© APR 2026 | IRE Journals | Volume 9 Issue 10 | ISSN: 2456-8880
DOI: https://doi.org/10.64388/IREV9I10-1716800

Assessment Of Genetic Variability Among Pearl Millet (Pennisetum Glaucum [L.] R. Br.) Genotypes Under Striga Infested Field Condition.

ADAMU USMAN IZGE[1], GRACE STANLEY BALAMI[2]

[1]*Department of Crop Science, Faculty of Agriculture, Federal University Dutse, PMB 7156, Ibrahim Aliyu Bypass, Dutse, Jigawa State, Nigeria*

[2]*Department of Crop Science, College of Agriculture, Federal University of Agriculture, Zuru, PMB 28, Zuru, Kebbi State, Nigeria.*

Abstract- ***A line × tester analysis using five lines and four testers was carried out to study the genetic variance and heritability for grain yield and other yield related traits in pearl millet in 2017 at Lushi Irrigation Station, Bauchi, Bauchi State Nigeria. The F1's and parents were evaluated at Bauchi and Maiduguri during the rainy season of 2018. Analysis of variance and mean performances revealed that significant differences among the mean squares was observed for lines, testers, crosses and for line × testers for some of the traits. The results indicated that significant variability among the genotypes exist. The results also showed that, genotypic variance was greater than environmental variances in almost all the traits, except for plant height. Days to 100% flowering, number of plants at harvest, days to 50% flowering, number of plants at emergence and total grain yield recorded very high heritability values of 82.96%, 79.77%, 79.14%, 76.63% and 74.66% respectively. The high heritability values obtained could be as a result of additive genetic effects. High value of GCV, PCV and heritability value estimates means that selection among these genotypes could be responsive and effective for the traits. The genotype Super SOSAT had the highest striga count and incidentally having the highest grain yield. The cross SOSAT C-88 × PS 202 was among crosses with high striga count and also among high grain yielders. These genotypes are promising and could have an inherent characteristic to withstand Striga attack. However, further indebt evaluation and genetic study on striga tolerance in these pearl millet genotypes needs to be conducted for more information.***

Index Terms- ***Variability, Heritability, Phenotypic, Genotypic, Striga***

I. INTRODUCTION

Pearl millet (*Pennisetum glaucum* [L.] R. Br.) known as *bajra* in Hindu or *yadi* in Margi language of north eastern Nigeria [14] is an important grain cereal. It is a quick growing grass with large stems and leaves that are tall and vigorous, with good grain and fodder yieid. It is cultivated under rain in arid and semi-arid areas and is grown in many countries, mostly in Africa and Asia as a staple food crop and as feed, fuel and construction materials. Pearl millet supports more than 100 million people, especially the extremely poor [12] [16].

It is grown in over 90 countries and on average contribute 32.3 million tons of food annually [12]. Major producers of millet include India, China, Nigeria, Niger, and many others in Sub-Saharan Africa [30]. It is a climate smart crop, remarkably tolerant to water stress, low soil fertility, high pH, and higher temperatures, making it most reliable in dry regions. It is a crop that has for long time been valued for its nutritional profiles and quality food and feed for human wellbeing. However, the average productivity of pearl millet is low in Africa. This is attributed to the effect of several production constraints, including lack of improved varieties, striga infestation, bird damage, drought, and poor soil [11] [28].

Striga (*Striga hermonthica* Del. Benth), a parasitic weed is endemic and a major constraint among many other biotic problems in pearl millet production in Northern Nigeria. The weed causes serious damage and makes it the most devastating of all the parasitic weeds [16]. Striga has been identified as a major constraint to pearl millet production [28]. Yield loss of up to 95% have been reported [35] [13]. It is an endemic weed in many pearl millet-growing areas, particularly in sub-Saharan Africa, making it a persistent and a challenging problem.

Various control methods, including cultural practices, chemicals, and bio-herbicides have been mostly ineffective in controlling Striga due to its complex life cycle, seed production, and prolonged seed dormancy. Breeding pearl millet for tolerance is crucial because Striga, a parasitic weed severely impacts pearl millet production negatively. Breeding for tolerance is an utmost strategy for food security and sustainable agriculture. Breeding for Striga resistance offers a cost-effective, environmentally friendly, and sustainable solution for controlling Striga and improving pearl millet yields. It is a promising approach, but has challenge due mainly to lack of locally adapted and resistant donor sources. Breeding for host plant tolerance therefore will mean identifying and incorporating genes that confer tolerance in pearl millet varieties. The objective of any crop improvement therefore has always been to increase grain yield. Information on genetic variability among crop plants are therefore a vital requirement in crop improvement programs.

Significant variability and heritability among cultivars and among yield and yield related traits could offer opportunity for improvement. Genotypic and phenotypic coefficients of variability are an important tool in pearl millet breeding. Heritability on the other hand could also be exploited to determine whether certain traits are heritable or not [24]. It is for these reasons therefore, this study was conducted to assess the magnitude of genetic variance, genetic variability, and heritability among traits of pearl millet genotypes and their crosses.

II. MATERIALS AND METHODS

The initial experiment was conducted with 4 male and 5 female genotypes to generate an F_1 population through line × tester mating in 2017 dry season at Lushi Irrigation Station, Bauchi-Nigeria. The parents were: Ex-Gubio, Ex-Monguno, Ex-Baga, PS 202 as testers and PEO 5984, Super-SOSAT, SOSAT-C88, Ex-Borno and LCIC9702 as lines. The genotypes were obtained from the Lake Chad Research Institute (LCRI), Maiduguri, Nigeria and from the International Crop Research Institute of the Semi-Arid Tropics (ICRISAT) in Niamey. The materials used are as described by [3]. The F_1 population and their parental lines were evaluated during the cropping season of 2018 at Bauchi, Nigeria and at Maiduguri, also in Nigeria. Data on yield and agronomic traits were collected and subjected to combined analysis of variance and the means were compared and separated by DNMRT.

Genotypic and phenotypic (δ^2g and δ^2p) variances were computed according to [1] as in the following equation:

Genotypic variance $\delta^2g = \frac{MSt - MSe}{r}$ where MS_t = Mean sum of squares for traits of genotypes, MS_e = Mean sum of squares for errors of genotypes and r = Number of replications.

Phenotypic variance $\delta^2p = \delta^2g + \delta^2e$, Where δ^2p = Phenotypic variance for each trait of the genotypes, δ^2g = Genotypic variance for each trait of the genotypes and δ^2e = Environmental variation among the tested traits.

The phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) on the other hand were computed according to the method suggested by [7] and [8]. The PCV and the GCV were classified into three categories as; low (less than 10%), moderate (10-20%) and high (above 20%).

$PCV = \frac{\sqrt{\text{Phenotypic Variance}}}{\text{Mean}} \times 100$ and $GCV = \frac{\sqrt{\text{Genotypic Variance}}}{\text{Mean}}$

Heritability in broad sense (h^2b) was estimated as the ratio of genetic variance to the phenotypic variance as suggested by [17] and [7]. Heritability in broad sense $= \frac{\text{Genotypic Variance}}{\text{Phenotypic Variance}} \times 100$

III. RESULTS AND DISCUSSION

3.1 Mean Squares of Traits of Pearl Millet Genotypes

The mean squares are presented in Table 1. The result shows a highly significant difference among genotypes in location mean squares for striga count and 1000 grain weight, meaning that the traits performed differently across locations. Result further revealed significant or highly significant difference among crosses in striga count, grain yield and 1000 grain weight. Other traits did not show significant difference among hybrids.

Similarly, significant or highly significant difference were found among females in plants at emergence, grain yield and 1000 grain weight. There was also significant or highly significant difference among males in grain yield and 1000 grain weight. There was however no significant difference among males in plants at emergence as was also among females. The interaction between males × females indicated significant difference among genotypes in plants at harvest and in total grain yield. All other traits did not show any significant difference among the genotypes in male × female interaction. The result was significantly different in location × crosses interaction in grain yield and 1000 grain weight. All genotypes did not show any significant difference in location × female interactions in all traits. However, there was significant difference among genotypes in 1000 grain weight in locations × males' interaction. Similar result was reported by [13] in a variance estimation study in pearl millet.

3.2 Mean Performance in Agronomic Traits

Performance of different traits among lines, testers and hybrids are presented in Table 2. Variability in plant height, panicle length, and grain yield were evident among lines, testers and crosses. The result indicated that PS 202 is the best in plants at emergence (22 plants) among males. On the other hand, SOSAT C-88 had the highest number of plants at emergence (24 plants) among females and also among crosses. The best performing cross in plants at emergence was LCIC 9702 × Ex-Gubio with 24 plants. Ex-Borno × PS 202 and Ex-Borno × Ex-Baga had the least plants at emergence among all genotypes with values of 11 and 13 plants respectively.

The result indicated that Ex-Borno × Ex-Monguno had the highest days to first flowering. While Ex-Borno × Ex-Baga and Super SOSAT × Ex-Monguno had the highest days each to 100% flowering, indicating they could be late maturing. The female lines PEO 5984 had the least days to first flowering and incidentally least days to 100% flowering with 56 days and 62 days respectively. Lesser number of days to flowering is an important trait especially in Maiduguri and Bauchi situated in a marginal rainfall area. These materials could escape drought and stressful weather conditions in this region. [15] has reported similar result where early flowering genotypes were able to escape drought.

Plant height is one of the important traits in a pearl millet growing communities in Nigeria where the stems are used for building and as a thatching material. [15] reported a similar result where stem of pearl millet is used as a building material and other purposes. The result indicated that SOSAT C-88 had the tallest plants measuring 196.50 cm, while the hybrid PEO 5984 × Ex-Monguno had the shortest plant 149.17 cm. In some instances, shorter stem in pearl millet have been found to be of advantage as they can be easily harvested and promptly mechanized. However, longer stem in some places as reported by [23] had more advantage because they are used in thatching and building houses. The panicle length in Ex-Borno × Ex-Monguno was the lengthiest (28.0 cm), while that of PEO5984 × Ex-Baga was the shortest with 18.67 cm.

A close comparison of plants at emergence and plants at harvest shows that none of plants among the parents and the corresponding hybrids survived 100% to maturity. Lower number of plants at harvest could have negative implication on grain yield. The result shows that PEO 5984 × Ex-Baga had the highest number of plants at harvest, it however was not among that produced highest number of plants at emergence. The lowest number of plants at harvest was found in Ex-Borno × Ex-Baga and incidentally this same hybrid produced the lowest number of plants at emergence. Ex-Baga and Ex-Borno were among the parents with the lowest number of plants at emergence and at harvest. This characteristic could be inherent among these genotypes.

Super SOSAT had the highest number of leaves among parents, while Super SOSAT × Ex-Monguno had highest among hybrids. Higher leaves per plant has been reported to increase photosynthetic area in crop plants which may lead to an increase in grain yield. Super SOSAT which produced highest number of leaves also had the highest striga count of 202.5 and highest grain yield of 670.2kg/ha. Even though, there was high number of striga count in Super

© APR 2026 | IRE Journals | Volume 9 Issue 10 | ISSN: 2456-8880
DOI: https://doi.org/10.64388/IREV9I10-1716800

SOSAT, it produced the highest grain yield. It therefore means that Super SOSAT was able to tolerate high population of striga and could have an inherent gene to confer tolerance. Similar result was reported by [3]. The result also shows that SOSAT C-88 × PS 202 and SOST C-88 × Ex-Monguno had a high grain yield. All the hybrids that produced high grain yield has SOSAT C-88, PS 202 or Ex-Monguno as one of their parents. Ex-Gubio and Super SOSAT had a high 1000 grain weight among parents, while SOSAT C-88 × Ex-Baga had the highest 1000 seed weight of 19.95 grams across both the parents and the hybrids.

Table 1: Mean Squares from Analysis of Variance of Traits of Pearl Millet Genotypes

Source of Variation	DF	NPE	DFF	DHF	PLH	PNL	NPH	NLP	STC	GRY	TGW
Location	1	880.21	1591.41	907.50	13568.13	85.01	1435.21	267.01	86779.41**	207954.30	338.10**
Rep. × location	4	13.43	94.82**	83.12**	1956.36*	8.88	10.92	0.43	20140.98**	541373.90	17.33
Hybrids	19	60.39	83.55	73.14	762.32	23.57	58.97	1.39	10819.86*	59871.69**	37.05*
Females	4	154.07**	266.89	277.18	1430.64	27.43	151.76	1.08	4489.35	129960.10**	49.67*
Males	3	31.88	37.43	9.43	956.60	29.81	15.54	1.32	1972.82	25629.16**	36.25*
Males × females	12	36.30	33.97	21.05	490.98	20.72	38.90*	1.51	15141.78	45069.52*	33.24
Locations × crosses	19	18.96	16.99	14.78	535.08	16.78	21.82	2.36	7896.67	33321.09*	35.52*
Locations × females	4	36.73	11.01	9.48	510.20	10.36	29.48	2.97	5560.72	39830.18	20.45
Locations × males	3	24.23	11.25	8.90	304.73	29.10	35.83	1.28	514.70	39522.27	52.01*
Error	76	27.95	21	15.59	795.04	17.64	20.04	1.23	5604.10	32671.18	37.15

Key:
NPE = Number of plants at emergence
DFF = Days to 50% flowering
DHF = Days to 100% flowering
PLH = Plant height
PNL = Panicle length
NPH = Number of plants at harvest
NLP = Number of leaves/plants
STC = Striga count
GRY = Grain yield
TGW = 1000 seed weight

3.3 Variance Components, Coefficients of Variation and Heritability

Table 3 present the findings of genetic investigation among genotypes as well as crosses. The analysis revealed significant differences between traits among genotypes and their crosses. As expected the phenotypic variances were greater than corresponding genotypic variances in all traits. The result further indicated that genotypic variances in all traits were greater and had a wider margin than environmental variances except for plant height.

© APR 2026 | IRE Journals | Volume 9 Issue 10 | ISSN: 2456-8880
DOI: https://doi.org/10.64388/IREV9I10-1716800

The genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) helps in assessing the extent of genetic and environmental influences on the expression of traits. The result indicated that PCV in all traits were greater than corresponding values of GCV. This indicates environmental effects were preponderant in expression of traits and suggesting a lower potential for genetic improvement through breeding programs. Similar results were reported by [36].

The PCV of grain yield (48.96%) was greater than all PCV of other traits. Striga count, number of leaves/plants, days to 100% flowering, days to 50% flowering and panicle length had the lowest PCV of 1.55%, 5.50%, 10.95%, 12.90% and 13.40% respectively. All other traits had a more than moderate PCV. The result further indicated that grain yield had the highest GCV of 42.3% followed by plants at harvest and plant height with 22.4% and 20.75% respectively.

The dominance of the genotypic variance in almost all the traits indicated that the traits were controlled genetically rather than environmentally. However, plant height could not be genetically controlled rather it is environmentally controlled because the environmental variance is greater than the genotypic variance. In most cases the environmental variances are low and negligible as rightly also reported by [29]. High value of genotypic variances means that these traits are expressed additively and they can genetically be transmitted.

A comparison of the phenotypic coefficients of variation and genotypic coefficients of variation however revealed that, in general phenotypic coefficients of variation was higher than the genotypic coefficients of variation, indicating the influence of environment. This difference was narrow in almost all the traits, indicating that these traits were least influenced by the environment, and if any selection pressure operated on these traits, it will help to realize the improvement. High values of PCV and GCV for grain yield was reported by [20] and [6], and for plant height by [19]. Total variability present for a character is indicated by the coefficient of variation. However, the extent of variability, which could be transferred from parent to offspring would determine response to selection and this is provided by the estimates of heritability. The heritability estimates for various traits ranged from 49% to 82.96%. High estimates of heritability were obtained for days to 100% flowering (82.96%, number of plants at harvest (79.99%), days to 50% flowering (79.14%), number of plants at emergence (76.63%), grain yield (74.66%), striga count (66.69%) and 1000 grain weight (62.62%). These results are similar to findings of [22], [10] and [19]. They also reported high heritability for 1000 grain weight in pearl millet. [21] also reported high heritability for grain yield, and 1000 grain weight.

The performance among parents and particularly among crosses showed a wide range of variability. The results clearly indicate the existence of adequate genetic variability in the studied material for most of the traits. This would allow selection for the traits having high heritability like, days to 100% flowering, number of plants at emergence, days to 50% flowering, number of plants at emergence and total grain yield. Consequently, selection for taller plants having higher biomass, early maturity, long and thicker ear heads and higher panicle harvest index would form ideal selection indices for improving grain yield. The phenotypic variance was generally higher than the genotypic variances, revealing the role of environment in the expression of the traits among the genotypes and the crosses. It can be concluded that the values of PCV were higher than GCV for all the studied traits indicating high influence of the environment. Higher heritability of between 49.00% and 82.96% was recorded among the traits.

© APR 2026 | IRE Journals | Volume 9 Issue 10 | ISSN: 2456-8880
DOI: https://doi.org/10.64388/IREV9I10-1716800

Table 2: Mean Performance in Agronomic Traits among Pearl Millet Genotypes

Genotypes	NPE	DFF	DHF	PLH	PNL	NPH	NLP	STC	GRY	TGW
Testers										
PS 202	22.17a-d	69.17a-d	74.67abc	172.17a-d	24.50a-d	17.17b-e	8.50a-d	62.00def	360.70b-g	9.61b
Ex-Baga	18.50b-f	67.33a-f	72.50a-f	170.83a-d	26.17ab	13.83c-g	8.67a-d	48.50ef	459.00a-g	8.49b
Ex-Gubio	21.50a-e	68.17a-e	73.67a-e	186.50abc	22.67ab	16.83b-f	9.00abc	59.33def	372.20b-g	10.07b
Ex-Monguno	20.33b-e	67.33a-f	72.50a-f	176.67a-d	25.56ab	17.17b-e	8.33a-d	39.50f	400.20b-g	8.53b
Lines										
PEO 5984	22.50a-d	56.33j	61.67k	155.83cd	20.67c-e	18.17b-d	7.83cd	61.83def	476.30a-f	9.56b
Super SOSAT	22.33a-d	64.00e-i	68.50f-j	191.67ab	23.33b-e	18.33bcd	9.33a	202.50a	670.20a	10.75b
SOSAT C-88	23.67a	65.83a-f	70.17c-h	196.50a	24.50a-d	18.00bcd	8.00bcd	98.00c-f	521.00a-e	9.17b
Ex-Borno	19.33b-e	63.33e-i	69.67e-i	162.83a-d	22.00b-e	14.00c-g	7.83cd	40.83f	306.30d-g	9.56b
LCIC 9702	21.83a-e	60.50g-j	65.33i-k	165.83a-d	22.00b-e	17.33b-d	7.67d	88.67c-f	556.3abc	8.34b
Hybrids										
PEO 5984 × PS 202	21.00a-e	60.50g-j	66.17h-k	178.50a-d	24.67a-d	17.17b-e	7.83cd	109.17b-f	465.00a-g	7.58b
Super SOSAT × PS 202	18.83b-e	69.67ab	74.50a-d	160.50bcd	23.67a-d	14.17c-g	8.33a-d	38.17f	436.80a-g	9.29b
SOSAT C-88 × PS 202	23.50ab	63.50e-i	72.17a-f	185.67abc	24.83a-d	18.17b-d	8.67a-d	163.83abc	591.20ab	10.24b
Ex-Borno × PS 202	11.17g	66.50a-f	72.83a-f	175.00a-d	24.33a-d	9.67gh	8.50a-d	108.33b-f	299.30e-g	9.56b
LCIC 9702 × PS 202	19.33b-e	59.50h-j	66.17h-k	157.33b-d	21.83b-e	14.50c-g	8.00bcd	58.83d-f	587.30a-f	9.65b
PEO 5984 × Ex-Baga	20.50b-e	59.33ij	65.33i-k	170.67a-d	18.67e	21.50a	8.33a-d	102.33b-f	501.20a-f	9.41b
Super SOSAT × Ex-Baga	19.67b-e	64.17e-i	71.67a-f	181.50a-d	22.33b-e	16.67b-f	7.83cd	186.17ab	358.70b-g	8.74b

SOSAT C-88 × Ex-Baga	19.50b-e	63.33e-i	69.50f-i	189.00abc	23.33a-e	15.17c-f	8.83a-d	49.67ef	459.80a-g	19.95a
Ex-Borno × Ex-Baga	13.17g	69.33abc	75.33a	174.17a-d	21.83b-e	8.67h	8.17a-d	34.33f	352.00c-g	10.24b
LCIC 9702 × Ex-Baga	18.00c-f	64.33d-h	70.00c-h	181.17a-d	23.17b-e	14.67c-g	8.33a-d	79.83c-f	397.80b-g	9.18b
PEO 5984 × Ex-Gubio	20.17b-e	20.50f-i	67.00g-j	164.17a-d	23.00b-e	14.50c-g	8.67a-d	58.83def	383.30b-g	10.07b
Super SOSAT× Ex-Gubio	20.33b-e	67.17a-f	73.17a-e	177.83a-d	24.83a-d	14.67c-g	8.33a-d	42.83ef	423.20b-g	10.48b
SOSAT C-88 × Ex-Gubio	16.00e-g	68.17a-e	73.67a-e	186.00abc	25.00abc	11.83gh	8.00bcd	78.33def	282.20g	9.30b
Ex-Borno × Ex-Gubio	17.17def	67.50a-e	72.83a-f	179.17a-d	21.83b-e	13.67c-g	7.83cd	76.50def	295.80e-g	9.15b
LCIC 9702 × Ex-Gubio	23.67a	65.17b-g	70.33b-h	191.83ab	24.17a-d	18.50a-d	7.67d	142.50a-d	543.30a-d	8.19b
PEO 5984 × Ex-Mongun o	22.17a-d	57.50j	64.17jk	149.17d	20.17de	18.00b-d	7.83cd	78.50c-f	353.30c-g	8.96b
Super SOSAT × Ex-Mongun o	18.50b-f	69.33abc	75.33a	164.17a-d	23.17b-e	15.67c-f	9.33a	55.33ef	442.70a-g	9.33b
SOSAT C-88 × Ex-Mongun o	21.33a-e	64.83b-g	70.00d-h	185.50abc	23.50a-d	18.83abc	8.83a-d	126.50a-e	591.70ab	10.10b
Ex-Borno × Ex-Mongun o	18.00c-f	70.17a	74.84ab	169.67a-d	24.83a-d	12.67e-h	8.17a-d	50.83ef	436.80a-g	8.37b

LCIC 9702 × Ex-Mongun o	22.83ab	67.00a-f	72.00a-f	174.33a-d	28.00a	16.67c-f	9.17ab	85.00c-f	432.70a-g	9.40b
Mean	19.89	63.43	70.54	174.97	23.40	15.73	8.34	83.69	439.87	9.70
S E+	1.98	1.76	1.65	12.71	1.71	1.81	0.45	30.53	84.92	2.04

Table 3: Variance components, Coefficient of Variation, and Heritability

Traits	σ^2g	σ^2p	σ^2e	PCV (%)	GCV (%)	h^2_{bs} (%)
Number of plants at emergence	68.62	89.55	20.93	21.22	18.57	76.63
Days to 50% flowering	84.62	106.93	22.31	12.90	11.55	79.14
Days to 100% flowering	70.11	84.51	14.40	10.95	9.97	82.96
Plant height	753.41	1537.42	784.01	29.64	20.75	49.00
Panicle length	23.77	42.04	18.27	13.40	10.08	56.54
Number of plants at harvest	78.98	99.01	20.03	25.09	22.40	79.77
Number of leaves/plants	1.33	2.61	1.28	5.50	4.00	50.96
Striga count	10611.82	15911.96	5300.14	1.55	1.12	66.69
Grain yield	7871.69	10542.87	2671.18	48.96	42.30	74.66
1000 seed weight	39.05	62.36	23.31	25.36	25.36	62.62

REFERENCES

[1] Al-Jibouri H.A., Miller P.A., and Robinson H.F. 1958. Genotypic and environmental variance and covariance's in an upland cotton cross of interspecific origin. *Agronomy Journal*. 50 (1958), 633-636.

[2] Anuradha N., Satyavathi C.T., Bharadwaj C., Sankar M., Singh S.P., Pathy T.L. 2018. Pearl millet genetic variability for grain yield and micronutrients in the arid zone of India. Journal of Pharmacognosy and Phyto-Chemistry. 7, 1 (2018), 875-878.

[3] Balami G.S., Izge A.U., Sabo M.U, Buba U.M., and Fagam A.S. 2022. Combining ability analysis for Striga tolerance among pearl millet (*Pennisetum galucuum* [L.] R. Br.) inbreds in a line × tester cross. *Direct Research of Agriculture and Food Science.* 10, 1 (2022), 2 - 4.

[4] Balami, G. S., and Izge, A. U. 2024. Genetic variability and heritability among indigenous pearl millet (*Pennisetum glaucum* [L.] R. Br.) in Striga infested fields of Sudan Savanna, Nigeria. *Direct Research of Agriculture and Food Science.* 12(1): 76-82. https://doi.org/10.26765/DRJAFS12219610

[5] Basavaraj P.S., Biradar B.D., Sajjanar G.M. 2017. Genetic variability studies for quantitative traits of restorer (R) lines in pearl millet (*Pennisetum glaucum* [L.] R. Br.) *International Journal of Current Microbiology and Applied Sciences*. 6, 8 (2017) 3353-3358.

[6] Borkhataria, P. R., Bhatiya, V. J., Pandya, H. M. and Value, M. G. 2005. Variability and

correlation studies in pearl millet. *National Journal of Plant Improvement*. 7: 21-23.

[7] Burton, G. W. (1952). Quantitative inheritance in grasses. Proc. 6th. Int. Grasslands. Cong. J. 1, 227-283.

[8] Burton, G. W., and De Vane, E. H. 1953. Estimating heritability in tall fescue (*Fistvea arundiancea*) from replicated clonal material. *Agricultural Journal*. 45, 284–291. doi: 10.2134/agronj1953.00021962004500100005x

[9] Chauhan S., Mishra U., Singh A.K. 2020. Genetic variability, heritability and genetic advance studies for yield and yield related traits in pearl millet (*Pennisetum glaucum* [L.] R. Br.). *Journal of Pharmacognosy and Phytochemistry*. 9, 3 (2020), 1199-1202.

[10] Dang, J. K., Thakur, D. P. and Das, S. 1985. Genetics of grain yield and some plant characters in pearl millet. *Crop Improvement*. 12: 39-41.

[11] Drabo I, Zangre R.G., Danquah E.Y., Ofori K, Witcombe J.R., Hash C.T. 2018. Identifying famers' preferences and constraints to pearl millet production in the Sahel and North-Sudan zones of Burkina Faso. *Experimental Agriculture*. 55(5):76-75.

[12] FAO. (2021). Food and Agricultural Organization of United Nations-FAOSTAT http://faostat.fao.org/site/567/default.aspx.

[13] Izge A.U., Abubakar A.M. and Echekwu A.C. 2005. Estimation of genetic and environmental variance components in pearl millet (*Pennisetum glaucum* [L.] R. Br.). *Nigerian Journal of Environmental and Applied Biology*. 6 (1): 705-714.

[14] Izge, A. U., Song, I. M. 2013. Pearl millet breeding and production in Nigeria: problems and prospects. *Journal of Environmental Issues and Agriculture in Developing Countries.* 5: 2, 25-33.

[15] Izge A.U., Kaddams A.M. and Gungula D.T. 2007. Heterosis and inheritance of quantitative characters in a diallel cross of pearl millet (*Pennisetum glaucum* [L.] R. Br.). *Journal of Agronomy*. 62 (2017), 278-285.

[16] Johnson H.W., Robinson H.F. and Comstock R. E. 1955. Estimate of genetic and environmental variability in soybeans. *Agronomy Journal*. 47, 7 (1955), 314-318.

[17] Kumar RS., Dalal H.M.S., Malik V., Devvart L., Chuch K., Gargand P. 2014. Studies on variability, correlation and path analysis in pearl millet (*Pennisetum glaucum* [L]. R. Br.) genotypes. *Forage Research*. 40, 3 (2014), 163-167.

[18] Kumar M., Gupta P.C., Shekhawat H.V. 2016. Correlation studies among pearl millet (*Pennisetum glaucum* [L.] R. Br.) hybrids. *Electronic Journal of Plant Breeding*. 7, 3 (2016), 727-729.

[19] Kunjir, A. N. and Patil, R. B. 1986. Variability and correlation studies in pearl millet. *Journal of Maharashtra Agricultural University*,11:273-275.

[20] Lakshmana, D., Surendra, P. and Gurumurthy, R. 2003. Combining ability studies in pearl millet. *Research on Crops.,* 4: 358-362.

[21] Lakshmana, D., Birdar, B. D. and Ravikumar, L. R. 2009. Genetic variability studies for quantitative traits in a pool of restorers and maintainers lines of pearl millet (*Pennisetum glaucum* L.). *Karnataka Journal of Agricultural Sciences,* 22: 881-882.

[22] Manga V.K. 2013. Components of genetic variance and interrelationship among quantitative traits in CAZRI-bred inbred restorers of pearl millet (*Pennisetum glaucum* [L.] R. Br.). *Electronic Journal of Plant Breeding*. 4, 4 (2013), 1325-1330.

[23] Quendeba, B., Ejeta G., Hanna, W.W and Kumar, A.K. 1995. Diversity among African pearl millet land race populations. *Crop Sciences*. 35: 919-924.

[24] Ogunniyan D.J., and Olakojo S.A. 2015. Genetic variation, heritability, genetic advance and agronomic character association of yellow elite inbred lines of maize (*Zea mays* L.), *Nigerian Journal of Genetics*. (2015), 1-5.

[25] Pallavi M., Sanjana Reddy P., Radha Krishna K.V., Ratnavathi C.V., Sujatha P. 2020. Genetic variability, heritability and association of grain yield characters in pearl millet (*Pennisetum*

glaucum [L.] R. Br.), *Journal of Pharmacognosy and Phytochemistry*. 9, 3 (2020), 1666 - 1669.

[26] Parker C., and Riches C.R. 1993. *Parasitic Weeds of the World, Biology and Control*. Wallingford, Oxfordshire: CAB International. (1993), 40-57.

[27] Poonam R., Manoj K.T., Solanki R.S., Sushma T., Niraj T., Shailja C., Pandya R.K., and Vikas K. 2023. Genetic variability and multivariate analysis in pearl millet (*Pennisetum glaucum* [L.] R. Br.) germplasm lines, *The Pharma Innovation Journal*. 12, 4 (2023), 216-226.

[28] Rouamba A, Shimelis H, Drabo I, Laing M, Gangashetty P, Mathew I, Mrema E, Shayanowako AIT, 2021. Constraints to pearl millet (*Pennisetum glaucum*) production and farmers' approaches to *Striga hermonthica* management in Burkina Faso. Sustainability. 13:8460.

[29] Saleh G. B., Abbdullahi D, and Ammuar A.R. 2002. Performance, heterosis and heritability in selected tropical maize single, double and tree-way cross hybrids, *Journal of Agricultural Sciences*. 138 (2002), 21-28.

[30] Sangham, D., H. Upadhyaya, S. Senthilvel, and C. Hash. 2012. Millets: genetic and genomic resources. *Plant Breeding Reviews*. 35: 246-374.

[31] Sanjana P.R., Pallavi M., Radha K.K.V., Ratnavathi C.V., and Sanjatha P. 2020. Genetic variability, heritability and association of grain yield characters in pearl millet (*Pennisetum glaucum* [L.] R. Br), *Journal of Pharmacognosy and Phytochemistry*. (2020), 2349-8234.

[32] Sumathi P, Madineni S, Veerabadhiran P. 2010. Genetic variability for different biometrical traits in pearl millet genotypes (*Pennisetum glaucum* [L.] R. Br.). *Electronic Journal of Plant Breeding*. 1, 4 (2010), 437-440.

[33] Talawar A., Girish G., Channabasavanna A., Kitturmath M. 2017. Studies on genetic variability, correlation and path analysis in pearl millet (*Pennisetum glaucum* [L.] R. Br) germplasm lines. *Agricultural Science Digest*. 37, 1 (2017), 75-77.

[34] Upasna M., Shailja C. and Singh A.K. 2021. Genetic variability, heritability and genetic advance studies for yield and yield related traits in pearl millet [(*Pennisetum glaucum* [L.] R. Br.] *Journal of Pharmacognosy and Phytochemistry*. (2021), 2349-8234.

[35] Wilson J.P., Hess D.E., Hanna W.W. 2011. Resistance to *Striga hermonthica* in wild accessions of the primary gene pool of *Pennisetum glaucum*. *Phytopathology*. 90 (2011), 1169-1172.

[36] Zaki H.E.M. and Radwan K.S.A. 2022. Estimates of genotypic and phenotypic variance, heritability, and genetic advance of horticultural traits in developed crosses of cowpea (*Vignaunguiculata* [L.] Walp). *Frontier Plant Science*. 13:987985. doi: 10.3389/fpls.2022.987985