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VARIABILITY AND INHERITANCE AMONG PEARL MILLET GENOTYPES UNDER RAINFED CONDITION- AN OVERVIEW

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SUMMARY

Pearl millet is C_4 plant grown in arid and semi-arid tropics. It is drought, low soil fertility, high salinity, low pH, or high temperature. It has gluten-free protein which has therapeutic effect for those vulnerable to gluten allergy and celiac disease. It has a high fiber content, which slows down digestion and releases the glucose into the blood at a slower rate and also boosts immunity therefore, named as "nutri-cereal". Malnutrition is a serious health issue in India, and India to be free from this. A large amount of variability found in the pear millet accessions and commercial hybrids has been utilized in the bio-fortification breeding. The positive association between Ca and Mg, will lead to the improvement of other related nutrients content as an associated trait. G×E interactions play an important role in the expression of grain yield and its attributing traits because these are complex traits and governed by many genes. Therefore, a comprehensive knowledge on correlation of yield and biochemical trait with morphological traits helps in indirect selection of these traits *via* highly heritable traits will be beneficial. The estimate the extent of genetic variability for yield and attributing traits, their correlation which will be helpful in finding the association among yield and nutritional traits in pearl millet genotypes. Recent, important and relevant literature pertaining to these aspects has been reviewed in this article.

Key words: Pearl millet, *Pennisetum glaucum*, rainfed, nutri-cereal, variability, inheritance

Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is highly cross-pollinated with protogynous flowering, diploid (2n=2x=14) having a relatively large (1.76 Gb) genome size and belongs to the family Poaceae. It is highly nutritious major cereal grown in arid and semi-arid tropical environments of Africa and Asia including the driest parts of India (Arya and Yadav, 2009). Pearl millet acts as an utmost source of nourishing food for poorest people in arid and semi-arid of tropical and sub-tropical countries (Arya *et al*., 2010). It can be grown in areas where there is drought, low soil fertility, high salinity, low pH, or high temperature. It is grown for grain and fodder purpose in the arid and semi-arid of tropical and sub-tropical countries (Bikash *et al*., 2013a). As a C_4 species, it has a huge potential for biomass production, with the majority of it accumulating in its vegetative parts. However, in United States (US) and Europe, pearl millet is grown as a fodder and feed crop for livestock.

Besides its importance as food and feed crop, pearl millet is an ideal species for genetic studies due to its small diploid genome with large chromosome, large amount of phenotypic and genotypic diversity. Pearl millet has higher protein content than other staple crops with more impartial amino acid profile having high protein efficiency ratio. It has gluten-free protein which has therapeutic effect for those vulnerable to gluten allergy and celiac disease (Arya *et al*., 2013). It has a high fiber content, which slows down digestion and releases the glucose into the blood at a slower rate, thereby helps to maintain normal blood sugar levels for a comparatively longer duration of time which is used to maintain normal blood sugar level. Thus, we can say that foods prepared from pearl millet have low glycemic index, and are suitable to those suffering from or prone to diabetes. So, due to all these characteristics makes pearl millet a "nutri-cereal".

Bio-fortification is a cost-effective and sustainable agricultural strategy to address malnourishment related problem. In India, malnutrition is a serious health issue, and efforts are made towards "Kuposhan Mukt Bharat". A large amount of variability found in the potential germplasm accessions and commercial hybrids as follow as (85-249 mg/kg Ca; 1127-1837 mg/kg Mg) and (82-210 mg/kg Ca; 1060-1650 mg/kg Mg), respectively has been utilized in the bio-fortification breeding programme (Andrews and Kumar, 1996). There is high significant and positive association between these two important macronutrients (Ca and Mg), major emphasis is on either one of the mineral, because with the enhancement of the concentrations of one nutrient will lead to the improvement of other related nutrients content as an associated trait. G×E interactions play an important role in the expression of grain yield and its attributing traits because these are complex traits and governed by many genes (Kumar *et al*., 2013). Hence, direct selection for these traits is not worthy. Consequently, a comprehensive knowledge on correlation of yield and biochemical trait with morphological traits helps in indirect selection of these traits *via* highly heritable traits will be beneficial (Lakshmana *et al*., 2010).

Macronutrient deficiency has a disastrous cost to society because magnesium deficiency causes global cardiovascular disease prevalence and low mineral density in the bone and calcium deficiency causing osteoporosis. Among the cereals and pulses, pearl millet is the most cost effective resource of energy, proteins, iron, phosphorous , calcium and magnesium. Bio-fortification in pearl millet is usually done with two aims: first, to make the crop more nutrient dense and, second, elimination of the anti-nutritional factors. In comparison to wheat and rice, in pearl millet very little work has been done on nutritional quality. Therefore, efforts should be made to identify effective and stable genotypes for yield and nutritional traits for utilizing them in future breeding. The extent of genetic variability for yield and attributing traits, their correlation which will be helpful in finding the association among yield and nutritional traits in pearl millet genotypes. Recent, important and relevant literature pertaining to these aspects has been reviewed in brief under the following heads:

Variability in terms of variances and co-efficient of variation

Abdalla *et al.* (1998) studied mineral contents in ten pearl millet genotypes were analysed and found that it ranged between180-270 mg/g 10-80mg/g and 450-990mg/g for magnesium, calcium and phosphorus respectively. Calcium content exhibited highest in IS 91777 (80mg/g) and lowest in IS 91666 (10mg/g). But, there were significantly higher in Mg content in all genotypes except IS 91777 which had180mg/g grain. Sumathi *et al.* (2010) revealed that number of tillers per plant, ear head length, root-shoot ratio and seed yield showed moderate PCV and GCV while the traits, days to 50% flowering, plant height, ear head breadth, root length and shoot length showed low PCV and GCV but plant height and shoot length recorded higher genotypic and phenotypic variation than the other characters.

Govindaraj *et al*. (2010) evaluated twenty one different pearl millet genotypes and found that considerable amount of genetic variation was existed in plant height (110-194.50 cm), number of productive tillers (1.50-3.98) and for grain yield (40.85-189.78) which are two folds, two folds and four folds respectively. The phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all traits under investigation. Govindaraj *et al*. (2011) studied genetic variability among 61 elite germplasm lines the pearl millet. As per analysis of variance, significant differences between the genotypes for yield and nutritional quality traits under study, revealed the existence of substantial amount of variation among the genotypes for yield and nutritional quality traits especially calcium content.

Choudhary *et al*. (2012) evaluated 50 pearl millet genotypes (including 3 checks viz. Raj-171, ICTP-3616, ICTP 8203) for genetic variability and character association among morphological characters. The analysis of variance revealed significant differences among genotypes for all the characters indicating the presence of adequate variability in the pearl millet genotypes. The grain yield per plant showed significant and positively associated with plant height, productive tillers per plant, ear girth, dry fodder yield per plant, test weight and harvest index. Dry fodder yield/plant and harvest index also had high direct effect on grain yield per plant. Hence, main emphasis should be given tothese traits in pearl millet breeding programme.

Dehinwal (2013) studied 100 pearl millet inbreds and demonstrated that dry fodder yield were ranged from (525-3962.5 g/plot grains) and plant height (117.5-228.7cm), respectively. Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) also estimated which showed that maximum value of GCV and PCV was for dry fodder yield (40.40, 40.71) followed by grain yield (34.20, 35.56), ear weight (31.11, 32.09). It showed that the material possessed sufficient genetic variability. Subi *et al.* **(**2013) observed the magnitude of genetic variability in fifteen genotypes of pearl millet. They showed wide range of variation, highly significant differences (P? 0.01) were observed for days to 50%flowering and days to maturity in the two seasons, highly significant differences for genotypes and genotype × seasons interaction for most of the characters in both seasons. This variation could be attributed to genetic and environmental effects as well as their interactions. Along with those phenotypic coefficients of variation (PCV) and genotypic coefficients of variation (GCV) estimates showed that estimate of PCV were higher than genotypic coefficients of variation (GCV) estimates for all the studied characters in all genotypes displaying the influence of environment effect on the studied characters.

Kanatti *et al*. (2014) conducted experimental trial which included two sets of hybrid referred as Set-A and Set-B consist of 32 hybrids and 3 control, and 28 hybrids and 3 controls respectively. They accessed variability among the hybrids which they showed highly significant differences among the hybrids for all traits, both in individual environments as well as across the environments. These experimental trials had showed sufficient variability for all the traits in hybrids would be beneficial for further study in future. Bashir *et al.* (2014) estimated the potential of 225 accessions of Sudanese pearl millet landraces in Sudan at three locations for agro-morphological traits. They observed that across three locations showed mostly significant (P<0.001) genetic variation for the agro-morphological traits under studied. Maximum genetic variability exhibited for dry fodder yield (296.6-739.8g/m^2) followed by Grain yield (79.6-267.8g/m^2) among agro-morphological traits showed a wide variation.

Kulthe *et al.*(2016) conducted a trial consist of 3 cultivars of pearl millet *viz*., *Shanti* (RHRBH 9808), *Dhanshakti* (ICTP 8203 Fe 10-2) and Pioneer 86M64 and result come from this investigation showed that maximum calcium, phosphorus and iron contents in Dhanshakti (42.67, 327.82 and 8.12 mg/100g, respectively). Among three pearl millet cultivars, minimum nutrient contents were observed in Pioneer 86M64 (40.07, 255.67 and 5.08 mg/100g, respectively). Kaushik and Grewal (2017) studied thirteen different varieties of pearl millet for mineral content and results were showed that released hybrids HHB-197, HHB-226 and HHB-146 exhibitedmaximum density of potassium, magnesium and calcium content and minimum density was in composite varieties HC-10, HC-20 and released hybrid HHB-223 variety.

Anuradha *et al.* (2018) studied the genetic variability and correlation among grain yield and its attributing traits in 130 pearl millet lines and the result from analysis of variance revealed that significant variation were observed for all the traits under study. GCV and PCV were ranged from low to moderate for most of traits studied indicating presence of low to moderate variability in the current population. Days to 50% flowering was only trait showed low GCV and PCV which revealed lesser variability for this trait? Marmouzi *et al.*(2018) were observed a considerable amount of calcium and magnesium density 211.01 ± 5.12, 174.04 ± 3.12, respectively in their Moroccan pearl millet seed. Sharma *et al.*(2018) evaluated 34 germplasm of pearl millet which showed highly significant differences among the genotypes for all the characters studied, indicating the presence of sufficient variability in the experimental material. The PCV were slightly higher than GCV indicating little influence of environment on the expression of characters. High PCV and GCV were recorded for all the characters.

Kumawat *et al.* (2019) elucidated 50 pearl millet single cross for genetic variability and these hybrids were generated by line ´ tester mating design at ICRISAT, Hyderabad during *Summer*, 2018 and then these crosses were evaluated during *Kharif*, 2018. The analysis of variance indicated that high values of GCV and PCV were obtained for the characters like grain yield per plant and number of effective tillers per plant. Hence, they concluded that scope for genetic improvement through selection was effective for these traits.

Kaushik (2020) studied 60 pearl millet lines which revealed that sufficient amount of variability for all the characters by analysis of variance. Also, calcium and magnesium content was estimated in stem, leaf and grain showed highly significant mean sum of square due to genotypes in case of both calcium and magnesium. It can be said that there must be sufficient variability present for both the characters and they can be studied further. Kumar *et al*. (2022) studied 50 germplasm lines of pearl millet and reported high estimates of GCV and PCV under rainfed conditions for all the characters under study.

Heritability and genetic advance

Govindaraj *et al.* (2010) evaluated 21 different pearl millet genotypes and they concluded that greater magnitude of broad sense heritability coupled with higher genetic advance for grain yield per plant and panicle length, is the evidence that these plant traits were under the control of additive genetic effects for inheritance of these traits and simple selection should be conducted to improve concerned traits. The high estimates of heritability with low genetic advancement were found for plant height and panicle girth and this relationship indicate the presence of no additive gene action, thus simple selection procedure in early segregating generation will not be effective for screening of the desirable character for potential breeding programme.

Sumathi *et al.* (2010) observed days to 50% flowering, plant height, number of tillers per plant, ear head length, ear head breadth, root length, shoot length, root shoot ratio and seed yield per plant in 47 pearl millet genotypes. They examined genetic advance as per cent of mean along with heritability which revealed high heritability was recorded for all the characters under study except number of tillers per plant, which showed moderate heritability. High heritability combined with high genetic advance as per cent of mean (GAM) was descried for ear head length and seed yield per plant. This indicates that in expression of these characters prevalence of additive gene action was most prominent, hence amenable for simple selection. High heritability coupled with low genetic advance as per cent of mean was recorded for days to 50% flowering, ear head breadth and shoot length indicating non-additive gene action for these traits, hence heterosis breeding would be recommended for these trait.

Subi *et al.* (2013) evaluated fifteen genotypes of pearl millet and analysed heritability in broad sense along with genetic advance for the yield and yield contributing characters which were fluctuating at the two seasons. The differences in the magnitude of heritability would be attributed to the effect of the environment. The results showed that for days to 50% flowering and days to maturity were high estimates of heritability in broad sense and genetic advance lowest estimates for yield and yield components. However, high estimate of heritability with low genetic advance were there for number of productive tillers, which indicated the presence of non-additive gene action. So, for such character simple selection will not be effective and in such situation recombination breeding may be give better response for improvement of millet.

Dehinwal (2013) studied 100 germplasm lines of pearl millet for various quantitative traits and he observed that high heritability coupled with high to moderate genetic advance expressed as per cent of mean for all the traits. It is the evidence that these plant traits were under the control of additive genetic effects for inheritance of these traits and simple selection should be conducted to improve such traits.

Sharma *et al.*(2018) revealed that high heritability values coupled with high genetic advance as percent of mean was recorded for number of effective tiller per plant, grain yield and seed size in 34 pearl millet genotypes which indicate the prevalence of additive gene action in their inheritance indicating the selection based on these traits to be quite effective. High heritability coupled with moderate genetic advance as percent of mean was observed for ear girth, protein content and seed density. High heritability along with low genetic advance as percent of mean was noticed for days to maturity.

Govindaraj *et al.* (2020a) evaluated 39 pearl millet core collection accessions for genetic variability parameters. Based on a two-season evaluation, heritability varied from moderately high (57%) to very high (91%) & maximum for days to 50% flowering & minimum for macronutrient potassium (65%). The relative performance of accessions did not significantly differ from one season to the next, demonstrating that G x E influences do not affect the ranking and selection of mineral content in these pearl millet accessions.

Kaushik (2020) showed that genetic parameters in 60 pearl millet cultivars. Calcium and magnesium content showed high genotypic and phenotypic coefficient of variation, heritability and genetic advance as percent of mean which that these traits can be easily exploited through simple selection procedures. Calcium and magnesium content ranged from 15.3-86.7 mg/100g, 47.9-381.5 mg/100g, respectively.

Kumar *et al.* (2022) studied 50 germplasm lines of pearl millet and reported high estimates of GCV, PCV, heritability and genetic advance as percent of mean for panicle length, panicle diameter, effective tillers/plants, 1000 seed weight, dry fodder yield and grain yield. These traits are governed by additive gene action and can be improved through simple selection.

Correlation coefficient and path coefficient analysis

Izge *et al.* (2006) carried out two year experiment at Maiduguri and at Yola to estimated association and direct and indirect effect on grain yield/

TABLE 1
Summary of previous work show relationship between grain yield and other traits

Correlation between	Type	Reference(s)
Grain yield with number of effective tillers	Positive	Dhillon *et al.*(1977), Gupta and Gupta (1971), Bhasker *et al.*(2017), Sharma *et al.*(2018), Subbulakshmi *et al.*(2018)
Grain yield with grains per sq.cm	Positive	Yadav (1977), Gupta and Gupta (1971)
Grain yield with 1000 seed weight	Positive	Dhillon *et al.* (1977), Yadav (1977), Govil and Murty (1982), Bhasker *et al.*(2017), Subbulakshmi *et al.*(2018)
Grain yield with plant height	Positive	Gupta and Gupta (1971), Bhasker *et al.*(2017), Ezeaku *et al.*(2015), Kumar *et al.*(2020), Subbulakshmi *et al.*(2018)
Grain yield with ear length	Positive	Saxena *et al.* (1978), Yadav (1977), Sharma *et al.* (2018), Bhasker *et al.*(2017), Ezeaku *et al.*(2015), Talawar *et al.* (2017), Subbulakshmi *et al.* (2018)
Grain yield with ear girth.	Positive	Dhillon *et al.*(1977), Saxena *et al.* (1978), Bhasker *et al.*(2017), Sharma *et al.*(2018), Talawar *et al.*(2017), Subbulakshmi *et al.* (2018)
Grain yield with dry fodder yield per plot	Positive	Bhasker *et al.*(2017), Choudhary *et al.*(2012), Kumar *et al.* (2014)
Grain yield and days to 50% flowering	Negative	Dhillon *et al.* (1977), Balakrishnan and Das (1995), Ezeaku *et al.*(2015), Atif *et al.*(2012),Subbulakshmi *et al.*(2018)
Ca content with Mg content	Positive	Govindaraj *et al.*(2020a), Bashir *et al.*(2014), Kaushik (2020)
Mg content with days to 50% flowering	Negative	Bashir *et al.*(2014)
Ca content with grain yield/plant	Positive	Bashir *et al.*(2014), Kaushik (2020)
Mg content with grain yield/plant	Positive	Bashir *et al.*(2014), Kaushik (2020)

ha with other morphological traits. It was revealed that grain yield/ha had positive and significant correlation with yield/plant, number of tillers/plant, number of leaves/plant, plant height, panicle length and number of seeds/panicle. Grain yield per plant, number of seeds/panicle and plant height appeared to be the prominent characters when selection should be done in increasing total grain yield in pearl millet.

Dehinwal (2013) examined that grain yield expressed positive significant correlation with dry fodder yield (0.87) followed by ear weight (0.83), total tillers/plant (0.29), effective tillers/plant (0.29) and spike girth (0.17). Beside, these highest positive and direct effects on grain yield per plant were also recorded by dry fodder yield followed by ear weight, total tillers per plant, effective tillers per plant. Therefore, selecting superior cultivars for enhanced yield production more emphasis should be given to these traits such as total tillers per plant, effective tillers per plant and dry fodder yield. Bikash *et al.* (2013b) assessed 30 pearl millet hybrids and reported that grain yield had significant and positive association with ear girth, effective tillers, harvest index, dry fodder and biological yield. Biological yield had direct and indirect positive effect on grain yield. Therefore, selection for high grain yield based on biological yield, plant height, effective tillers will be effective.

Bashir *et al.*(2014) evaluated 225 accessions of Sudanese pearl millet landraces for relationship among (Fe, Zn, Ca, P, K, Mg, Mn, S, Na, Cu and b-carotene) content and found that between Mg and P (r=0.81) followed by Fe and Zn (r=0.77), Zn and S (r=0.76) and Cu and S (r=0.74), while no correlations were observed between Zn and K (r=0.02), Na and Mg (r= -0.02) and Na and S (r= -0.02) and also examined correlation estimated between the mineral nutrient contents and yield traits which were too low and mostly non-significant. With the help of Principal component biplot showed strong positive associations among all the nutritional traits, especially between Fe and Zn, Zn and Mn as well as among S, Ca, Mg, P and Cu.

Ezeaku *et al.* (2015) examined correlation and path coefficient in twenty four parental lines of pearl millet A/B pairs along with a seed parent (ZATIB) across five locations and found that correlation coefficient analysis for stand count, plant height and head weight expressed positive and significant correlation with grain yield. Head weight had high positive and significant environmental, genotypic and phenotypic correlation coefficient with grain yield. Stand count (r=0.249), plant height (r=0.435) and head weight (r=0.958) significantly ($p<0.05$) and positively correlated with grain yield while days to 50% flowering significantly but negatively correlated (r=-0.539) with grain yield. Path coefficient analysis indicated that stand count had strong positive direct effect (0.970) on grain yield followed by plant height (0.953). Head weight expressed high negative direct effect (-0.846) on grain yield.

Kanatti *et al.* (2014) studied relationship among grain yield and its attributing traits in pearl millet hybrids across the environments in two sets of hybrid in 5 diverse environmental conditions consisted of 32 hybrid and 3 control, and 28 hybrids and 3 control respectively and found that grain yield were highly significant and positive correlation with days to 50% flowering, plant height and panicle length. Fe content with grain yield in both sets in hybrids but with Zn content there were not always significant and mostly negative with grain yield. There were highly significant correlation between Fe and Zn content in both set of hybrids across the environment showed both character will be simultaneously enhanced in these set of hybrids.

Kumar *et al.* (2014) evaluated 97 diverse pearl millet genotypes for genetic variability, correlation and path analysis for several characters among and found that genotypic and phenotypic coefficients of variation were highest for the trait grain yield. The genotypic correlation estimates showed significant positive association of grain yield with panicle length, panicle diameter, number of nodes and internode length. Singh *et al.*(2015b) revealed that analysis of variance, mean sum of squares due to treatments were highly significant for all the traits under study indicating abundant amount of genetic variability present in their genotypes. Significant positive correlations were there for yield with almost all other characters.

Bhasker *et al.* (2017) conducted an experiment which included Five lines parental lines with eight testers in (Line x Tester) design and their resulting forty F1 crosses and two standard checks were evaluated for Correlation and Path analysis. Grain yield per plant showed significant positive association with 1000 grain weight followed by panicle length, productive tillers per plant, panicle diameter, fodder yield per plot and plant height but negative association with days to maturity. The path coefficient analysis revealed that characters, fodder yield per plot (0.520) showed highest direct effect followed by panicle length (0.467), 1000 grain weight (0.371), number of productive tillers per plant (0.352) on grain yield and also characters like days to maturity, days 50 per cent flowering, panicle diameter and plant height recorded negative direct effect on grain yield. So, from that we could conclude that direct effect of grain yield on other traits appeared to be the main factors for their strong association with grain yield per plant.

Anuradha *et al.*(2018) observed relationship between grain yield and all of the agronomic traits in 130 pearl millet genotypes. They concluded that all agronomic traits except days to 50% flowering were highly and significantly correlated with grain yield per plant. So, it was suggested that indirect selection of inherited agronomic traits can aid in effective grain yield selection. Grain yield per plant was not significantly associated with any of the biochemical trait under their study.

Subbulakshmi *et. al.* (2018) studied correlation in 54 hybrids of pearl millet for yield and nutritional traits and found that single plant yield has positive significant correlation with the agronomic traits viz., plant height, number of productive tillers, test weight, single head grain weight and quality traits viz., crude fibre, beta carotene and iron whereas the trait such as days to fifty per cent flowering alone was recorded negatively significant correlation with single plant yield. It is therefore inferred that simple selection will be effective against positively correlated characters. There is no correlation between grain zinc and yield which suggests that, there is possibility of selection for increased grain zinc content without reducing the grain yield.

Kumawat *et al.* (2019) revealed that both genotypic and phenotypic correlation for characters such as ear head diameter, number of effective tillers per plant, test weight with grain yield per plant were significant and positive but for other characters such as plant height, panicle head length, days to 50% flowering and days to maturity were negative and significant. Hence, from such association they concluded that major emphasis should be given on these characters for selection of genotypes in breeding programmes for developing high yielding cultivars along with early maturity in pearl millet.

Kaushik (2020) revealed that positive and high significant association with magnesium while positive and non-significant associations with grain yield/plant 60 pearl millet germplasm lines. Morphological and physiological traits also had highly significant correlation with grain yield/plant. Days to 50% flowering had negative non-significant association with grain yield/plant. Govindaraj *et al.*(2020b) studied correlation in 122 entries, including public-sector-bred hybrids and released/commercialized as truthfully labelled seed at Mandor and Patancheru. The analysis was performed across two locations pooled data to determine the relationships between grain micronutrients and macronutrients. In both locations, they studied that calcium was positively correlated with magnesium demonstrating that simultaneous selection for high-calcium and magnesium density in seed could be very successful in pearl millet. The occurrence of a highly significant and positive correlation between Ca and Mg with P, K, S, Na and Mn implies that Mg and Ca can be improved with all of these nutrients.

Kumar *et al.* (2020) studied correlation coefficient and path analysis in eighty seven F_1s with three and revealed that association between seed yield per plant was positive and significant at genotypic level with characters viz., number of effective tillers per plant, plant height, ear head diameter biological yield per plant and test weight but negative and significant association were observed for days to 50% flowering and days to maturity with seed yield. Hence, from such associations they were able to conclude that early days to 50% flowering, test weight, number of effective tillers per plant, biological yield are the important yield determiners. Pallavi *et al.*(2020) elucidated 49 parental lines of pearl millet cultivars and found that grain yield per plant expressed a significant positive correlation with plant height and ear length. Maximum direct effect on yield was exhibited by days to maturity (0.765) followed by seed diameter (0.548), ear width (0.485) and plant height (0.373) on grain yield per plant In the breeding programme for pearl millet yield improvement, path analysis indicates that late maturing, taller plants with wider ear width would be effective selection attributes.

Kumar *et al.* (2022). studied correlation coefficient and path analysis in 50 germplasm lines of pear millet unser rainfed conditions and revealed that dry fodder yield, plant height and 1000 seed weight were the major grain yield contributing characters, therefore, emphasis should be given on these traits while making breeding prohramme.

CONCLUSCIONS

The maximum gain yield during breeding depends upon estimates of variability parameters such as GCV, PCV, heritability and genetic advance as % of mean. The estimates of PCV & GCV for traits like panicle length, panicle diameter, tillers/plant, fodder yield per plant, 1000 seed weight, Ca content and grain yield per plant were of higher magnitude, reflected significant role in improvement. Moreover, heritability coupled with genetic advance is usually more informative. In pearl millet, high heritability with high genetic advance as a percentage of the mean was observed for panicle length, panicle diameter, productive tillers/plant, plant height, fodder yield per plant, 1000 seed weight, Ca content and grain yield per plant, clearly indicating the relevance of additive gene action and greater response to phenotypic selection and improvement of such traits could be anticipated. The correlation of the characters is clearly correlated due to a mutual association (positive or negative) with other characters. The yield invariably forms a positive or negative relationship with other traits. Due to the balancing of positive and negative contribution, a superficial association of a trait to yield may appear. As a result, path coefficient analysis seems to be a more effective method for use in selection.

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