas are legumes botanically known as *Cajanus cajan*, with diploid 2n = 2x = 22, 44 or 66 chromosomes (Varshney *et al*. 2012). According to Mallikarjuna *et al*. (2011), pigeon pea has the highest production rate among grain legumes ranking 6$^{th}$ position. Egbe, and Adeyemo, (2006) reported that Nigerian pigeon pea thrives well under annual rainfall between 24 and 40 inches (600 to 1000mm). Pigeon pea generally grow well where the temperatures are in the range of 64 to 85ºF (18-30ºC), but under moist soil conditions, it can withstand temperatures of 95ºF (35ºC) or above (Ratnaparkhe and Gupta, 2007).

It is an erect, glandular-pubescent and perennial shrub. The plant grows up to 1-2m high with tetrarch tap roots. The erect and ribbed stem is 15cm in diameter. The branch can compact (erect), semi-spreading (semi-erect), and spreading types .Leaves are trifoliate, alternate in dark green color above and silvery underneath. The plant yields yellow to red flowers which is 1.2cm-1.7cm in diameter that turns into fruit as seed pods. The pods are linear-oblong, green or red,2-13cm long and 0.5-1.7cm wide. Each pod contains about nine seeds which are sub-globo seellipsoid or squarish in shape having 5mm as a diameter. The seeds are white, cream,brown, purple to black in colour (Heuze *et al.*, 2017).

According to Corriher *et al.* (2007), pigeon pea supply good quality protein; they are both food crop (dried peas, flour or green vegetables) and a forage cover crop.They are also used as fodder and feed for livestock (Rao *et al.*, 2002). Pigeon pea improves the physical, chemical, and biological properties of the soil; it functions as a mini-nitrogen factory (Mathew *et al.*, 2015). The seed is made up of 85% cotyledon, 14% Seed coat, and about 1% embryo and it is a rich source of carbohydrates, minerals and vitamins. It Carbon, Hydrogen and Oxygen content ranges between of 51.4 – 58.8%, CF ranges between 1.2 – 8.1% and lipid ranges between 0.6 – 3.8% (Singh *et al.*, 1990).

***Corresponding Author:** Daudu O.A.Y

According to Bekele, (2007), pigeon pea is used as counter hedge in erosion control. It is a Nitrogen fixing legume; it does not need inoculation before sowing. It has ability to fix about 40-97kg of Nitrogen per hectare per year in Africa and up to 235kg of Nitrogen per hecter per year in Florida. Ahsan and Islam, (2009), reported that it has been explored for the treatment of Ischemic necrosis, bed sore and wound healing. Ambasta, (2004), stated that it has been used widely for many years for treating sores, skin irritation, hepatitis, measles, jaundice, dysentery and many other illnesses, for expelling bladder stones and stabilizing menstrual period.

Despite the importance of pigeon pea with wide variation little information exists on the qualitative and quantitative characteristics of the seeds, which could be used for delineation of the crop. Seed quality and characterization had been found to be important for naming and improving of any variety, however, the information is lacking on Nigeria pigeon pea. Therefore, this paper seeks to evaluate the qualitative and quantitative characteristics of the seeds of selected accessions of Nigeria pigeon pea accession.

## MATERIALS AND METHODS

**Collection of pigeon pea seeds**

Eight (8) accessions of Nigerian pigeon peas were collected from National center for Genetic Resources and Biotechnology (NACGRAB) Ibadan Nigeria.This accessions include, NG/SA/07/19,NG/SA/07/210,NG/SA/JAN/09/179,NA/AO/11/08/108,NG/SA/JAN/09/149,NG/SA/07/208,NG/AO/MAY/09/021/01and NG/AO/MAY/09/021/02.

Standard procedure suggested by IBPGR (1993) on the characterisation and description of pigeon peas was used in determining parameters such as: seed colour patterns, base seed colour, seed eye colour, and seed shape colour.

**Data Analysis**

Data collected on the qualitative parameter are expressed in percentage and presented in chart using Microsoft excel. The various data collected were pooled and Principal Component Analysis (PCA) was used to determine the trait that influences the observed variations in the crop. The information from the PCA was used in constructing hierarchical cluster dendrogram to determine the relationships among the seeds, this was drawn done using Past software.

## RESULT AND DISCUSSION

The seed colour patterns of the pigeon pea accessions are presented in Figure 1; it shows that mottled colour pattern is the highest (63 %), this is followed by speckled pattern (25 %) and the lowest is plain with 13%. This indicates that there are variations in terms of seed colour pattern in the crop. This could also be attributed to the genetic and environmental differences of the accessions in line with the work of Egbe and Adeyemo, (2006) who stated that, there is variability in pigeon pea accessions especially in the genetic characters. The base seed colour of pigeon pea accessions are presented in Figure 2; the highest percentage was obtained in light-brown (50%) and the least (25%) was obtained in cream and brown. The seed eye colour of the pigeon pea accessions are represented in Figure 3; it indicates that the highest being 38% was obtained from cream and light brown and the lowest 12% from light and dark brown. The variations observed in colours were in line with the result of Sinefu (2011) and Adebimpe *et al*. (2018). The highest percentage in seed eye width was obtained from narrow with percentage of 50% and the lowest with percentage of 13% (wide) in Figure 4. This shows that there is significant difference between the parameters. This is in line with the work of Gowda *et al.* (2011) which stated that difference occur in pigeon pea accessions as they get activated in various biotic and abiotic conditions of the environment. The percentage difference in the seed shape shown in figure 5; indicates that the highest percentage was Globular (37%) followed by Elongate and Oval of equal percent (25%) and the least being square with 13%. Variations in shape were also repoted by Madihavi *et al.* (2008) and Adebimpe *et al*. (2018).

The principal component analysis of the measured parameters grouped the trait into seven (7) components (Table 1). In PC1, the seed eye colour has the highest value (0.87) followed by seed colour pattern (0.11), indicating that these parameters contribute more to the variation. It also implies that both traits being positive are closely related than the other traits with negative value. The Eigen value of PC1 (9.79) is the highest while the lowest is PC7 with (0.00) this shows that there is significant difference ($P<0.05$).The principal component of the accessions showed that PC4 (97.60%), PC5 (99.15%), PC6 (99.99%) PC7 (100%) contributed greatly to the variability among pigeon pea accession. The principal component of both parameters and accessions varied. This implies that certain phenotypic character influenced them. The result is contrary to the observations of (Sharma *et al.*, 2012.) who reported that large variation of characters in pigeon pea accessions is as a result of environmental factors only.

The pigeon pea accessions were divided into five (5) clusters based on the phenotypic characteristics of the seeds. The first two grouped NG/08/108 and NG/09/179) together. This showed that both accessions are quite related to each other. The second clusters contained only NG/09/149, showing that it is distinct from most of the accessions. The last two clusters are also closely related to each other. But NG/021/02 was the most isolated in the sub-cluster and had the highest number of unique properties than the rest. Each clusters contained highly similar pigeon pea accessions. Cluster analysis also explains the nature and level of genetic diversity among the cultivars in the dendrogram (Figure 6). The level of genetic diversity was high based on the pattern of convergence and divergence of accessions. Similar cluster was observed by Adebimpe *et al*. (2018).


Plate 1: Plate1: Variation in Seeds of the Pigeon Pea Accessions (A): NG/21/01, (B): NG/21/02, (C): NG/08/108, (D): NG/09/149, (E): NG/09/179, (F): NG/07/208, (G): NG/07/2I0, (H) NG/07/191

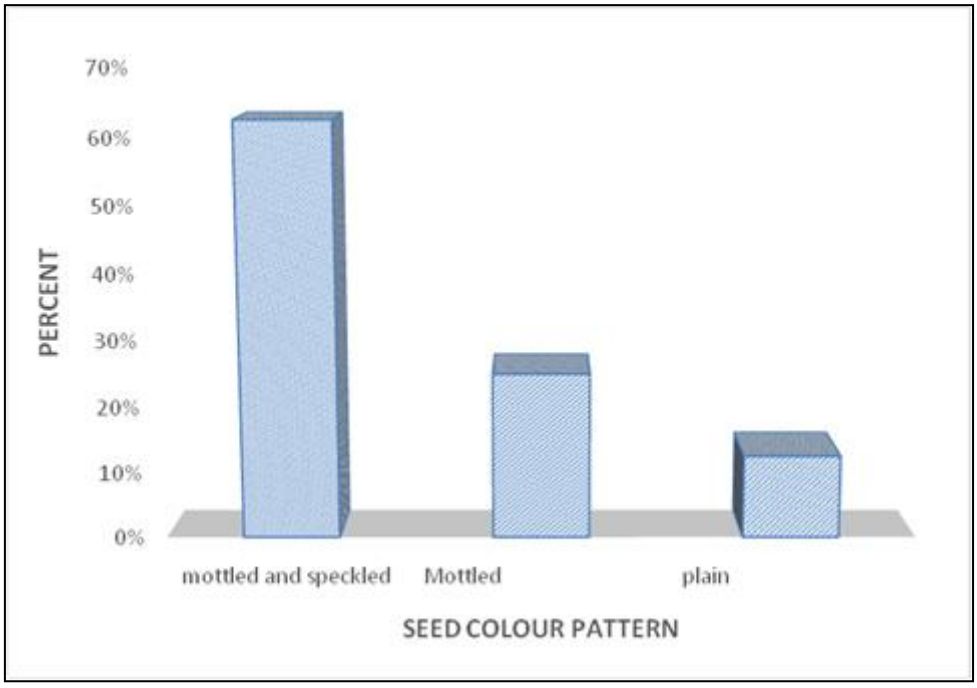


**Figure 1:** Seed colour patterns of the *C. cajan* accession

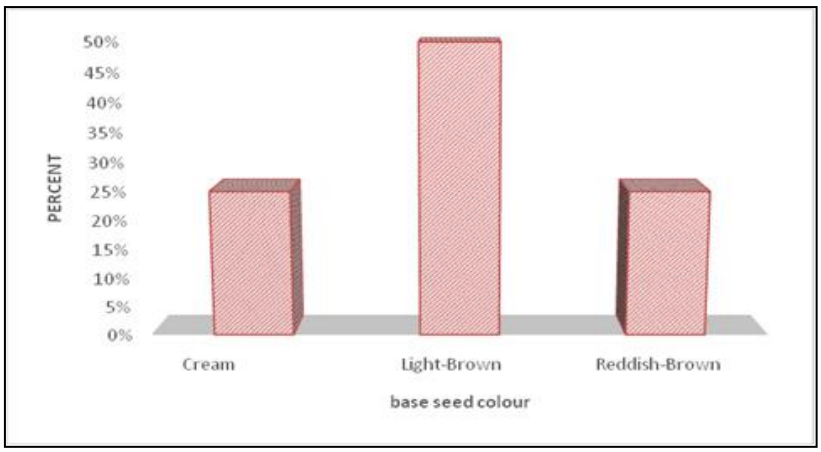


**Figure 2**: Base seed colour pattern of *C. cajan* accessions

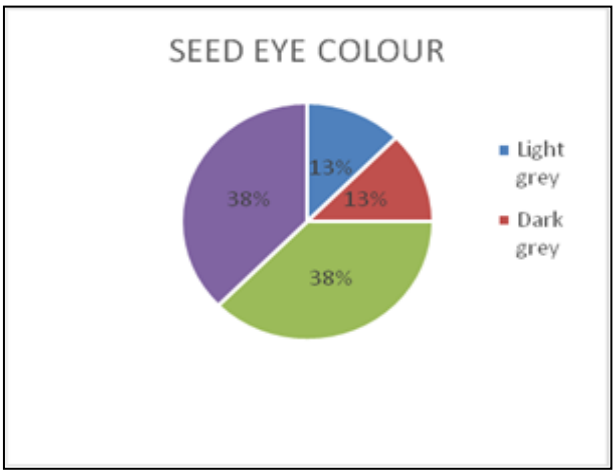


**Figure 3:** Seed eye colour of C.cajan accessions

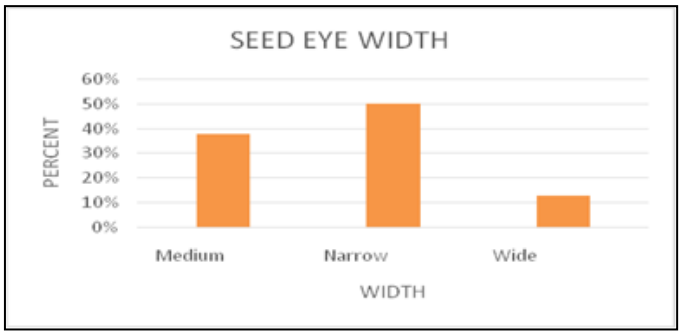


**Figure 4**: Seed eye width of C. cajan accessions

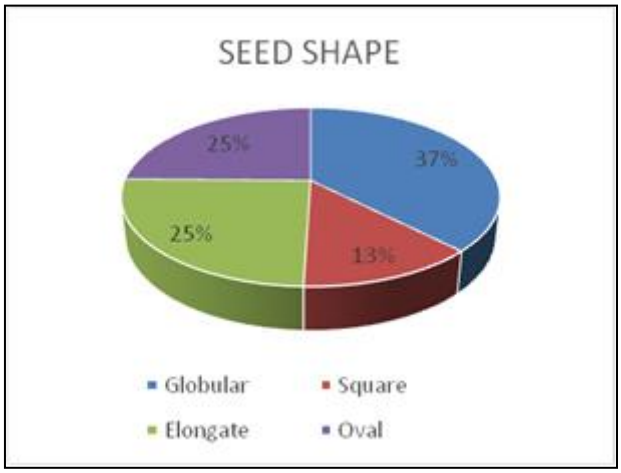


**Figure 5**: seed shape of C. cajan accessions.

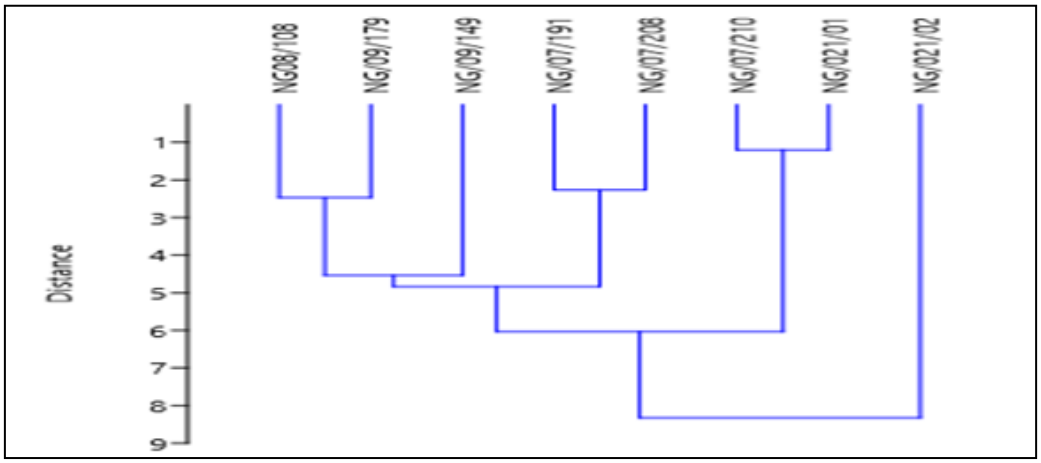


**Figure 6:** UPGMA dendrogram of the C. cajan accessions

Table 1: Principal Component Analysis of the Pigeon Pea Parameters

| PARAMETERS | PC 1 | PC 2 | PC 3 | PC 4 | PC 5 | PC 6 | PC 7 |
|---|---|---|---|---|---|---|---|
| Seed Colour Pattern | 0.11 | -0.34 | -0.31 | 0.87 | 0.00 | -0.12 | 0.01 |
| Base Seed Colour | -0.15 | 0.59 | -0.71 | 0.04 | 0.12 | 0.35 | 0.00 |
| Seed Eye Colour | 0.87 | 0.18 | 0.19 | 0.09 | 0.10 | 0.39 | 0.00 |
| Seed Eye Width | -0.10 | 0.57 | 0.33 | 0.34 | -0.66 | -0.12 | 0.03 |
| Seed Shape | -0.09 | 0.42 | 0.32 | 0.23 | 0.72 | -0.38 | -0.04 |
| Seed Hilum | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Length | -0.01 | 0.00 | 0.00 | -0.01 | 0.04 | 0.00 | 1.00 |
| Weight | -0.44 | -0.12 | 0.40 | 0.25 | 0.15 | 0.74 | 0.00 |
| Eigen value | 9.79 | 4.91 | 2.31 | 1.44 | 0.29 | 0.16 | 0.00 |
| Percentage individual | 51.77 | 25.98 | 12.21 | 7.64 | 1.55 | 0.84 | 0.00 |
| Percentage cumulative | 51.77 | 77.75 | 89.96 | 97.60 | 99.15 | 99.99 | 100.00 |

## CONCLUSION

The present study has observed wide genetic variation among the accessions collected. The seeds of the various accessions evaluated showed variability qualitatively in seed eye colour, seed colour pattern, base seed colour and quantitatively in seed weight, length. This indicates that genetic variability exist among the accessions and It also revealed that the variations in the seeds morphology of the pigeon pea accessions could determine consumer's preference and could be exploited for selection of the crop.

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**Conflicts of interest**
The authors declare that there are no conflicts of interest related to the publication of this study.

## REFERENCES

1. Adebimpe, Y. A., Falusi, O. A., Daudu, O. A. Y., Abubakar A., Kolo, J., Ahiwe, A. U., Onobo, I. Y., Abdullahi, A. S., & Abdulmumin. (2018). Phenotypic Characterization of Seeds of some Nigerian Pigeon Pea (Cajanus cajan L. Millsp.) Accession. Book of Proceedings of the 42nd National Annual Conference of Genetic Society of Nigeria (GSN). P. 482-489
2. Ahsan, R., & Islam, M. (2009). In vitro Antibacterial Screening and Toxicological Study of Some Useful Plants (Cajanuscajan). European Journal of Science Research, 41, 227-232.
3. Ambasta, A.S. (2004). The Useful Plants of India.National Institute of Science Communication.New Delhi, 2nd Edition, pp: 94-95.
4. Bekele, T. A. (2007). Profitable agroforestory innovation for Estern Africa.Expriences from 10 agroclimatic zones of Ethopia. Available at Animal feed resources information system. Retrieved on 10/10/2018.
5. Corriher, V.A., Hill, G.M., Phatak, S.C., & Mullinix, B.G. Jr. (2007). Effect of feeding ottonseed, corn gluten or pigein peas on performance of beef heifers and diet digestibility by beef. Available at http://www.ads.ugu.edu/documents/effectsoffeedingcotton. Accessed on 4th September, 2019
6. Egbe, O. M., & Adeyemo, M. O. (2006). Estimation of the effect of intercropped pigeon pea on the yield and yield components of maize in Southern Guinea Savanna of Nigeria. Journal of Sustainable Development in Agriculture and Environment, 2, 107-119.
7. Gowda, C. L. L., Saxena, K. B., Srivastava, R. K., Upadhyaya, H. D., & Silim S. N. (2011). Pigeon pea: From an orphan to leader in food legumes. Biodiversity in Agriculture: Domestication, Evolution and Sustainability.University of

California, Davis, USA, Cambridge university press.pp 361-373.
8. Heuze. V.., Thiollet. H., Tran. G., Delagrade. R., Bastianelli. D. & Lebas. F (2017). Pigeon pea.https://www.feedipidia.org/node/329.updated 26/04/2012.
9. IBPGR. (1993). Descriptors for pigeonpea [Cajanus cajan (L.) Millsp.] International Board for Plant Genetic Resources, (IBPGR), Rome, (Italy). Pages:31 p.
10. Jalal, A. A., & Ahmad, H. A. (2012).Genetic variation, Heritability, Phenotypic Correlation Studies for Yield Components in promising Barly Genotypes.Journal of Agricultural Science, 4(3), 193-210.
11. Madhavi, Y., Radha-krishna, K. V., Ankaiah, R., & Ganesh, M. (2008).Varietal characterization through morphological characteristics, chemical tests and electrophoretic tecniques in green gram (Vigna radiata L.)Available at Rangara agricultural University of Hyderabad. Accessed on 9/10/2018.
12. Mallikarjuna, N., Saxena, K. B., Jadhav, D. R. and Kole, C. (2011). Wild Crop Relatives: Genomic and Breeding Resources. Legume Crops and Forages. Springer-Verlag, Berlin, Hei, pp. 21–33.
13. Mathew, B.A., Sule, H.A., Toluhi, O.J., Idachaba, S,O., Ibrahim, A.A., & Abuh, S.J. (2015). Studies on Protein Composition of Pigeon Pea [Cajanus Cajan (L.) Millspaugh] Treated With Sodium Azide and Gamma Radiation. *Journal of Pharmacy and Biological Sciences, 10(1), 1-4.*
14. Rao, S. C., Coleman, S. W., & Mayeux, H. S. (2002). Forage production andnutritive value of selected pigeonpea ecotypes in the southern Great Plains. Journal of Crop Science, 42, 1259–1263.
15. Ratnaparkhe, M. B., & Gupta, V. S. (2007). In genome mapping and molecular Breeding in plant.Heidelberg, Germany (Spring-Verlag). Germany. Pp. 133-145.
16. Sharma, R., Gangwar, R. K., & Yadav, V. (2012). A study on genetic variability and correlation in pigeon pea.International journal of science and research, 6, 2319-7064.
17. Sinefu, F. (2011). Bambara groundnut response to controlled environment and planting date associated water stress. *South African Journal of plant and soil, 31(4), 219-226.*
18. Singh, U., Jambunathan, R., Saxena, K., & Subrah-manyam, N. (1990). Nutritional quality evaluation of newly developed high protein genotypes of pigeon pea (Cajanus cajan). Journal of the Science of Food and Agriculture, 50, 201-209.
19. Varshney, R. K., Chen, Y., Li, A. K., Bharti, R. K., Saxena, K. B., & Schlueter, J. A. (2012). Draft Genome sequence of Pigeon pea (Cajanus cajan), an orphan Legume crop of resource – poor farmers. *Journal of Nature Biotechnology, 30(1), 83-89.*
20. Mathew, B.A., Sule, H.A., Toluhi, O.J., Idachaba, S.O., Ibrahim, A.A., & Abuh, S.J. (2015). Studies on Protein Composition of Pigeon Pea [Cajanus Cajan (L.) Millspaugh] Treated With Sodium Azide and Gamma Radiation. *Journal of Pharmacy and Biological Sciences, 10(1), 1-4.*