A Correlation and Path-Coefficient Analysis of Components of Indigenous Collections of Finger millet (*Eleusine coracana* (L.) Gaertn) under varied Edaphic conditions

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ABSTRACT: The present investigation was carried out for fifty finger millet genotypes that were tested for four different environments *viz.*, E_1 and E_2 at Student Research Farm, C.S.A.U.A. &T. Kanpur and E_3 and E_4 sown at Research Farm, Daleep Nagar, Kanpur. The genotypes were evaluated in randomized block design with three replications to derive Correlation coefficient and Direct and Indirect effects in fifty different genotypes of finger millet to estimate analysis of variance, mean, correlation and path analysis. Analysis of Variance showed significant differences for all characters under study at 1% and 5% Level of Significance, indicated that presence of ample genetic variation among genotypes. Association studies revealed that grain yield per plant exhibited highly significant positive correlation at genotypic level with number of fingers per ear, ear head weight, straw yield per plant, harvest index and 1000 grain weight for all the environments and pooled and harvest index for E_1 showed maximum positive direct effect (0.919) followed by E_2 (0.899), straw yield per plant for E_2 (0.830). Path studies reported that grain yield per plant showed positive direct effect with all the characters except days to maturity and earhead width at both genotypic and phenotypic level. Thus, these traits are identified as the efficient and potential for indirect selection for the improvement of productivity in the present experimental material. The challenge of the study is to find out the character associations to the yield and to estimate the direct and indirect effects of each character on yield. Ultimate aim is to enhance the yield and also enhance the quality of grain.

Keywords: Finger millet, Correlation, Path-Coefficient, Genotype, Yield attributes.

INTRODUCTION

Eleusine coracana (L.) Gaertn. 2n=4x=36, sometimes known as finger millet, is a member of the Poaceae family and is widely grown throughout the world's arid and semi-arid regions. It is also referred to as nagali, nachani, ragi, and African millet. Finger millet is said to be originated from Africa and India as a secondary centre of origin (Chandra *et al.*, 2016). Various small millets grown in India are finger millets (*Eleusine coracana*), foxtail millets (*Setaria italica*), kodo millets (*Paspalum scrobiculatum*), barnyard millets (*Echinochloa frumentacea*), little millets (*Panicum sumatrense*) and Proso millets (*Panicum miliaceum*)

(Malleshi, 1989). In India, finger millet is grown in an area of 1.19 million hectares with a production of 1.20 million tonnes and average productivity of 1.66 tonnes per hectare (Sakamma *et al.*, 2018). Millets are a recent "Nutricereal" crop designated by the Indian government as a rich supplier of minerals. It ranks third in importance among after sorghum and pearl millet in India (Thilakarathna and Raizada 2015). It is a small-seeded minor cereal with a minutely undulating surface and a seed coat that ranges in colour from light brown to red and white. The crop is doing well in a variety of soil, climatic, and moisture conditions. Finger millet is an upright, tufted annual that has numerous tillers and

grows to a height of 60 to 120 cm. The tillers have whorls of finger-like spikes for ears. A narrow rachis is surrounded on all sides by tightly spaced spikelets. All fingers experience synchronous flowering. On the zigzag rachilla, hermaphrodite flowers are alternately placed. The last ones could be infertile or masculine. It produces self-fertilization because of its cleistogamy blooming nature. Millets are nutria-cereals and rich in carbohydrates (76.32%), dietary fibers energy, essential fatty acid, proteins (9.2%), vitamin-B, fat (1.29%) and minerals (2.70%). It contains a high concentration of minerals (2.70%), including calcium (452 mg/100 g), iron (3.90 mg/100 g), and ash (3.90 g/100 g), which are the main components of a typical human diet (Pandey and Kumar 2005). Given its high protein, iron, and calcium content, finger millet is a crucial staple food for rural communities in developing tropical nations where anaemia and calcium insufficiency are common (Owere *et al.*, 2015). Its grain is rich in methionine, tryptophan, cysteine, tyrosine, calcium, phosphorous, and iron, making the crop an excellent nutritional source compared to other major cereals (Gupta *et al.*, 2017). The crop contains nutritionally important starch fractions which are easily digested absorbed and are favourable in the diet pattern for metabolic disorders such as diabetes, hypertension and obesity (Sharavathy *et al.*, 2001). Furthermore, finger millet is a row material for ethanol production (Tekaligne *et al.*, 2015). Combining correlation and route analysis can provide a deeper understanding of the causal connections between various character pairs. The selection procedure will be aided by knowledge of character associations and the direct and indirect effects that each character has on yield. The breadth of the relationship between yield and its constituent parts is established by correlation and path analysis, which also highlight the relative importance of their direct and indirect impacts and provide a clear knowledge of their relationship to grain production. Ultimately, the breeder might build his selection tactics to increase grain yield with the use of this kind of study.

MATERIAL AND METHODS

The present study was conducted atStudent Research Farm, College of Agriculture, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur and Research Farm, Daleep Nagar Kanpur. Proper crop management practices were followed to raise a better crop. Evaluation of fifty different genotypes of finger millet that were sown during *Kharif*, 2021 in Randomized Block Design with three replications with four different environments (Table 1), having number of rows per plot seven with the spacing 30 cm × 10 cm. Biometrical observations were recorded on randomly five plants in each genotype in three replications on days to 50 per cent flowering, days to maturity, plant height, number of fingers/ear, finger length, finger width, ear head length, earhead weight, thousand seed weight, grain yield/plant, straw yield/plant, harvest index and protein content. To raise a good crop, the suggested set of procedures was performed together with the mandatory preventative plant protection measures. Observations were documented, and the data was statistically analysed. The correlation coefficient measures the degree and direction of association between two or more variables and is denoted by 'r'. A positive value of 'r' indicates that the changes in two variables are in same direction *i.e.* they are positively correlated and the negative value of 'r' indicates that the changes are in opposite direction. Depending upon the cause of correlation, it is of three types *viz.* Genotypic correlation, phenotypic correlation and environmental correlation. All possible correlation coefficient among fifteen characters were calculated at genotypic and phenotypic levels following the procedure of Miller *et al.* (1958).

RESULT AND DISCUSSION

In present investigation analysis of variance for fifteen characters studied was significant mean sum of square, these indicates there is a sufficient variability present in the genotypes taken for the study. This showed that the germplasm lines chosen were the right ones and that they were significantly unique in relation to the researched traits, making them ideal for genetic studies. The statistical analyses and estimates of genotypic parameters showed that the cultures displayed a wide range of variance for nearly all of the examined features. However, depending on the characters, the level of unpredictability varied greatly. This opens up a lot of options for choosing the genotypes for a specific character and parent in the breeding cycle. Analysis of variance computed for different traits showed that mean sum of squares of almost all characters were found to be significant which indicated significant differences for their characters among the genotypes. Similar findings were also reported by Singametti *et al.* (2018). The magnitude of genotypic coefficient of variation was generally less than the respective phenotypic coefficient of variation for all the environment. Similar results were also obtained by Priyadarshni *et al.* (2011); Lule *et al.* (2012); Reddy *et al.* (2013); Jyothsna *et al.* (2016); Udamala *et al.* (2020). The high heritability was recorded for plant height, finger width, ear head weight, straw yield per plant, harvest index, 1000 grain weight, protein content and grain yield per plant for all the environment; days to flowering for E_1, E_2; days to maturity for E_2, E_4; number of fingers per ear for E_2; finger length for E_2, E_3, E_4 and pooled; ear head width for E_1, E_2 and E_4 and ear head length for E_2, E_3 and E_4.The low values of broad sense heritability were recorded for number of productive tillers per plant for all the characters. Similar results were also obtained by Shinde *et al.* (2014); Manjunath *et al.* (2015); Eric *et al.*

(2016); Anuradha *et al.* (2017). High heritability coupled with high genetic advance was recorded for plant height, finger width, ear head weight, straw yield per plant, harvest index, 1000 grain weight and grain yield per plant for all the environment while, high heritability coupled with low genetic advance was observed in days to 50 % flowering for E_1. Suryanarayana *et al.* (2014) also reported high heritability coupled with high genetic advance for seed yield per plant, while, Manjunath *et al.* (2015) reported high heritability coupled with high genetic advance for days to 50 % flowering and finger length. Grain yield per plant exhibited highly significant positive correlation at phenotypic level (Table 2 & 3) with number of fingers per ear, ear head weight, straw yield per plant, harvest index and 1000 grain weight for all the environments and pooled; days to 50 % flowering for E_4 and pooled, number of productive tillers per plant for E_2, E_3, E_4 and pooled; finger length for E_1, E_2, E_3 and pooled; ear head width for E_1, E_3, E_4 and pooled; ear head length for E_1, E_3 and pooled. It also exhibited significant positive correlation with days to 50% flowering for E_2; finger length for E_4 and ear head width for E_2; ear head length for E_3. Reddy *et al.* (2013) also reported high positive and significant correlation of seed yield/plant with days to maturity, fodder weight, days to 50% flowering and length of finger at genotypic and phenotypic levels while, Ulaganathan and Kumari (2014) reported significant positive association of days to 50 % flowering with grain yield per plant. Rani *et al.*

(2015) also confirmed these findings. Sao *et al.* (2016) also found positive influence of days to maturity on plant height, main ear length, numbers of fingers per ear and the days to flowering. Grain yield per plant exhibited highly significant positive correlation at genotypic level with number of fingers per ear, ear head weight, straw yield per plant, harvest index and 1000 grain weight for all the environments and pooled; days to 50 % flowering for E_4 and pooled, number of productive tillers per plant for E_2, E_3, E_4 and pooled; finger length for E_1, E_2, E_3 and pooled; ear head width for E_1, E_3, E_4 and pooled; ear head length for E_3 and pooled. It also exhibited significant positive correlation with days to 50% flowering for E_2; finger length for E_4; ear head width for E_2 and ear head length for E_1 and E_3. Similar results were also reported by Haradari *et al.* (2012), Shinde *et al.* (2014); Auti *et al.* (2017); Suman *et al.* (2018); Lad *et al.* (2020). The relationship between grain yield per plant and yield-contributing traits was calculated using route coefficients at both the genotypic and phenotypic levels. The harvest index (%), followed by earhead weight per plant (g), 1000 grain per yield, and straw yield per plant, which had the highest direct effects on grain yield per plant at both genotypic level and phenotypic level, emerged as the characters that were exerted as the major component of grain yield per plant in path coefficient analysis (Table 4 & 5). These results are in confirmation with the findings of Ganapathy *et al.* (2011); Anuradha *et al.* (2013); Jyothsna *et al.* (2016); Negi *et al.* (2017).

Table 1: Description of environments.

Environment	Location	Date of sowing	pH of soil	EC of soil (dsm^{-1})
E_1	Student Research Farm C.S.A.U.A.&T. Kanpur	June 21, 2021	7.5	0.31
E_2	Student Research Farm C.S.A.U.A.&T. Kanpur	July 20, 2021	7.5	0.31
E_3	Research Farm Daleep Nagar Kanpur	June 22, 2021	9.6	1.59
E_4	Research Farm Daleep Nagar Kanpur	July 26, 2021	9.6	1.59

Table 2: Phenotypic correlation coefficient amongst grain yield, its components and protein content.

Sr. No.	Characters		Days to 50% flowering	Days to maturity	Plant height (cm)	Number of productive tillers per plant	Number of Fingers per ear	Finger length (cm)	Finger width (cm)	Earhead width (g)	Earhead length (cm)	Earhead weight (g)	Straw yield per plant (g)	Harvest index (%)	1000 grain weight (g)	Protein content (%)	Grain yield per plant (g)
1.	Days to 50 % flowering	E1	**-0.002**	-0.008	0.001	-0.001	0.001	0.004	-0.001	-0.006	0.006	0.007	0.010	0.021	0.001	0.001	0.033
		E2	**0.029**	-0.017	0.027	0.000	0.012	0.001	0.000	-0.005	-0.003	-0.001	-0.005	0.094	-0.001	-0.002	0.130
		E3	**-0.033**	0.007	0.007	0.001	-0.001	0.002	0.001	-0.001	0.013	0.007	0.026	0.037	-0.011	0.001	0.056
		E4	**0.080**	-0.001	-0.010	0.000	0.004	0.004	-0.003	-0.025	-0.008	0.037	0.120	0.077	0.000	-0.006	0.269**
		P	**0.013**	-0.005	0.005	0.000	0.001	0.005	0.000	-0.001	0.001	0.012	0.040	0.056	-0.002	-0.002	0.123**
2.	Days to maturity	E1	-0.001	**-0.016**	0.001	-0.001	0.000	0.003	0.000	-0.001	0.007	0.003	0.069	-0.052	-0.004	0.000	0.007
		E2	0.017	**-0.030**	0.023	0.000	0.017	0.001	-0.001	-0.001	-0.003	0.000	-0.065	0.036	-0.009	-0.002	-0.017
		E3	-0.014	**0.016**	0.005	0.000	-0.001	0.002	-0.002	0.000	0.006	0.005	-0.067	-0.026	-0.016	0.000	-0.091
		E4	0.028	**-0.004**	-0.010	-0.002	0.007	0.003	-0.001	-0.016	-0.007	0.009	-0.027	0.047	-0.006	-0.004	0.016
		P	0.006	**-0.011**	0.004	0.000	0.000	0.004	0.000	-0.001	0.001	0.004	-0.021	0.005	-0.010	-0.002	-0.021
3.	Plant height (cm)	E1	-0.001	-0.009	**0.002**	-0.001	0.000	0.006	0.000	0.001	0.008	-0.002	0.017	-0.046	-0.007	-0.002	-0.035
		E2	0.023	-0.019	**0.035**	0.001	0.008	0.001	-0.002	-0.007	-0.003	0.000	-0.083	0.034	-0.017	0.000	-0.022
		E3	-0.022	0.007	**0.010**	0.001	-0.001	0.002	0.001	-0.001	0.014	0.005	0.038	-0.051	-0.005	0.000	-0.013
		E4	0.037	-0.002	**-0.021**	-0.002	0.007	0.006	0.002	-0.006	-0.012	0.010	-0.043	-0.057	-0.012	0.002	-0.085
		P	0.008	-0.006	**0.007**	-0.001	0.000	0.006	0.000	0.002	0.002	0.002	-0.018	-0.030	0.003	0.000	-0.039
4.	Number of productive tillers per plant	E1	0.000	0.002	0.000	**0.011**	-0.001	-0.001	0.000	0.003	0.000	-0.003	0.141	-0.091	0.006	0.000	0.062
		E2	-0.002	-0.002	-0.004	**-0.005**	0.013	0.000	0.001	0.001	0.002	0.000	0.138	0.004	0.021	0.001	0.157
		E3	0.004	-0.001	-0.001	**-0.004**	0.000	0.000	-0.001	0.005	0.009	0.004	-0.019	0.154	0.001	-0.003	0.164*
		E4	-0.001	0.001	0.002	**0.017**	-0.007	0.000	0.000	-0.001	-0.001	-0.003	0.090	0.096	0.008	-0.002	0.198*
		P	-0.001	0.001	-0.001	**0.007**	0.000	-0.001	0.000	-0.001	0.001	-0.001	0.081	0.050	0.006	0.000	0.144**
5.	Number of fingers per ear	E1	0.000	0.001	0.000	-0.002	**0.006**	0.001	-0.002	-0.018	0.000	0.028	-0.051	0.338	-0.001	-0.003	0.304**
		E2	0.004	-0.006	0.003	-0.001	**0.085**	0.001	0.002	-0.002	-0.002	-0.001	-0.148	0.311	0.006	0.000	0.243**
		E3	0.002	-0.001	-0.001	0.000	**0.013**	0.000	-0.002	-0.001	-0.002	0.004	0.024	0.048	0.002	-0.002	0.089
		E4	-0.003	0.000	0.002	0.001	**-0.083**	0.000	-0.002	-0.017	0.004	0.050	0.065	0.222	0.005	-0.007	0.233**
		P	0.000	0.000	0.000	0.000	**0.017**	0.001	0.000	-0.002	-0.001	0.022	-0.032	0.203	0.011	-0.002	0.213**
6.	Finger length (cm)	E1	0.000	-0.011	0.015	-0.001	0.000	**0.015**	0.000	-0.012	0.013	0.022	0.135	0.066	0.011	-0.003	0.239**
		E2	0.012	0.003	0.003	0.000	0.015	**0.003**	0.001	-0.001	-0.002	-0.001	0.058	0.166	0.000	-0.003	0.264**
		E3	-0.008	-0.001	-0.005	0.000	0.000	**0.009**	0.002	0.000	0.029	0.014	0.037	0.138	0.008	-0.005	0.233**
		E4	0.015	-0.002	0.002	0.000	0.001	**0.024**	0.002	-0.019	-0.023	0.032	0.066	0.084	-0.001	-0.006	0.169*
		P	0.003	-0.001	0.000	0.000	0.001	**0.020**	0.000	-0.002	0.004	0.020	0.071	0.106	0.015	-0.004	0.228**
7.	Finger width (cm)	E1	0.000	-0.002	0.004	0.000	-0.001	0.000	**0.009**	0.001	0.002	0.001	0.061	-0.013	-0.009	0.006	0.062
		E2	-0.001	-0.001	0.000	0.000	-0.006	0.001	**-0.021**	-0.004	0.005	0.000	-0.015	0.080	0.002	0.002	0.057
		E3	-0.014	0.000	-0.002	0.000	-0.001	0.002	**0.032**	-0.001	0.006	-0.003	-0.100	0.115	0.002	0.003	0.041
		E4	-0.001	0.000	0.000	0.000	0.010	0.000	**0.019**	0.006	-0.005	-0.025	-0.072	0.044	0.017	0.002	-0.033
		P	0.001	0.000	0.000	0.000	-0.002	0.000	**0.005**	0.002	0.002	-0.003	-0.026	0.053	0.011	0.003	0.035
8.	Earhead width (g)	E1	0.000	0.001	0.000	0.000	0.002	0.004	0.000	**-0.047**	0.003	0.063	0.080	0.454	0.038	-0.002	0.572**
		E2	-0.005	0.001	-0.009	-0.001	-0.007	0.000	0.003	**0.028**	0.002	0.000	0.264	-0.119	0.009	-0.003	0.167*
		E3	0.002	0.000	-0.001	-0.001	-0.001	0.000	-0.004	**0.010**	-0.007	0.030	0.023	0.246	0.024	0.000	0.335**
		E4	0.019	-0.001	-0.001	-0.001	-0.013	0.004	-0.001	**-0.105**	-0.003	0.114	0.062	0.437	-0.001	-0.010	0.511**
		P	0.001	0.000	-0.001	0.000	0.001	0.002	0.000	**-0.022**	0.001	0.039	0.100	0.256	0.015	-0.003	0.397**
9.	Earhead length (cm)	E1	0.000	-0.001	0.001	0.000	0.000	0.009	0.001	-0.005	**0.023**	0.016	0.246	-0.083	0.006	0.003	0.203*
		E2	0.006	-0.005	-0.006	-0.001	-0.011	0.000	-0.006	0.004	**0.016**	0.000	0.144	-0.194	0.000	0.001	-0.041
		E3	-0.007	0.005	0.003	-0.001	0.000	0.005	0.004	-0.001	**0.057**	0.003	0.121	0.037	0.003	-0.001	0.225**
		E4	0.020	0.002	-0.008	0.001	0.011	0.018	0.003	-0.009	**-0.031**	0.022	0.115	0.046	0.019	0.002	0.187**
		P	0.002	-0.001	0.001	0.001	-0.001	0.008	0.001	-0.001	**0.010**	0.006	0.146	-0.035	0.043	0.001	0.140**
10.	Earhead weight (g)	E1	0.000	-0.001	0.000	0.000	0.002	0.004	0.000	-0.038	0.005	**0.078**	0.160	0.399	0.033	0.000	0.628**
		E2	0.006	-0.001	-0.001	0.001	0.034	0.002	0.000	-0.002	-0.001	**-0.004**	0.123	0.356	0.008	-0.002	0.553**
		E3	-0.004	0.002	0.001	0.000	0.001	0.005	-0.002	0.005	0.003	**0.056**	0.139	0.380	0.031	-0.004	0.610**
		E4	0.018	0.000	-0.001	0.000	-0.025	0.005	-0.003	-0.074	-0.004	**0.162**	0.141	0.341		-0.007	0.561**
		P	0.002	-0.001	0.000	0.000	0.005	0.005	0.000	-0.010	0.001	**0.080**	0.134	0.344		-0.003	0.588**

11.	Straw yield per plant (g)	E₁	0.000	0.000	0.000	-0.001	0.002	0.003	0.001	-0.005	0.007	0.016	**0.778**	-0.383	-0.002	0.011	0.425**
		E₂	0.000	-0.004	-0.015	0.002	-0.001	0.000	0.000	0.009	0.003	-0.001	**0.830**	-0.412	0.035	0.000	0.448**
		E₃	-0.001	0.001	0.001	0.000	0.000	0.001	-0.005	0.000	0.011	0.012	**0.645**	-0.261	0.022	0.006	0.429**
		E₄	0.021	0.002	-0.012	0.003	0.003	0.003	-0.003	-0.014	-0.008	0.049	**0.467**	-0.015	0.009	0.006	0.509**
		P	0.001	0.000	-0.001	0.001	0.001	0.002	0.000	-0.003	0.002	0.016	**0.653**	-0.247	0.015	0.004	0.443**
12.	Harvest index (%)	E₁	0.000	0.001	0.000	-0.001	0.002	0.001	0.000	-0.023	-0.002	0.034	-0.325	**0.919**	0.020	-0.009	0.617**
		E₂	0.003	-0.001	0.001	0.000	0.029	0.001	-0.002	-0.004	-0.004	-0.001	-0.380	**0.899**	0.013	-0.002	0.552**
		E₃	-0.002	-0.001	-0.001	-0.001	0.001	0.002	0.005	0.003	0.003	0.026	-0.207	**0.811**	0.036	-0.010	0.665**
		E₄	0.008	0.000	0.002	0.002	-0.023	0.003	0.001	-0.058	-0.002	0.070	-0.009	**0.791**	0.014	-0.011	0.787**
		P	0.001	0.000	0.000	0.000	0.004	0.003	0.000	-0.007	0.000	0.034	-0.201	**0.803**	0.028	-0.007	0.659**
13.	1000 grain weight (g)	E₁	0.000	0.001	-0.002	0.001	0.001	0.001	0.000	-0.017	0.000	0.031	-0.036	0.396	**0.047**	-0.003	0.422**
		E₂	0.000	0.003	-0.002	0.000	-0.001	0.000	-0.003	0.003	0.002	-0.002	0.269	0.113	**0.107**	0.000	0.488**
		E₃	0.003	-0.002	-0.002	-0.001	0.001	0.001	-0.003	0.003	0.003	0.016	0.122	0.244	**0.118**	-0.004	0.499**
		E₄	0.001	0.001	0.004	0.001	-0.006	0.000	0.001	-0.030	0.000	0.041	0.125	0.339	**0.032**	-0.001	0.507**
		P	0.000	0.001	-0.001	0.001	0.001	0.002	0.000	-0.006	0.000	0.027	0.103	0.242	**0.093**	-0.002	0.461**
14.	Protein content (%)	E₁	0.000	0.000	0.000	0.000	-0.001	-0.001	0.001	0.002	0.002	0.000	0.231	-0.236	-0.003	**0.036**	0.031
		E₂	-0.004	0.004	-0.001	0.000	-0.002	-0.001	-0.003	-0.005	0.001	0.000	0.026	-0.156	-0.003	**0.014**	-0.132
		E₃	-0.001	0.000	0.000	0.000	-0.001	-0.002	0.003	0.000	-0.002	-0.008	0.127	-0.261	-0.016	**0.032**	-0.128
		E₄	-0.010	0.000	-0.001	-0.001	0.012	-0.003	0.001	0.020	-0.001	-0.021	0.051	-0.164	-0.001	**0.052**	-0.065
		P	-0.001	0.001	0.000	0.000	-0.001	-0.003	0.001	0.002	0.000	-0.008	0.099	-0.187	-0.006	**0.029**	-0.074*

* Significant at 5%,
*Significant at p = 0.05

** Significant at 1%
**Significant at p = 0.01

Table 3: Genotypic correlation coefficient amongst grain yield, its components and protein content.

Sr. No.	Characters		Days to 50 % flowering	Days to maturity	Plant height (cm)	Number of productive tillers per plant	Number of Fingers per ear	Finger length (cm)	Finger width (cm)	Earhead width (g)	Earhead length (cm)	Earhead weight (g)	Straw yield per plant (g)	Harvest index (%)	1000 grain weight (g)	Protein content (%)	Grain yield per plant (g)
1.	Days to 50 % flowering	E₁	1.000	0.856**	0.981**	-0.495**	0.170*	0.478**	-0.030	0.138	0.359**	0.126	0.020	0.045	0.012	-0.082	0.064
		E₂	1.000	0.793**	0.898**	-0.127	0.211**	0.474**	0.001	-0.213**	-0.171*	0.212**	-0.009	0.142	0.014	-0.178*	0.171*
		E₃	1.000	0.913**	0.933**	-0.166*	-0.573**	0.311**	0.049	0.001	0.403**	0.202*	0.075	-0.001	-0.173*	0.048	0.088
		E₄	1.000	0.637**	0.694**	0.061	-0.096	0.292**	-0.181*	0.345**	0.356**	0.342**	0.309**	0.193*	0.007	-0.182*	0.356**
		P	1.000	0.764**	0.928**	-0.210**	0.055	0.394**	-0.051	0.125**	0.322**	0.229**	0.107*	0.079*	-0.013	0.118**	0.171**
2.	Days to maturity	E₁		1.000	0.835**	-0.407**	0.110	0.564**	0.067	0.025	0.654**	0.123	0.129	-0.129	-0.134	-0.010	-0.038
		E₂		1.000	0.808**	-0.192*	0.232**	0.445**	0.075	-0.003	-0.192*	0.021	-0.099	0.020	-0.103	-0.141	-0.037
		E₃		1.000	0.754**	-0.121	-0.478**	0.325**	-0.175*	-0.016	0.194*	0.129	-0.149	-0.043	-0.266**	-0.023	-0.152
		E₄		1.000	0.627**	-0.390**	-0.125	0.224**	-0.073	0.186*	0.324**	0.085	-0.097	0.051	-0.249**	-0.057	0.032
		P		1.000	0.771**	-0.308**	0.162**	0.369**	0.015	0.034	0.306**	0.086*	-0.090*	-0.001	-0.207**	-0.053	-0.049
3.	Plant height (cm)	E₁			1.000	-0.319**	0.035	0.524**	0.000	-0.022	0.492**	-0.033	0.019	-0.053	-0.163*	-0.029	-0.038
		E₂			1.000	-0.152	0.109	0.440**	0.120	-0.297**	-0.172*	-0.024	-0.111	0.053	-0.087	-0.029	-0.016
		E₃			1.000	-0.231**	-0.034	0.301**	0.036	-0.242**	0.264**	0.103	0.045	-0.064	-0.129	0.006	-0.007
		E₄			1.000	-0.222**	-0.142	0.268**	0.120	0.069	0.424**	0.063	-0.107	-0.075	-0.155	0.044	-0.088
		P			1.000	-0.241**	0.061	0.396**	0.067	-0.135**	0.347**	0.034	-0.041	-0.041	-0.141**	-0.004	-0.044
4.	Number of productive tillers per plant	E₁				1.000	-0.653**	-0.103	0.007	-0.308**	-0.133	0.000	0.549**	-0.416**	0.180*	-0.044	0.149
		E₂				1.000	0.055	0.137	-0.043	0.250**	0.343**	-0.215**	0.349**	-0.050	0.147	0.208**	0.311**
		E₃				1.000	0.967**	0.080	-0.023	0.223**	0.111	0.103	-0.102	0.420**	0.304**	-0.163*	0.274**
		E₄				1.000	0.211**	0.101	0.010	-0.238**	0.133	-0.016	0.361**	0.211**	0.077	-0.052	0.386**
		P				1.000	0.076*	0.046	-0.019	-0.009	0.238**	-0.056	0.266**	0.162**	0.174**	-0.016	0.360**
5.	Number of fingers per ear	E₁					1.000	0.169*	-0.248**	0.449**	0.046	0.448**	-0.040	0.490**	0.220**	-0.117	0.417**
		E₂					1.000	0.222**	-0.148	-0.098	-0.134	0.473**	-0.189*	0.400**	-0.033	-0.028	0.261**
		E₃					1.000	0.097	-0.268**	0.476**	-0.363**	0.527**	0.211**	0.211**	0.145	-0.365**	0.389**
		E₄					1.000	-0.065	-0.206*	0.298**	-0.112	0.465**	0.177*	0.371**	0.061	-	0.325**

Trait	Env	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	P	1.000	0.178**	-0.247**	0.624**	-0.101*	0.558**	-0.002	0.538**	0.185**	0.233**
6. Finger length (cm)	E1		1.000	-0.030	0.409**	0.873**	0.480**	0.258**	0.135	0.102	-0.248**
	E2		1.000	-0.091	-0.057	-0.103	0.269**	0.070	0.203**	0.122	-0.054
	E3		1.000	0.074	0.065	0.602**	0.279**	0.064	0.206**	0.105	-0.195*
	E4		1.000	0.099	0.245**	0.865**	0.234**	0.156	0.125	0.002	-0.187*
	P		1.000	0.028	0.204**	0.777**	0.318**	0.150**	0.179**	0.132*	-0.169*
7. Finger width (cm)	E1			1.000	0.021	0.063	0.012	0.091	-0.013	-0.060	-0.170**
	E2			1.000	-0.184*	0.351**	0.014	-0.030	0.082	0.170*	0.226**
	E3			1.000	-0.126	0.147	-0.065	-0.174*	0.165*	-0.092	0.185*
	E4			1.000	-0.028	0.198*	-0.159	-0.151	0.026	0.042	0.118
	P			1.000	-0.158**	0.274**	-0.047	-0.079*	0.077	0.038	0.046
8. Earhead width (g)	E1				1.000	0.207*	0.906**	0.094	0.622**	0.446**	0.176**
	E2				1.000	0.134	-0.069	0.368**	-0.160	0.131	-0.066
	E3				1.000	-0.109	0.674**	0.061	0.447**	0.460**	0.234**
	E4				1.000	0.126	0.887**	0.169*	0.665**	0.358**	0.013
	P				1.000	-0.018	0.892**	0.264**	0.614**	0.508**	-0.230**
9. Earhead length (cm)	E1					1.000	0.256**	0.436**	-0.101	-0.020	-0.203**
	E2					1.000	-0.069	0.182*	-0.254**	0.127	0.117
	E3					1.000	0.056	0.216**	0.074	0.056	0.040
	E4					1.000	0.124	0.266**	0.068	0.000	-0.042
	P					1.000	0.110*	0.341**	-0.009	0.082*	0.039
10. Earhead weight (g)	E1						1.000	0.223**	0.477**	0.455**	0.042
	E2						1.000	0.152	0.421**	0.446**	0.024
	E3						1.000	0.227**	0.515**	0.307**	-0.126
	E4						1.000	0.323**	0.471**	0.270**	-0.144
	P						1.000	0.230**	0.524**	0.470**	-0.136
11. Straw yield per plant (g)	E1							1.000	-0.445**	-0.046	-0.111*
	E2							1.000	-0.492**	0.366**	0.343**
	E3							1.000	-0.347**	0.296**	0.031
	E4							1.000	0.002	0.280**	0.214**
	P							1.000	-0.243**	0.299**	0.149
12. Harvest index (%)	E1								1.000	0.472**	0.199**
	E2								1.000	0.138	-0.286**
	E3								1.000	0.350**	-0.200*
	E4								1.000	0.463**	-0.362**
	P								1.000	0.410**	0.219**
13. 1000 grain weight (g)	E1								0.519**	1.000	-0.292**
	E2								0.680**	1.000	-0.085
	E3								0.362**	1.000	-0.023
	E4								0.831**	1.000	-0.152
	P								0.705**	1.000	-0.015
14. Protein content (%)	E1								0.043	0.457**	1.000
	E2								-0.154	0.548**	1.000
	E3								-0.142	0.568**	1.000
	E4								-0.067	0.533**	1.000
	P								-0.090*	0.613**	1.000

Table 4: Phenotypic path amongst grain yield, its components and protein content.

Sr. No.	Characters	Env	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of productive tillers per plant	Number of Fingers per ear	Finger length (cm)	Finger width (cm)	Earhead width (g)	Earhead length (cm)	Earhead weight (g)	Straw yield per plant (g)	Harvest index (%)	1000 grain weight (g)	Protein content (%)	Grain yield per plant (g)
1.	Days to 50 % flowering	E₁	-0.002	-0.008	0.001	-0.001	0.001	0.004	-0.001	-0.006	0.006	0.007	0.010	0.021	0.001	0.001	0.033
		E₂	**0.029**	-0.017	0.027	0.000	0.012	0.001	0.000	-0.005	-0.003	-0.001	-0.005	0.094	-0.001	-0.002	0.130
		E₃	**-0.033**	0.007	0.007	0.001	-0.001	0.002	0.001	-0.001	0.013	0.007	0.026	0.037	-0.011	0.001	0.056
		E₄	**0.080**	-0.001	-0.010	0.000	0.004	0.004	-0.003	-0.025	-0.008	0.012	0.120	0.070	0.000	-0.006	0.269**
		P	**0.013**	-0.005	0.005	0.000	0.001	0.005	0.000	-0.001	0.001	0.012	0.040	0.056	-0.002	-0.002	0.123**
2.	Days to maturity	E₁	-0.001	**-0.016**	0.001	-0.001	0.000	0.003	0.000	-0.001	0.007	0.003	0.069	-0.052	-0.004	0.000	0.007
		E₂	0.017	**-0.030**	0.023	0.000	0.017	0.001	-0.001	-0.001	-0.003	0.000	-0.065	0.036	-0.009	-0.002	-0.017
		E₃	-0.014	**0.016**	0.005	-0.002	-0.001	0.002	-0.002	0.000	0.006	0.005	-0.067	-0.026	-0.016	0.000	-0.091
		E₄	0.028	**-0.004**	-0.010	0.000	0.007	0.003	-0.001	-0.016	-0.007	0.009	-0.027	0.047	-0.006	-0.004	0.016
		P	0.006	**-0.011**	0.004	0.000	0.000	0.004	0.000	-0.001	0.001	0.004	-0.021	0.005	-0.010	-0.002	-0.021
3.	Plant height (cm)	E₁	-0.001	-0.009	**0.002**	-0.001	0.000	0.006	0.000	0.001	0.008	-0.002	0.017	-0.046	-0.007	-0.002	-0.035
		E₂	0.023	-0.019	**0.035**	0.001	0.008	0.001	-0.002	-0.007	-0.003	0.000	-0.083	0.034	-0.007	0.000	-0.022
		E₃	-0.022	0.007	**0.010**	0.001	-0.001	0.002	0.001	-0.001	0.014	0.005	0.038	-0.051	-0.017	0.000	-0.013
		E₄	0.037	-0.002	**-0.021**	-0.002	0.007	0.006	0.002	-0.006	-0.012	0.010	-0.043	-0.057	-0.005	0.002	-0.085
		P	0.008	-0.006	**0.007**	-0.001	0.000	0.006	0.000	0.002	0.002	0.002	-0.018	-0.030	-0.012	0.000	-0.039
4.	Number of productive tillers per plant	E₁	0.000	0.002	0.000	**0.011**	-0.001	-0.001	0.000	0.002	0.000	-0.003	0.141	-0.091	0.003	0.000	0.062
		E₂	-0.002	-0.002	-0.004	**-0.005**	0.013	0.000	0.001	0.003	0.002	0.000	0.138	0.004	0.006	0.001	0.157
		E₃	0.004	-0.001	-0.001	**-0.004**	0.000	0.000	-0.001	0.001	0.009	0.004	-0.019	0.154	0.021	-0.003	0.164*
		E₄	-0.001	0.001	0.002	**0.017**	-0.007	0.000	0.000	0.005	-0.001	-0.003	0.090	0.096	0.001	-0.002	0.198*
		P	-0.001	0.001	-0.001	**0.007**	0.000	0.000	0.000	-0.001	0.001	-0.001	0.081	0.050	0.008	0.000	0.144**
5.	Number of fingers per ear	E₁	0.000	0.001	0.000	-0.002	**0.006**	0.001	-0.002	-0.018	0.000	0.028	-0.051	0.338	0.006	-0.003	0.304**
		E₂	0.004	-0.006	0.003	-0.001	**0.085**	0.001	0.002	-0.002	-0.002	-0.001	-0.148	0.311	-0.001	0.000	0.243**
		E₃	0.002	-0.001	-0.001	0.000	**0.013**	0.000	-0.002	-0.001	-0.002	0.004	0.024	0.048	0.006	-0.002	0.089
		E₄	-0.003	0.000	0.002	0.001	**-0.083**	0.000	-0.002	-0.017	0.004	0.050	0.065	0.222	0.002	-0.007	0.233**
		P	0.000	0.000	0.000	0.000	**0.017**	0.001	0.000	-0.002	-0.001	0.022	-0.032	0.203	0.005	-0.002	0.213**
6.	Finger length (cm)	E₁	-0.001	0.002	0.001	-0.001	0.000	**0.015**	0.000	-0.012	0.013	-0.001	0.135	0.066	0.005	-0.003	0.239**
		E₂	0.012	-0.011	0.015	0.000	0.015	**0.003**	0.002	-0.001	-0.002	0.014	0.058	0.138	0.011	-0.005	0.264***
		E₃	-0.008	0.003	0.003	0.000	0.000	**0.009**	0.001	0.000	-0.001	0.004	0.037	0.166	0.000	-0.006	0.233**
		E₄	0.015	-0.002	-0.005	0.000	0.001	**0.024**	0.000	-0.019	0.004	0.032	0.066	0.084	0.000	-0.004	0.169*
		P	0.003	-0.001	0.002	0.000	0.001	**0.020**	0.000	-0.002	-0.002	0.020	0.071	0.106	0.008	-0.003	0.228**
7.	Finger width (cm)	E₁	0.000	-0.001	0.000	0.000	0.000	0.000	**0.009**	0.001	0.001	0.000	0.061	-0.013	-0.001	0.006	0.062
		E₂	-0.001	-0.002	0.004	0.000	-0.006	0.000	**-0.021**	-0.004	-0.006	-0.003	-0.015	0.080	0.015	0.003	0.057
		E₃	-0.001	-0.001	0.000	0.000	-0.001	0.000	**0.032**	-0.001	0.004	-0.025	-0.100	0.115	-0.009	0.002	0.041
		E₄	-0.014	0.000	-0.002	0.000	0.010	0.004	**0.019**	0.006	0.003	-0.003	-0.072	0.044	0.002	0.003	-0.033
		P	-0.001	0.000	0.000	0.000	0.000	0.000	**0.005**	0.002	0.000	0.001	-0.026	0.053	0.002	0.002	0.035
8.	Earhead width (g)	E₁	0.000	0.000	0.000	0.000	0.002	0.000	0.003	**-0.047**	0.003	0.063	0.080	0.454	0.017	-0.003	0.572**
		E₂	-0.005	0.001	-0.009	-0.001	-0.007	0.000	-0.004	**0.028**	0.002	0.000	0.264	-0.119	0.011	-0.003	0.167*
		E₃	0.002	0.000	-0.001	-0.001	-0.001	0.004	-0.001	**0.010**	-0.007	0.030	0.023	0.246	0.038	0.000	0.335**
		E₄	0.019	-0.001	-0.001	-0.001	-0.013	0.002	0.001	**-0.105**	-0.003	0.114	0.062	0.437	0.009	-0.010	0.511**
		P	0.001	-0.001	-0.001	0.000	0.000	0.009	0.001	**-0.022**	0.001	0.039	0.100	0.256	0.024	-0.003	0.397**
9.	Earhead length (cm)	E₁	-0.001	-0.005	0.001	0.000	0.000	0.000	0.001	-0.005	**0.023**	0.016	0.246	-0.083	-0.001	0.003	0.203*
		E₂	-0.005	0.005	-0.006	-0.001	-0.011	0.005	-0.006	0.004	**0.016**	0.000	0.144	-0.194	0.011	0.001	-0.041
		E₃	-0.007	0.002	0.003	-0.001	0.000	0.018	0.004	-0.001	**0.057**	0.003	0.121	0.037	0.006	-0.001	0.225**
		E₄	0.020	-0.001	-0.008	0.001	0.011	0.008	0.003	-0.009	**-0.031**	0.022	0.115	0.046	0.000	0.002	0.187*
		P	0.002	-0.001	0.001	0.001	-0.001	0.004	0.000	-0.001	**0.010**	0.006	0.146	-0.035	0.003	0.001	0.140***
10.	Earhead weight (g)	E₁	0.000	0.000	-0.001	0.000	0.002	0.004	0.000	-0.002	0.005	**0.078**	0.160	0.399	0.019	0.000	0.628**
		E₂	0.006	0.000	0.001	0.001	0.034	0.001	0.000	-0.002	-0.001	**-0.004**	0.123	0.356	0.043	-0.002	0.553**
		E₃	-0.004	0.002	0.001	0.000	0.001	0.002	-0.002	0.005	0.003	**0.056**	0.139	0.380	0.033	-0.004	0.610*
		E₄	0.018	0.000	-0.001	0.000	-0.025	0.005	-0.003	-0.074	-0.004	**0.162**	0.141	0.341	0.008	-0.007	0.561**

Table 5: Genotypic path coefficient amongst grain yield, its components and protein content.

S.N.	Characters		Days to 50% flowering	Days to maturity	Plant height (cm)	Number of productive tillers per plant	Number of Fingers per ear	Finger length (cm)	Finger width (cm)	Earhead width (g)	Ear head length (cm)	Ear head weight (g)	Straw yield per plant (g)	Harvest index (%)	1000 grain weight (g)	Protein content (%)	Grain yield per plant (g)
1.	Days to 50 % flowering	E₁	**-0.010**	-0.087	0.094	0.012	-0.012	0.007	0.000	-0.011	-0.006	0.013	0.018	0.045	0.000	-0.001	0.064
		E₂	-0.052	0.061	0.038	-0.004	0.009	-0.018	0.000	0.012	-0.005	-0.002	-0.009	0.139	0.001	0.000	0.171*
		E₃	-0.182	0.184	0.025	0.024	-0.027	-0.018	0.002	0.000	0.040	-0.013	0.062	-0.001	-0.011	0.003	0.088
		E₄	22.420	-14.271	-10.298	-4.520	2.286	-0.270	-2.666	-61.632	2.918	41.578	5.585	16.372	-0.094	2.948	0.356**
		P	0.597	0.010	-0.554	-0.006	0.007	0.023	-0.003	-0.038	-0.010	0.024	0.068	0.065	-0.001	-0.010	0.171**
2.	Days to maturity	E₁	-0.009	-0.101	0.080	0.010	-0.007	0.008	-0.001	-0.002	-0.011	0.013	0.118	-0.130	-0.004	0.000	-0.038
		E₂	-0.041	0.077	0.035	-0.005	0.010	-0.017	-0.004	0.000	-0.006	0.000	-0.094	0.019	-0.010	0.000	-0.037
		E₃	-0.166	0.202	0.018	0.017	-0.023	-0.019	-0.007	0.001	0.019	-0.008	-0.122	-0.046	-0.017	-0.002	-0.152
		E₄	14.273	-22.418	-9.307	28.766	2.967	-0.207	-1.073	-33.118	2.658	10.392	-1.750	4.330	3.589	0.931	0.032
		P	0.456	0.013	-0.461	-0.009	0.022	0.021	0.001	-0.010	-0.009	0.009	-0.057	-0.001	-0.019	-0.004	-0.049
3.	Plant height (cm)	E₁	-0.010	-0.085	0.096	0.008	-0.002	0.007	0.000	0.002	-0.009	-0.003	0.018	-0.054	-0.005	0.000	-0.038
		E₂	-0.047	0.063	0.043	-0.004	0.005	-0.017	-0.007	0.016	-0.005	0.000	-0.106	0.052	-0.008	0.000	-0.016
		E₃	-0.188	0.152	0.024	0.033	-0.002	-0.017	0.002	0.009	0.026	-0.007	0.037	-0.069	-0.008	0.000	-0.007
		E₄	15.562	-14.065	-14.835	16.354	3.385	-0.248	1.772	-12.326	3.481	7.644	-1.945	-6.390	2.234	-0.712	-0.088
		P	0.554	0.010	-0.597	-0.007	0.008	0.023	0.004	0.041	-0.011	0.003	-0.026	-0.033	-0.013	0.000	-0.044
4.	Number of productive tillers per plant	E₁	0.005	0.041	-0.031	-0.025	0.044	-0.001	0.000	0.024	0.002	0.000	0.503	-0.419	0.005	0.000	0.149
		E₂	0.007	-0.015	-0.007	**0.028**	0.002	-0.005	0.002	-0.014	0.010	0.002	0.333	-0.049	0.014	0.000	0.311***
		E₃	0.030	-0.024	-0.006	**-0.143**	0.050	-0.005	-0.001	-0.009	0.011	-0.007	-0.083	0.451	0.020	-0.011	0.274**
		E₄	1.375	8.752	3.293	**-73.680**	-5.024	-0.093	0.154	42.404	1.091	-1.999	6.533	17.838	-1.110	0.851	0.386**
		P	-0.125	-0.004	0.144	**0.029**	0.010	0.003	-0.001	0.003	-0.007	-0.006	0.169	0.132	0.016	-0.001	0.360**
5.	Number of fingers per ear	E₁	-0.002	-0.011	0.003	0.016	**-0.068**	0.002	0.002	-0.035	-0.001	0.046	-0.037	0.495	0.007	-0.001	0.261**
		E₂	-0.011	0.018	0.005	0.002	**0.043**	-0.009	0.008	0.005	-0.004	-0.005	-0.180	0.392	-0.003	0.000	0.389**
		E₃	0.104	-0.096	-0.001	-0.153	**0.047**	-0.006	-0.011	-0.019	-0.036	-0.034	0.382	0.226	0.009	-0.025	0.325**
		E₄	-2.154	2.794	2.109	-15.552	**-23.804**	0.060	-3.038	-53.244	-0.915	56.540	3.204	31.414	-0.877	3.785	0.433**
		P	0.033	0.002	-0.036	0.002	**0.133**	0.010	-0.016	-0.190	0.003	0.058	-0.001	0.438	0.017	-0.020	0.372**
		E₁	-0.005	-0.057	0.050	0.003	-0.012	**0.014**	0.000	-0.032	-0.015	0.049	0.237	0.137	0.003	-0.001	

Continuation of Table 5:

			Days to 50% flowering	Days to maturity	Plant height (cm)	Number of productive tillers per plant	Number of Fingers per ear	Finger length (cm)	Finger width (cm)	Earhead width (g)	Ear head length (cm)	Ear head weight (g)	Straw yield per plant (g)	Harvest index (%)	1000 grain weight (g)	Protein content (%)	Grain yield per plant (g)
		P	0.002	-0.001	0.000	0.000	0.005	0.005	0.000	-0.010	0.001	**0.080**	0.134	0.344	0.031	-0.003	0.588**
11.	Straw yield per plant (g)	E₁	0.000	-0.001	0.000	0.002	0.000	0.003	0.001	-0.005	0.007	0.016	**0.778**	-0.383	-0.002	0.011	0.425***
		E₂	0.000	0.002	-0.004	-0.001	-0.015	0.000	0.000	0.009	0.003	-0.001	**0.830**	-0.412	0.035	0.000	0.448***
		E₃	-0.001	-0.002	0.001	0.000	0.001	0.001	-0.005	0.000	0.011	0.012	**0.645**	-0.261	0.022	0.006	0.429**
		E₄	0.021	0.000	0.002	0.003	-0.012	0.003	-0.003	-0.014	-0.008	0.049	**0.467**	-0.015	0.009	0.006	0.509**
		P	0.001	0.000	0.000	0.001	-0.001	0.002	0.000	-0.003	0.002	0.016	**0.653**	-0.247	0.015	0.004	0.443***
12.	Harvest index (%)	E₁	0.000	0.001	0.000	-0.001	0.002	0.001	0.000	-0.023	-0.002	0.034	-0.325	**0.919**	0.020	-0.009	0.617***
		E₂	0.003	-0.001	0.001	0.000	0.029	0.001	0.000	-0.004	-0.004	-0.001	-0.380	**0.899**	0.013	-0.002	0.552***
		E₃	-0.002	-0.001	-0.001	-0.001	0.001	0.002	0.005	0.003	0.003	0.026	-0.207	**0.811**	0.036	-0.010	0.665***
		E₄	0.008	0.000	0.002	0.002	-0.023	0.003	0.001	-0.058	-0.002	0.070	-0.009	**0.791**	0.014	-0.011	0.787***
		P	0.001	0.000	0.000	0.000	0.004	0.003	0.000	-0.007	0.000	0.034	-0.201	**0.803**	0.028	-0.007	0.659***
13.	1000 grain weight (g)	E₁	0.000	0.001	0.000	0.001	0.001	0.000	0.000	-0.017	0.000	0.031	-0.036	0.396	**0.047**	-0.003	0.422**
		E₂	0.000	0.003	-0.002	0.000	-0.001	0.000	-0.003	0.003	0.002	-0.002	0.269	0.113	**0.107**	0.000	0.488**
		E₃	0.003	-0.002	-0.002	-0.001	0.001	0.001	-0.003	0.003	0.003	0.016	0.122	0.244	**0.118**	-0.004	0.499**
		E₄	0.001	0.001	0.004	0.001	-0.006	0.000	0.001	-0.030	0.000	0.041	0.125	0.339	**0.032**	-0.001	0.507***
		P	0.000	0.001	-0.001	0.001	0.001	0.002	0.000	-0.006	0.000	0.027	0.103	0.242	**0.093**	-0.002	0.461**
14.	Protein content (%)	E₁	0.000	0.000	0.000	0.000	-0.001	-0.001	0.001	0.002	0.002	0.000	0.231	-0.236	-0.003	**0.036**	0.031
		E₂	-0.004	0.004	-0.001	0.000	-0.002	-0.001	-0.003	-0.005	-0.005	0.000	0.026	-0.156	-0.003	**0.014**	-0.132
		E₃	-0.001	0.000	0.000	-0.001	-0.001	-0.002	0.003	0.000	0.000	-0.008	0.127	-0.261	-0.016	**0.032**	-0.128
		E₄	-0.010	0.000	-0.001	0.012	0.012	-0.003	0.001	0.020	-0.001	-0.021	0.051	-0.164	-0.001	**0.052**	-0.065
		P	-0.001	0.001	0.000	-0.003	-0.003	-0.003	0.001	0.002	0.000	-0.008	0.099	-0.187	-0.006	**0.029**	-0.074*

No.	Character	Env.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	r
6.	Finger length (cm)	E2	-0.025	0.035	0.019	0.004	0.010	-0.038	0.005	0.003	-0.003	-0.003	0.067	0.199	0.012	0.000	0.283**
		E3	-0.057	0.066	0.007	-0.012	0.005	-0.058	0.003	-0.003	0.060	-0.018	0.052	0.222	0.007	-0.013	0.262**
		E4	6.545	-5.022	-3.975	-7.407	1.542	-0.926	1.457	-43.691	7.093	28.429	2.821	10.617	-0.029	2.737	0.194*
		P	0.235	0.005	-0.237	0.001	0.024	0.057	0.002	-0.062	-0.024	0.033	0.095	0.146	0.012	-0.014	0.273**
7.	Finger width (cm)	E1	0.000	-0.007	0.000		0.017	0.000	-0.009	-0.002	-0.001	0.001	0.084	-0.013	0.016	0.002	0.070
		E2	0.000	0.006	0.005	0.000	-0.006	0.004	-0.055	0.010	0.011	0.000	-0.028	0.081	-0.006	0.000	0.041
		E3	-0.009	-0.035	0.001	0.003	-0.013	-0.004	0.040	0.005	0.015	0.004	-0.142	0.177	-0.600	0.008	0.044
		E4	-4.054	1.631	-1.783	-0.771	4.905	-0.092	14.744	5.007	1.625	-19.382	-2.725	2.195	0.003	-0.750	-0.050
		P	-0.030	0.000	-0.040	-0.001	-0.033	0.002	0.065	0.048	-0.008	-0.005	-0.050	0.063	0.014	0.014	0.029
8.	Earhead width (g)	E1	-0.001	-0.003	-0.002	0.008	-0.030	0.006	0.000	-0.078	-0.004	0.103	0.086	0.627	0.013	-0.001	0.725**
		E2	0.011	0.000	-0.013	0.007	-0.004	0.002	0.010	-0.055	0.004	0.001	0.351	-0.156	0.030	0.000	0.171*
		E3	0.000	-0.003	-0.006	-0.032	0.023	-0.004	-0.005	-0.039	-0.011	-0.044	0.050	0.480	-5.162	0.001	0.439**
		E4	7.743	-4.160	-1.025	17.508	-7.102	-0.227	-0.414	-178.451	1.032	107.858	3.061	56.295	0.047	3.740	0.696**
		P	0.075	0.000	0.081	0.000	0.083	0.012	-0.010	-0.304	0.001	0.093	0.168	0.500	-0.001	-0.017	0.727**
9.	Earhead length (cm)	E1	-0.004	-0.066	0.047	0.003	-0.003	0.012	-0.001	-0.016	-0.017	0.026	0.400	-0.102	0.012	0.001	0.280**
		E2	0.009	-0.015	-0.007	0.010	-0.006	0.004	-0.019	-0.007	0.030	0.001	0.174	-0.248	0.004	0.000	-0.063
		E3	-0.074	0.039	0.006	-0.016	-0.017	-0.035	0.006	0.004	0.100	-0.004	0.176	0.079	-0.001	-0.003	0.267**
		E4	7.975	-7.263	-6.296	-9.802	2.654	-0.800	2.921	-22.454	8.203	15.115	4.812	5.766	0.007	-0.626	0.203*
		P	0.192	0.004	-0.207	0.007	-0.013	0.045	0.018	0.005	-0.031	0.011	0.217	-0.008	0.014	0.003	0.251**
10.	Earhead weight (g)	E1	-0.001	-0.013	-0.003	0.000	-0.030	0.007	0.000	-0.078	-0.005	0.103	0.205	0.481	0.043	0.000	0.679**
		E2	-0.011	0.002	-0.001	-0.006	0.020	-0.010	-0.001	0.004	-0.002	-0.011	0.145	0.412	0.020	0.000	0.583**
		E3	-0.037	0.026	0.003	-0.015	0.025	-0.016	-0.003	-0.026	0.006	-0.065	0.185	0.554	-3.897	-0.010	0.647**
		E4	7.669	-1.917	-0.933	1.212	-11.073	-0.217	-2.351	-158.352	1.020	121.548	5.840	39.841	0.043	2.205	0.596**
		P	0.137	0.001	-0.020	-0.002	0.074	0.018	-0.003	-0.272	-0.003	0.104	0.146	0.426	-0.001	-0.009	0.641**
11.	Straw yield per plant (g)	E1	0.000	-0.013	0.002	-0.014	0.003	0.004	-0.001	-0.007	-0.008	0.023	0.917	-0.449	0.035	0.003	0.458**
		E2	0.001	-0.008	-0.005	0.010	-0.008	-0.003	0.002	-0.020	0.006	-0.002	0.954	-0.482	0.019	0.000	0.480**
		E3	-0.014	-0.030	0.001	0.015	0.022	-0.004	-0.007	-0.002	0.022	-0.015	0.816	-0.373	-4.037	0.015	0.465**
		E4	6.918	2.168	1.594	-26.595	-4.214	-0.144	-2.220	-30.182	2.181	39.222	18.099	0.167	0.027	-2.418	0.539**
		P	0.064	-0.001	0.025	0.008	0.000	0.009	-0.005	-0.080	-0.011	0.024	0.635	-0.198	0.014	0.016	0.512**
12.	Harvest index (%)	E1	-0.001	0.013	-0.005	0.010	-0.033	0.002	0.000	-0.048	0.002	0.049	-0.408	1.009	0.013	-0.003	0.601**
		E2	-0.007	0.002	0.002	-0.001	0.017	-0.008	-0.005	0.009	-0.008	-0.005	-0.470	0.979	0.023	0.000	0.519**
		E3	0.000	-0.009	-0.002	-0.060	0.010	-0.012	0.007	-0.017	0.007	-0.034	-0.283	1.075	-6.676	-0.025	0.680**
		E4	4.337	-1.147	1.120	-15.529	-8.835	-0.116	0.382	-118.697	0.559	57.218	0.036	84.634	0.038	3.546	0.831**
		P	0.047	0.000	0.024	0.005	0.072	0.010	0.005	-0.187	0.000	0.055	-0.154	0.814	-0.024	-0.024	0.705**
13.	1000 grain weight (g)	E1	0.000	0.014	-0.016	-0.004	-0.015	0.001	0.001	-0.035	0.000	0.047	-0.042	0.476	0.030	-0.001	0.457**
		E2	-0.001	-0.008	-0.004	0.004	-0.001	-0.005	-0.009	-0.007	0.004	-0.005	0.349	0.135	0.096	0.000	0.548**
		E3	0.032	-0.054	-0.003	-0.044	0.007	-0.006	-0.004	-0.018	0.006	-0.020	0.242	0.376	0.064	-0.011	0.568**
		E4	0.146	5.574	2.297	-5.667	-1.446	-0.002	0.613	-63.829	0.001	32.824	5.063	39.151	-14.431	0.240	0.533**
		P	-0.008	-0.003	0.084	0.005	0.025	-0.001	0.002	-0.155	-0.003	0.049	0.190	0.333	0.092	-0.007	0.613**
14.	Protein content (%)	E1	0.001	0.001	-0.003	0.001	0.008		-0.002	0.005	-0.002	0.003	0.315	-0.289	-0.003	0.009	0.043
		E2	0.009	-0.011	-0.001	0.006	-0.001	0.008	-0.010	0.013	0.001	0.001	0.030	-0.196	-0.002	0.000	-0.154
		E3	-0.009	-0.005	0.000	0.023	-0.017	0.011	0.005	-0.001	-0.004	0.009	0.175	-0.389	-0.010	0.069	-0.142
		E4	-4.073	1.286	-0.651	3.864	5.553	0.156	0.681	41.129	0.317	-16.516	2.697	-18.494	0.213	-16.228	-0.067
		P	-0.070	-0.001	0.002	0.000	-0.033	-0.010	0.011	0.062	-0.001	-0.012	0.126	-0.238	-0.008	0.082	-0.090*

* Significant at 5%,   ** Significant at 1%
* Significant at p = 0.05   ** Significant at p = 0.01

CONCLUSIONS

The correlation coefficient and path coefficient study revealed that grain yield per plant exhibited significant positive correlation with number of productive tillers per plant, number of fingers per ear, finger length, ear head width, ear head weight, straw yield per plant, harvest index and 1000 grain weight. It can be concluded that biological yield/plant, 1000 seed weight and oil content are the major yield contributing traits and must be considered during selection.

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