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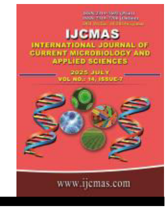

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Variability Studies for Yield and Yield Attributes in Foxtail Millet (*Setaria italica* (L.) P. Beauv)

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ABSTRACT

The study involving 40 genotypes of foxtail millet nine agronomic and yield-related traits indicated Significant differences among genotypes for all traits studied and substantial genetic diversity in the experimental material. PCV was higher than GCV for all traits but the narrow range of variation between PCV and GCV suggest the lesser environmental influence on the expression of traits. Heritability estimates were high for all traits ranging from 66.6% to 94.4%, suggesting reliable transmission of traits to the next generation. High PCV,GCV, heritability and genetic advance recorded for grain yield per plant, straw yield per plant and number of productive tillers per plant indicated the operation of additive gene action and the possibility of improvement them through simple selection. Days to 50% flowering, thousand grain weight and harvest index had high heritability coupled with moderate genetic advance as percent of mean suggesting the operation of both additive and non additive gene action. The study highlights the potential of simple selection strategies for key yield-related traits and provides valuable information for future breeding programs aimed at enhancing foxtail millet productivity.

Introduction

Foxtail millet (*Setaria italica* (L.) P. Beauv.) is one of the oldest domesticated cereal crops, belonging to the family Poaceae. It is widely cultivated in arid and semi-arid regions of Asia, particularly in China and India, which together account for the majority of global production.

In India, it is majorly grown in Andhra Pradesh, Karnataka, Tamil Nadu and Rajasthan. As a short-duration, drought-tolerant, and climate-resilient crop, foxtail millet plays a vital role in ensuring food and nutritional security in marginal environments. The crop is rich in dietary fiber, protein, essential amino acids (especially methionine), minerals like iron and calcium, and antioxidants, making it a functional food with numerous health benefits. Its low glycemic index also makes it suitable for diabetic and health-conscious populations. In recent years, there has been a renewed interest in foxtail millet due to its adaptability to low-input agriculture and its potential in sustainable farming systems.

Despite its agronomic and nutritional advantages, genetic improvement in foxtail millet remains limited compared to major cereals. Therefore, research aimed at evaluating genetic diversity, trait associations, and potential breeding strategies are crucial for enhancing productivity and stress resilience. This study focuses on evaluating the genetic variability among diverse foxtail millet genotypes to identify superior lines and formulate an effective selection strategy for improving yield and adaptation in foxtail millet.

Materials and Methods

The present investigation was carried out at S.V. Agricultural College, Wetland farm, Tirupati during *Rabi* 2024-25. The experimental material comprised 40 foxtail millet genotypes received from Regional Agricultural Research Station, Nandyal. The experiment was laid out in the Alpha Lattice with two replication. Each genotype was raised in two rows with spacing of 30 cm between row to row and 10cm between plant to plant.

Observations were recorded on days to 50% flowering, days to maturity, plant height (cm), number of productive tillers per plant, panicle length (cm), thousand grain weight (g), harvest index (%), straw yield per plant (g) and grain yield per plant (g).

The mean data were subjected to the analysis of variance (Panse and Sukhatme, 1957). Estimates of genotypic and phenotypic coefficient of variation, heritability and genetic advance as percent of mean were carried out according to Burton (1952); Burton and Devane (1953) and Johnson *et al.,* (1955), respectively.

Results and Discussion

Analysis of variance revealed the presence of significant differences among the genotypes for all the trait under study, indicating that genotypes under study were genetically diverse for most of the traits (Table 1). The narrow difference between PCV and GCV for all the traits indicated the lesser influence of environment factors on the traits studied (Table 2).

Higher magnitude of PCV and GCV were recorded for number of Productive tillers per plant (25.6 and 23.3), Straw yield per plant (25.4 and 23.9) and grain yield per plant (27.5 and 25.9) suggests presence of sufficient variability and these traits can be improved by simple selection. Similar findings in foxtail millet were reported by Mohan *et al.,* (2019); Anand *et al.,* (2020) and Venkatesh *et al.,* (2020); Vardhan *et al.,* (2024). The other traits *viz.,* panicle length (18.2 and 17.2) and plant height (13.5 and 12.1) showed moderate PCV and GCV estimates indicating that these traits can also be improved by simple selection procedures. However, days to 50% flowering (6.6 and 6.4) and days to maturity (3.2 and 2.7) showed low PCV and GCV respectively, suggesting less variation among genotypes for these traits. These traits may require multi-environment testing to identify stable and desirable genotypes.

The estimates of heritability along with genetic advance were helpful in predicting the genetic gain under selection. In the present study heritability estimates are high for all the traits *viz..,* days to 50% flowering (94.4%), days to maturity (72.2%), plant height (80.6%), number of productive tillers per plant (83.4%), panicle length (89.7%), thousand grain weight (66.6%), harvest index (72.3%), straw yield per plant (88.2%), grain yield per plant (89.2%). Similar findings were reported by Brunda *et al.,* (2015); Anand *et al.,* (2020); Kamal *et al.,* (2021); Harish *et al.,* (2022); Vardhan *et al.,* (2024).

Higher estimates of genetic advance as percent of mean were observed for number of productive tillers per plant (43.9%), plant height (22.5%), panicle length (33.7%), straw yield per plant (46.8%) and Grain yield per plant (50.5%). Similar results were reported by Brunda *et al.,* (2015); Anand *et al.,* (2020); Karvar *et al.,* (2021); Harish *et al.,* (2022); Vardhan *et al.,* (2024).

High heritability coupled with high genetic advance as percent of mean indicates the preponderance of additive gene action and genetic improvement can be done by simple selection procedures for the traits *viz..,* number of productive tillers per plant, straw yield per plant and grain yield per plant.

Higher estimates of heritability and moderate genetic advance as per cent of mean registered for days to 50% flowering (94.4% and 12.8%), thousand grain weight (66.6% and 16.22%) and harvest index (72.3% and 18.5%) also reveals that they are under the influence of both additive and non additive gene action.

The trait days to maturity with high heritability and low genetic advance as percent of mean (72.2% and 4.82%) was found to be governed by non additive gene action and not amenable for improvement through simple selection.

Table.1 ANOVA for grain yield and yield attributes in foxtail millet germplasm accessions

S. No.	Trait(s)	Mean squares			
		Replications (df:1)	Genotypes (df:39)	Blocks (df:6)	Error (df:33)
1.	Days to 50% flowering	0.200	20.50**	0.63	0.58
2.	Days to maturity	6.05	13.98**	1.75	2.29
3.	Plant height (cm)	23.28	223.11**	8.68	25.16
4.	Number of productive tillers per plant	0.001	0.281**	0.011	0.026
5.	Panicle length (cm)	1.07	10.74**	0.28	0.60
6.	Thousand grains weight (g)	0.0002	0.187**	0.06	0.03
7.	Straw yield per plant (g)	0.05	15.08**	0.25	1.00
8.	Harvest index (%)	22.70	36.41**	3.24	6.07
9.	Grain yield per plant (g)	1.04	6.03**	0.33	0.34

** Significant at 1% level of significance

Figure.1 Genotypic and Phenotypic coefficient of variation for yield and yield attributes in foxtail millet

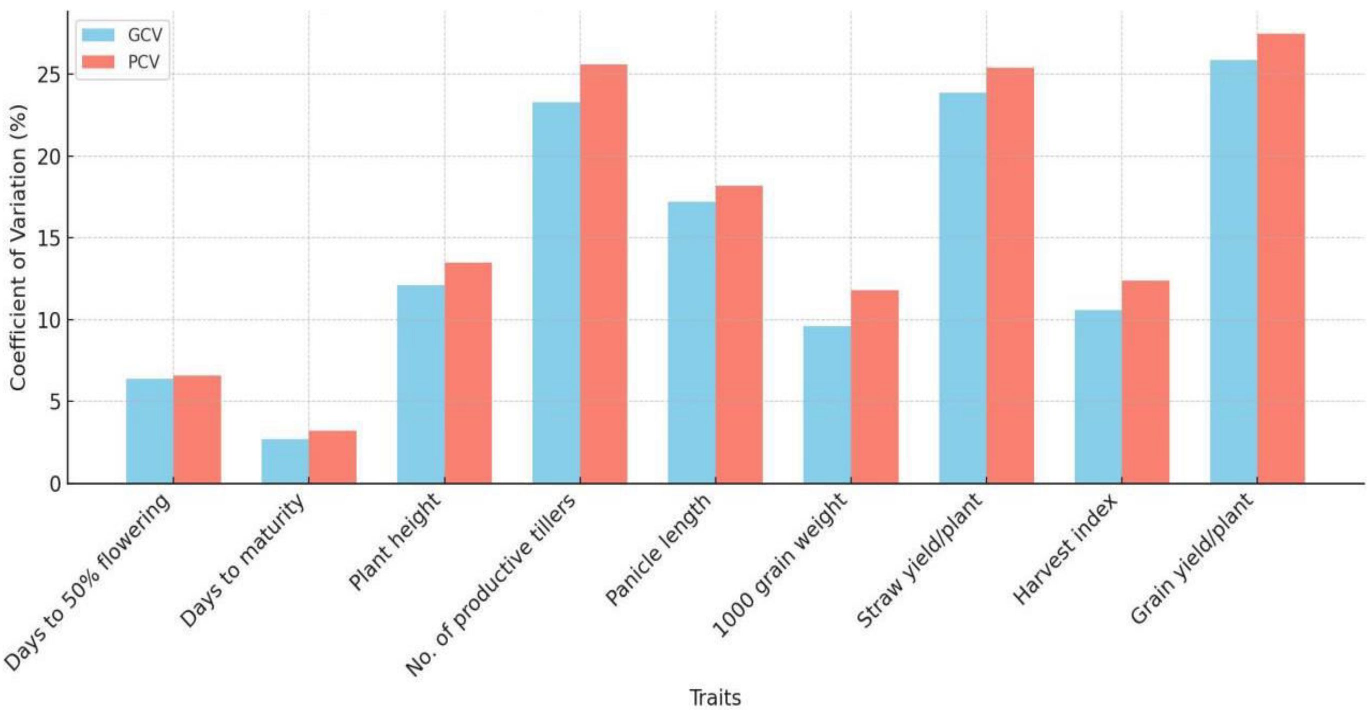
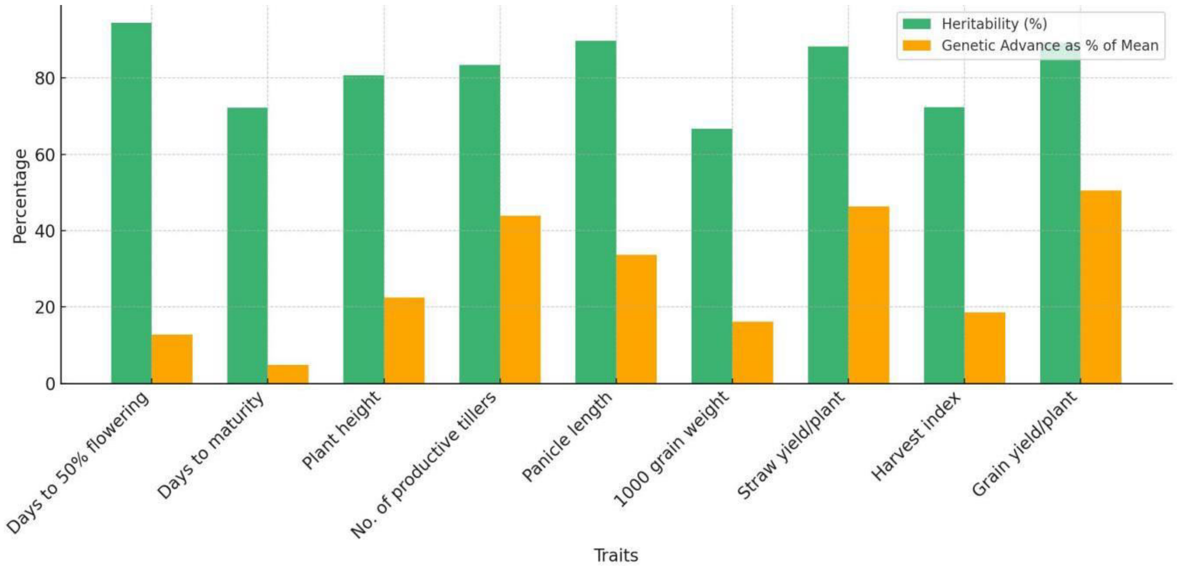


Table.2 Estimation of coefficient of variation, heritability and genetic advance as percent of mean for traits of foxtail millet accessions

S. No.	Character	Range		Mean	Coefficient of Variation (%)		Heritability (bs) (%)	Genetic Advance	Genetic Advance as per cent of Mean (%)
		Min.	Max.		Genotypic	Phenotypic			
1	Days to 50% flowering	42.5	55.0	49.2	6.4	6.6	94.46	6.31	12.8
2	Days to maturity	83.5	91.5	87.9	2.7	3.2	72.23	4.24	4.82
3	Plant height (cm)	63.3	108.8	81.9	12.1	13.5	80.65	18.46	22.53
4	Number of productive tillers per plants	1.0	2.7	1.5	23.3	25.6	83.41	0.67	43.9
5	Panicle length (cm)	7.2	18.1	13.0	17.2	18.2	89.74	4.40	33.7
6	Thousand grains weight (g)	2.2	3.2	2.8	9.6	11.8	66.67	0.46	16.22
7	Straw yield per plant (g)	6.3	18.6	11.1	23.9	25.4	88.21	5.14	46.30
8	Harvest index (%)	30.5	45.4	36.8	10.6	12.4	72.30	6.84	18.56
9	Grain yield per plant (g)	3.6	11.5	6.4	25.9	27.5	89.23	3.28	50.55

Figure.2 Estimates of heritability and genetic advance as percent of mean for yield and yield attributes in foxtail millet.



The study revealed the existence of sufficient variability for all the traits except days to flowering and days to maturity and the scope for further breeding programmes. Higher estimates of PCV, GCV, heritability and genetic advance as percent of mean i observed for number of productive tillers per plant, straw yield per plant (g) and grain yield per plant (g) revealed the involvement of additive gene action. While high heritability and moderate genetic advance as percent of mean registered for days to 50% flowering, thousand grain weight and harvest index also suggests the operation of additive and non additive gene action for the traits. Hence, simple selection procedures can be followed for improving the grain yield in foxtail millet.

Author Contributions

C. Bhavani Saiesha: Investigation, formal analysis, writing—original draft. N. Sabitha: Validation, methodology, writing—reviewing. R. Narasimhulu:—Formal analysis, writing—review and editing. K. V. Naga Madhuri: Investigation, writing—reviewing. M. Reddi Sekhar: Resources, investigation writing—reviewing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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