Original Research Article

CORRELATION AND PATH COEFFICIENT ANALYSIS FOR GRAIN YIELD COMPONENTS IN MAIZE (*Zea mays* L.)

ABSTRACT

In the present study, "Correlation and path coefficient analysis for grain yield components in maize (Zea mays L.)," the aim was to estimate genetic variability, genetic advance, correlation, and direct and indirect effects of yield contributing traits on yield. According to the analysis of variance, all traits exist. Hence, the data on all the 16 traits which showed significant differences among the entries were subjected to further statistical analysis. GP-184 had the shortest grain yield per plant in comparison to other genotypes, whereas GP-87 had the highest grain yield. Grain yield per plant, ear height, plant height, and cob weight exhibited the highest genotypic coefficient of variation. Cob weight. Among the traits, grain yield per plant, ear height, plant height, cob weight, and cob length showed a higher phenotypic coefficient of variation. The traits ear height, grain yield per plant, plant height, number of cobs per plant, cob length, number of kernels per row, cob weight, number of kernels per row per cob, anthesis to silking interval, shank weight, and days to 50% silking exhibited the highest heritability. Plant height, grain yield per plant, ear height, and cob weight were traits that showed higher genetic advances. These traits included grain yield per plant, ear height, plant height, cob weight, cob length, number of cobs per plant, tassel length, number of kernels per row, number of kernel rows per cob, 100-kernel weight, anthesis to silking interval, cob girth, and shank weight that showed higher genetic advance as a percent mean. The correlation coefficient indicates there is a significant positive correlation between grain yield and cob weight, number of cobs per plant, number of kernels per row, number of kernel rows per cob, 100 kernel weight, cob length, cob girth, plant height, ear height, shank weight, and tassel length at the phenotypic level. Grain yield per plant significantly positive correlation with cob weight, number of cobs per plant, number of kernels per row, number of kernel row per cob, 100 kernel weight, cob length, cob girth, plant height, shank weight, ear height, tassel length at the genotypic level the phenotypic level, the traits cob weight, 100 kernel weight, and plant height had the greatest direct impact on grain yield per plant. The traits were cob weight, number of kernel row per cob, 100 kernel weight showed higher direct effect on grain yield per plant at genotypic level.

Key Words: Maize, Genetic variability, Heritability, Genetic advance, Genotypic correlation, Phenotypic correlation, Path analysis.

INTRODUCTION

Maize (Zea mays L.; 2n = 20) is monoecious; the C4 plant belongs to the tribe Maydeae of the family Poaceae. It is a tall, robust, annual, usually with a single dominant stem, although there may be few tillers in some genotypes and environments. It contains about 32,000 genes spread across ten chromosomes with a genomic size of 2.3 gigabases **(Rebourg *et al.*, 2003).** About 9000 years ago maize originated through single domestication from its wild progenitor, teosinte in South Mexico according to Matsuoka et al. (2002). Morphologically maize exhibits greater diversity of phenotypes than any other grain crop (Kuleshov, 1933) and is extensively cultivated in temperate, subtropical, and tropical regions of the world. The suitability of maize for diverse environments is unmatched by any other crop. It is grown from 58˚N to 40˚S, from below sea level to altitudes higher than 3000 m, and in areas with 250 mm to more than 5000 mm of rainfall per year. The majority of the crop is however grown in warmer temperate regions and in humid subtropical climates, and the greatest production is found in areas with warmest month isotherms from 21 C to 27 C and frost-free seasons of 120 to 180 days.

Maize (Zea mays L.) is globally recognized as a favoured staple food for many people in Sub-Saharan Africa, Latin America, and Asia (Selvaraj & Nagarajan, 2011). It is the third most widely grown cereal crop after wheat and rice as it provides raw materials for agriculture-based industries in most growing regions of the world **(Anees, et al., 2016).** The crop is a reliable source of nourishment for humans, poultry, animals and livestock and its demand is increasing due to its versatile uses (extraction of starch, ethanol etc). The increase in demand of maize could partially be addressed either by bringing more area under maize cultivation or by increasing the productivity of the crop through the development and adoption of high yielding hybrids **(Jambagi & Wali, 2016).**

Maize is a tall, deep-rooted, warm weather and annual grass. A single long stalk will develop from seed. Long smooth leaves are attached to the stem nodes. Seed-producing shoots originate from the base of the main stem. The female flowers are borne on the corn 'ear', which arises at a leaf axil near the mid-point along the stem. The flower organs, and later the grain kernels, are enclosed in several layers of papery tissue, termed husks. A mass of long styles (silks) protrudes from the tip as a mass of silky threads. These strands are actually the stigmas from the flowers. The male flowers are borne at the top of the plant and are referred to as tassels. The male flower emerges a few days ahead of silk emergence, a condition commonly known as protandry. The pollen is windblown and comes in contact with the emerging silks of the same or different plants causing cross-pollination.

In India, during the 2019-2020 cropping seasons, 9.7 million ha of land was covered with maize with national average productivity of 2.9 tonnes/ha and production of 28.6
milliontons, far below the world average of 5.1 tons/ha **(Department of Agriculture Coope ration, 2020)**.

The correlation studies simply measure the associations between yield and other traits. Correlation between various characters is of high value as it indicates the degree to which different characters of a plant are associated with economic productivity (**Ahsan et al., 2008).** The association between two characters can be directly observed as phenotypic correlation, while genotypic correlation expresses the extent to which two traits are genetically associated **(Pavlov, et al., 2015)**. Both genotypic and phenotypic correlations among and between pairs of agronomic traits provide scope for indirect selection in a crop breeding program **(Muhammad & Muhammad, 2001).**

Path coefficient analysis has been widely used in crop breeding to determine the nature of relationships between grain yield (response variable) and its contributing components (predictor variables), and to identify those components with significant effect on yield for potential use as selection criteria **(Mohammadi et al., 2003)**. The major advantage of path analysis is that it permits the partitioning of the correlation coefficient into its components. It consists of two components: the path coefficient that measures the direct effect of a predictor variable on its response factor; and the indirect effect (s) of a predictor variable on the response variable through another predictor variable **(Dewey & Lu, 1959).**

1.1 Objectives

1. To estimate the genetic variability parameters for grain yield components in maize genotypes.
2. To estimate phenotypic and genotypic correlation between grain yield and yield contributing characters.
3. To find out direct and indirect effect of yield contributing characters on grain yield.

MATERIALS AND METHODS

The present investigation was carried out in the Field Experimentation Centre of the Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, U.P during Kharif-2021. A randomized block design was adopted with three replications and row-to-row spacing is 60 cm and plant-to-plant spacing is 20 cm with a plot size of 1m x1m. Replication-wise data on the basis of five randomly taken competitive plants from each replication were recorded on the following fourteen quantitative traits: Days to 50% tasselling, Days to 50% silking, Plant height (cm), Ear height (cm), Tassel length (cm), Days to 75% maturity, Cob weight (cm), Cob length (cm), Number of grain rows per cob, Number of grains per row, 100 kernel weight (g), Grain yield per plant (g). Data obtained from all the characteristics were subjected to analysis of variance with the formula suggested by Panse and Sukhatme. Further, different components of variance i.e., As per established methods, data were statistically analyzed to determine the genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV), heritability, genetic advance and genetic advance as a percent mean. For the analysis of variance, genotypic coefficient of variation and phenotypic coefficient of variation, standard statistical methods were utilised Burton, heritability Burton and Devane and genetic advance Johnson et al., Ai Jibouri et al., used genotypic and phenotypic variances and co-variances to calculate genotypic and phenotypic correlation coefficients. The path coefficient study was carried out using the technique proposed by **Dewey and Lu (1959).**

2.1 Layout Description

- Crop: Maize (Zea mays L.)
- Season: KHARIF, 2021
- Experimental design: Randomized Block Design
- Number of genotypes: 21
- Number of replications: 03
- Gross area: 144 sq.m

- Net area: 63.sq.m
- Individual plot size: 1x1 Sq. m
- Spacing: 36 X 20 cm
- Date of sowing: 22-02-2021
- Recommended Fertilizer dose: N: P: K @ 120:60:40 kg/ha

2.2 Experimental Material

Source: Professor Jayashankar Telangana State Agriculture University, Hyderabad, Telangana.

SOFTWARE: Software version used for analysis Winostat 9.3.

RESULT AND DISCUSSION

For all of the traits studied, the analysis of variance indicated substantial differences between the genotypes (Table 1). As a result, it revealed a significant level of genetic heterogeneity among twenty-one maize genotypes. Evaluation of genetic characteristics, correlation and path coefficient analysis aid in the examination of significant traits during the selection process for optimizing maize productivity. (Table 2) displays the genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability, genetic advance (GA) and genetic advance as a percent of mean GA (percent) for all yield contributing characteristics.

For all of the characters, PCV was higher than the matching GCV, indicating that the environment had an impact. The highest PCV and GCV were found for Grain yield per plant (40.504 and 40.318), ear height (40.173 and 40.038), plant height (24.444 and 24.181), cob weight (23.345 and 22.974), cob length (21.983 and 21.673) similar results were reported by **Pradhan *et al.* (2022), Yadesa *et al.* (2022), Rai *et al.* (2021), Mumo *et al.* (2018), Begum *et al.* (2016), Maruthi *et al.* (2015), Hemavathy *et al.* (2008).** The genotypic coefficient of variation estimations reflects the overall amount of genotypic variability present in the material.

Heritability, on the other hand, reflects the fraction of this genotypic polymorphism that is passed down from parents to offspring. **Lush (1947)** proposed the broad sense heredity idea. It influences how effective genotypic variability may be used in a breeding programme. (Table 2) shows the heritability estimates obtained during the current investigation. The heritability of the qualities is moderate to high, ranging from 69.1 percent to 99.3 percent. Ear height (99.3), Grain yield per plant (99.1), Cob length (97.2), Number of cobs per plant (97.2), Number of Kernels per row (97.1), Cob weight (96.8), Tassel length (96.2), 100 kernel weight (95.9), Number of Kernel row per cob (95.5), Anthesis to silking interval (95.1), Shank weight (92.3), Cob girth (91.4), Days to fifty percent silking (69.1). The high heritability values of the qualities examined in this study revealed that they were less influenced by the environment, allowing for successful selection of traits based on phenotypic appearance using a simple selection strategy and indicating the possibility of genetic progress. Similar findings were reported by **Ogguniyan *et al.* (2014), Reddy *et al.* (2014), Nzuve *et al.* (2014), Li *et al.* (2015), Singh *et al.* (2017), Bartaula e*t al.* (2019), Huqe *et al.* (2021), Magae *et al.* (2021), Rai *et al.* (2021), Yadesa *et al.* (2022).**

High genetic advance was recorded for Plant height (60.104), Grain yield per plant (36.804), Ear height (31.315), Cob weight (26.256). Similar findings were reported by **Rai *et al.* (2021), Mumo *et al.* (2018), Sesay *et al.* (2016), Ogunniyan *et al.* (2014), Akbar *et al.* (2008).**

High genetic advance as percent mean was recorded for Grain yield per plant (82.674), Ear height (82.202), Plant height (49.278), Cob weight (46.575), cob length (44.016), number of cobs per plant (37.17), tassel length (37.165), number of kernels per row (35.667), number of kernel row per cob (35.524), 100 kernel weight (34.968), anthesis to silking interval (33.974), cob girth (26.488), shank weight (25.06) showed higher genetic advance as percent mean. Similar findings were reported by **Yadesa *et al.* (2022)**, **Tesfaye *et al.* (2021), Hemavathy *et al.*, (2008), Magae *et al.* (2021).**

During the correlation study, associations between yield and yield contributing features were investigated under study. (Table 3) shows the phenotypic and genotypic correlation coefficients between the investigated features of 21 maize genotypes on different quantitative traits. In most cases, the genotypic correlation was higher than that of phenotypic correlation; reveal that association may be largely due to genetic reason (strong coupling linkage) **(Sharma, 1988)**. Cob weight (0.9669**, 0.9447**), number of cobs per plant (0.8566**, 0.8333**), number of kernels per row (0.7604**, 0.7338**), number of kernel row per cob (0.7453**, 0.7279**), 100 kernel weight (0.7372**, 0.7218**), cob length (0.6496**, 0.6552**), cob girth (0.5996**, 0.5996**), plant height (0.5211**, 0.5117**), ear height (0.4489**, 0.4452**), shank weight (0.4573**, 0.4378**), tassel length (0.2932*, 0.5844*) are positively and significantly correlated with grain yield per plant in both genotypic and phenotypic correlation. Similar findings were reported by **Gautam *et al.* (2022), Singh *et al.* (2020), Ferdoush *et al*. (2017**), **Kumar *et al.* (2014), Kanagarasu *et al.* (2013). Kinfe *et al.* (2015). Sadaiah *et al.* (2013). Aman *et al*. (2020), Soumya *et al.* (2017), Kote *et al.* (2014), Suhasini *et al.* (2016). Sadaiah *et al.* (2013), Premlatha *et al*. (2010), Pavan *et al.* (2011).**

Path analysis is one of the most accurate statistical techniques for determining the interdependence of features and the degree of control of independent characters on seed production, either directly or indirectly **Mushtaq *et al.* (2013).** When it comes to choosing high yielding germplasm, the idea of direct and indirect influence of yield contributing traits on the final end product yield in any crop is crucial. (Table 4) depicted the direct and indirect effects of 16 different quantitative characters The traits were Cob weight (0.9669), Number of cobs per Plant (0.8566), Number of Kernels per row (0.7604), Number of Kernel row per cob (0.7453), 100 kernel weight (0.7372), Cob length (0.6496), Cob girth (0.6288), Plant height (0.5211) showed higher direct effect on grain yield per plant at genotypic level. Similar findings were reported by **Amegbor *et al*. (2022), Devasree *et al.* (2020), Pandey *et al.* (2017), Alhussein *et al*. (2017), Kinfe *et al.* (2015), Kote *et al.* (2014), Reddy *et al*. (2012), Kumar *et al*. (2011), Selvaraj *et al.* (2011),** Saidaiah ***et al.* (2007), Geetha *et al.* (2000), Kanna *et al.* (2022).**

In path analysis the traits were cob weight (0.9447), Number of cobs per Plant (0.8333), Number of Kernels per row (0.7445), Number of Kernel row per cob (0.7279), 100 kernel weight (0.7218), Cob length (0.6352), Cob girth (0.5996), plant height (0.5117) showed higher direct effect on grain yield per plant at phenotypic level. Similar findings were reported by **Devasree *et al.* (2020), Pandey *et al.* (2017), Alhussein *et al*. (2017), Kote *et al.* (2014), Nataraj *et al.* (2014), Sumalini and Manjulatha (2012), Selvaraj *et al.* (2011), Saidaiah**

***et al.* (2007), Singh *et al.* (2017), Beulah *et al.* (2018), Kinfe *et al.* (2015), Reddy *et al.* (2012), Kumar *et al*. (2011), Geetha *et al*. (2000).**

CONCLUSION:

- Among 21 genotypes, GP-87 (74.67), MGW-357 (72.36) genotypes were found to be superior for grain yield per plant over the check (Shaktiman-5). GCV for all the characters were less than PCV, indicating the influence of environmental component on the expression of the character. High heritability coupled with high genetic advance as percent mean in the present genotypes was recorded for traits anthesis to silking interval, plant height, ear height, tassel length, cob length, cob girth, cob weight, number of kernels per row, number of kernel row per cob, number of cobs per plant, shank weight,100 kernel weight, grain yield per plant. In genotypic and phenotypic correlation cob weight, number of cobs per plant are positively and significantly correlated with grain yield per plant. In genotypic and phenotypic path analysis cob weight and 100 kernel weight are direct effect to grain yield per plant.
- Therefore, these characters should be given previously during selection for yield improvement in maize.

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Table 1 Analysis of variance for 16 yield and yield contributing traits of 21 Maize genotypes

S.No.	source	Replication	Genotypes	Error
	Degrees of Freedom	2	20	40
1	Days to fifty percent tasselling	5.349	21.818 **	1.618
2	Days to fifty percent silking	6.453	28.494**	1.887
3	Anthesis to silking interval	0.085	1.663**	0.028
4	Plant height	189.062	2628.587**	18.996
5	Ear height	4.716	699.495**	1.568
6	Tassel length	7.168	62.320**	0.810

7	Days to 75% maturity	44.081	38.012**	8.831
8	Cob length	0.613	20.296**	0.193
9	Cob girth	0.736	6.678**	0.203
10	Cob weight	14.791	508.671**	5.460
11	Number of Kernels per row	2.167	25.296**	0.254
12	Number of Kernel row per cob	0.719	11.719**	0.181
13	Number of cobs per Plant	0.006	0.212**	0.002
14	Shank weight	2.977	12.684**	0.342
15	100 kernel weight	5.182	54.728**	0.761
16	Grain yield per plant	20.698	969.425 **	2.980

Level of significance at 5 %, ** Level of significance at 1%

TRAITS	GCV	PCV	Heritability (Broad sense) %	GA 5%	GAM 5%
Days to fifty percent tasselling	4.222	5.716	54.5	3.63	6.423
Days to fifty percent silking	4.723	5.682	69.1	4.923	8.088
Anthesis to silking interval	16.908	17.334	95.1	1.483	33.974
Plant height	24.181	24.444	97.9	60.104	49.278
Ear height	40.038	40.173	99.3	31.315	82.202
Tassel length	18.394	18.754	96.2	9.149	37.165
Days to 75% maturity	3.484	4.812	52.4	4.651	5.196
Cob length	21.673	21.983	97.2	5.257	44.016
Cob girth	13.45	14.068	91.4	2.893	26.488
Cob weight	22.974	23.345	96.8	26.256	46.575
Number of Kernels per row	17.58	17.845	97.1	5.863	35.677
Number of Kernel row per cob	17.645	18.055	95.5	3.948	35.524
Number of cobs per Plant	18.304	18.568	97.2	0.537	37.17
Shank weight	12.66	13.175	92.3	4.015	25.06
100 kernel weight	17.331	17.694	95.9	8.558	34.969
Grain yield per plant	40.318	40.504	99.1	36.804	82.674

Table 2 Genetic parameters for 16 quantitative characters in 21 Maize genotypes

PCV: Phenotypic Coefficient of Variation, GCV: Genotypic Coefficient of Variation, h^2bs: heritability (broad sense), GA: Genetic Advance, GAM: Genetic Advance as Percent of Mean

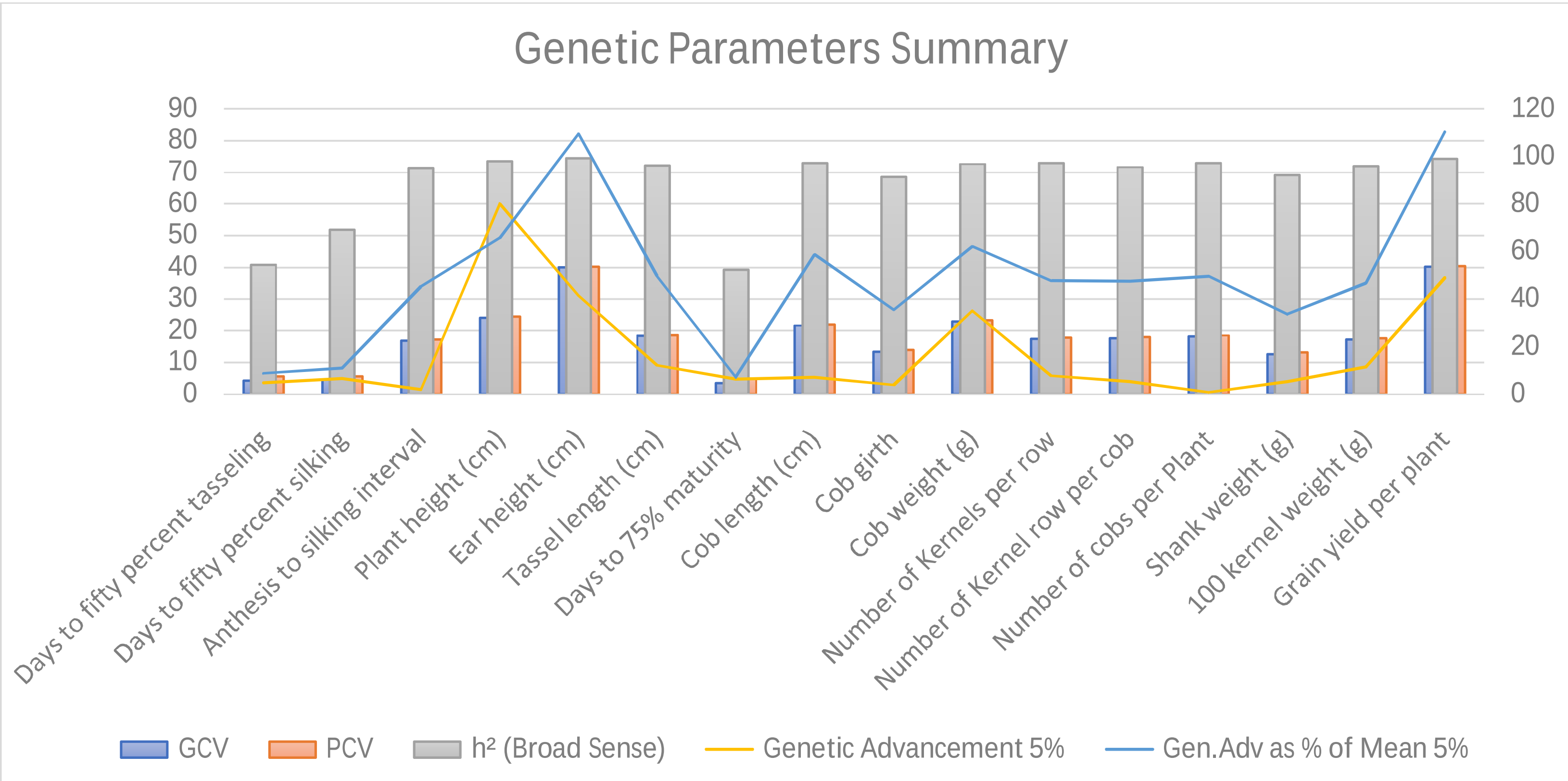

Fig. 1. Histogram depicting GCV, PCV, heritability and genetic advance for 16 quantitative characters of 21 Maize genotypes

TRAITS		Days to 50% tasselling	Days to 50% silking	Anthesis to silking interval	Plant height (cm)	Ear height (cm)	Tassel length	Days to 75% maturity	Cob length (cm)	Cob girth (cm)	Cob weight (gm)	Number of Kernels per row	Number of Kernel row per cob	Number of cobs per Plant	Shank weight	100 grain weight (gm)	Grain yield per plant
Days to 50% tasselling	G	1	0.984**	0.5041**	-0.139	-0.1661	-0.3239**	0.9338**	-0.3811**	-0.3053*	-0.6051**	-0.6031**	-0.5311**	-0.7079**	-0.205	-0.8432**	-0.5547**
	P	1	0.7528**	0.2934*	-0.1197	-0.1337	-0.2128	0.648**	-0.3127*	-0.2082	-0.4459**	-0.446**	-0.4196**	-0.5232**	-0.1676	-0.6108**	-0.4104**
Days to 50% silking	G		1	0.6481**	-0.1611	-0.1838	-0.2182	0.9264**	-0.4682**	-0.3615**	-0.5972**	-0.588**	-0.5667**	-0.6896**	-0.2633*	-0.8074**	-0.5464**
	P		1	0.5362**	-0.1503	-0.1626	-0.2068	0.7502**	-0.3926**	-0.3156*	-0.4777**	-0.4665**	-0.447**	-0.576**	-0.1906	-0.6471**	-0.4381**
Anthesis- silking interval	G			1	-0.1787	-0.179	0.1222	0.5313**	-0.553**	-0.477**	-0.3448**	-0.305*	-0.4172**	-0.401**	-0.3002*	-0.4025**	-0.3055*
	P			1	-0.1712	-0.1717	0.1066	0.3764**	-0.5308**	-0.4467**	-0.3225**	-0.2896*	-0.3854**	-0.3845**	-0.2752*	-0.3741**	-0.3007*
Plant height (cm)	G				1	0.8826**	0.3863**	0.0082	0.4238**	0.5023**	0.5737**	0.6878**	0.4766**	0.4963**	0.2323	0.1321	0.5211**
	P				1	0.871**	0.3805**	0.0133	0.4194**	0.4627**	0.5522**	0.6728**	0.4694**	0.482**	0.2205	0.1313	0.5117**
Ear height (cm)	G					1	0.2894*	-0.0891	0.4537**	0.5889**	0.5326**	0.6744**	0.5127**	0.5114**	0.1308	0.1592	0.4489**
	P					1	0.2834*	-0.067	0.4482**	0.5596**	0.5213**	0.6586**	0.5036**	0.5024**	0.1275	0.1531	0.4452**
Tassel length	G						1	-0.1333	0.1471	0.3475**	0.2779*	0.4254**	0.3571**	0.1287	0.2056	0.1171	0.2932*
	P						1	-0.1049	0.1396	0.3269**	0.2697*	0.406**	0.3451**	0.1227	0.208	0.1047	0.2844*
Days to 75% maturity	G							1	-0.5342**	-0.452**	-0.6346**	-0.5515**	-0.6584**	-0.7169**	-0.2219	-0.9283**	-0.6046**
	P							1	-0.4193**	-0.3823**	-0.4488**	-0.3892**	-0.4655**	-0.5431**	-0.1256	-0.6**	-0.4257**
Cob length (cm)	G								1	0.7048**	0.6779**	0.529**	0.5405**	0.6205**	0.5132**	0.5008**	0.6496**
	P								1	0.6662**	0.665**	0.5184**	0.5333**	0.6064**	0.486**	0.4739**	0.6352**
Cob girth (cm)	G									1	0.6634**	0.6792**	0.8649**	0.5852**	0.277*	0.4499**	0.6288**
	P									1	0.6315**	0.6335**	0.7973**	0.5553**	0.2167	0.4074**	0.5996**
Cob weight (gm)	G										1	0.814**	0.7899**	0.9361**	0.4992**	0.7441**	0.9669**
	P										1	0.7966**	0.7605**	0.9062**	0.4783**	0.722**	0.9447**
Number of Kernels per row	G											1	0.7442**	0.7501**	0.2645*	0.5958**	0.7604**
	P											1	0.7217**	0.7212**	0.2605*	0.5745**	0.7445**
Number of Kernel row per cob	G												1	0.7898**	0.1029	0.6626**	0.7453**
	P												1	0.7539**	0.0979	0.6349**	0.7279**
Number of cobs per Plant	G													1	0.3318**	0.8194**	0.8566**
	P													1	0.3085*	0.7886**	0.8333**
Shank weight	G														1	0.0533	0.4573**
	P														1	0.0545	0.4378**
100 grain weight (gm)	G															1	0.7372**
	P															1	0.7218**

Table 3: Genotypic and Phenotypic correlation among the different traits evaluated in Maize during Kharif-2021.

Table 4: Direct (Bold) and indirect effect at genotypic and phenotypic level for different quantitative traits on seed yield.

TRAITS		Days to 50% tasselling	Days to 50% silking	Anthesis to silking interval	Plant height (cm)	Ear height (cm)	Tassel length	Days to 75% maturity	Cob length (cm)	Cob girth (cm)	Cob weight (gm)	Number of Kernels per row	Number of Kernel row per cob	Number of cobs per Plant	Shank weight	100 grain weight (gm)
Days to 50% tasselling	G	**0.1016**	0.1179	0.0512	-0.0141	-0.0169	-0.0329	0.1152	-0.0387	-0.031	-0.0615	-0.0613	-0.054	-0.0719	-0.0208	-0.0857
	P	**0.041**	0.031	0.012	-0.005	-0.006	-0.009	0.027	-0.013	-0.009	-0.018	-0.018	-0.017	-0.022	-0.007	-0.025
Days to 50% silking	G	0.0773	**0.0666**	0.0432	-0.0107	-0.0122	-0.0145	0.0684	-0.0312	-0.0241	-0.0398	-0.0392	-0.0378	-0.0459	-0.0175	-0.0538
	P	0.044	**0.059**	0.032	-0.009	-0.010	-0.012	0.044	-0.023	-0.019	-0.028	-0.028	-0.026	-0.034	-0.011	-0.038
Anthesis- silking interval	G	-0.0186	-0.0239	**-0.0369**	0.0066	0.0066	-0.0045	-0.0196	0.0204	0.0176	0.0127	0.0112	0.0154	0.0148	0.0111	0.0148
	P	0.007	0.013	**0.024**	-0.004	-0.004	0.003	0.009	-0.013	-0.011	-0.008	-0.007	-0.009	-0.009	-0.007	-0.009
Plant height (cm)	G	-0.0077	-0.0089	-0.0099	**0.0553**	0.0488	0.0214	0.0005	0.0234	0.0278	0.0317	0.038	0.0264	0.0274	0.0128	0.0073
	P	-0.024	-0.031	-0.035	**0.204**	0.177	0.077	0.003	0.085	0.094	0.112	0.137	0.096	0.098	0.045	0.027
Ear height (cm)	G	-0.0147	-0.0162	-0.0158	0.078	**0.0883**	0.0256	-0.0079	0.0401	0.052	0.047	0.0596	0.0453	0.0452	0.0116	0.0141
	P	0.017	0.020	0.021	-0.109	**-0.125**	-0.035	0.008	-0.056	-0.070	-0.065	-0.082	-0.063	-0.063	-0.016	-0.019
Tassel length (cm)	G	0.0098	0.0066	-0.0037	-0.0116	-0.0087	**-0.0301**	0.004	-0.0044	-0.0105	-0.0084	-0.0128	-0.0108	-0.0039	-0.0062	-0.0035
	P	0.001	0.001	-0.001	-0.002	-0.001	**-0.004**	0.000	-0.001	-0.001	-0.001	-0.002	-0.002	-0.001	-0.001	0.000
Days to 75% maturity	G	-0.0712	-0.0644	-0.0333	-0.0005	0.0056	0.0084	**-0.0628**	0.0335	0.0284	0.0398	0.0346	0.0413	0.045	0.0139	0.0583
	P	-0.037	-0.042	-0.021	-0.001	0.004	0.006	**-0.057**	0.024	0.022	0.025	0.022	0.026	0.031	0.007	0.034
Cob length (cm)	G	-0.0172	-0.0212	-0.025	0.0192	0.0205	0.0067	-0.0242	**0.0452**	0.0319	0.0307	0.0239	0.0244	0.0281	0.0232	0.0226
	P	-0.002	-0.003	-0.004	0.003	0.003	0.001	-0.003	**0.007**	0.004	0.004	0.003	0.004	0.004	0.003	0.003
Cob girth (cm)	G	0.0986	0.1167	0.154	-0.1622	-0.1902	-0.1122	0.146	-0.2276	**-0.3229**	-0.2142	-0.2193	-0.2793	-0.189	-0.0894	-0.1453
	P	-0.002	-0.003	-0.004	0.004	0.004	0.003	-0.003	0.005	**0.008**	0.005	0.005	0.006	0.004	0.002	0.003
Cob weight (gm)	G	-0.8598	-0.8487	-0.49	0.8152	0.7568	0.395	-0.9017	0.9634	0.9426	**1.421**	1.1567	1.1224	1.3302	0.7094	1.0573
	P	-0.400	-0.429	-0.289	0.495	0.468	0.242	-0.403	0.597	0.567	**0.897**	0.715	0.682	0.813	0.429	0.648
Number of Kernels per row	G	0.0434	0.0423	0.0219	-0.0494	-0.0485	-0.0306	0.0397	-0.038	-0.0488	-0.0585	**-0.0719**	-0.0535	-0.0539	-0.019	-0.0428
	P	0.023	0.024	0.015	-0.034	-0.033	-0.021	0.020	-0.026	-0.032	-0.040	**-0.051**	-0.037	-0.036	-0.013	-0.029
Number of Kernel row per cob	G	-0.1713	-0.1828	-0.1345	0.1537	0.1653	0.1152	-0.2123	0.1743	0.2789	0.2547	0.24	**0.3225**	0.2547	0.0332	0.2137
	P	-0.028	-0.030	-0.026	0.031	0.034	0.023	-0.031	0.036	0.053	0.051	0.048	**0.067**	0.050	0.007	0.042
Number of cobs per Plant	G	0.5994	0.5838	0.3395	-0.4202	-0.433	-0.109	0.607	-0.5253	-0.4955	-0.7925	-0.635	-0.6687	**-0.8467**	-0.2809	-0.6938
	P	0.117	0.129	0.086	-0.108	-0.113	-0.028	0.122	-0.136	-0.125	-0.203	-0.162	-0.169	**-0.224**	-0.069	-0.177
Shank weight	G	-0.0115	-0.0148	-0.0169	0.0131	0.0074	0.0116	-0.0125	0.0289	0.0156	0.0281	0.0149	0.0058	0.0187	**0.0563**	0.003
	P	-0.009	-0.011	-0.015	0.012	0.007	0.011	-0.007	0.027	0.012	0.026	0.014	0.005	0.017	**0.055**	0.003
100 grain weight (gm)	G	-0.3128	-0.2995	-0.1493	0.049	0.0591	0.0434	-0.3443	0.1858	0.1669	0.276	0.221	0.2458	0.3039	0.0198	**0.3709**
	P	-0.159	-0.168	-0.097	0.034	0.040	0.027	-0.156	0.123	0.106	0.187	0.149	0.165	0.205	0.014	**0.260**
Grain yield per plant	G	-0.5547	-0.5464	-0.3055	0.5211	0.4489	0.2932	-0.6046	0.6496	0.6288	0.9669	0.7604	0.7453	0.8566	0.4573	0.7372

G*: genotypic correlation, P*: phenotypic correlation

	P	-0.4104	-0.4381	-0.3007	0.5117	0.4452	0.2844	-0.4257	0.6352	0.5996	0.9447	0.7445	0.7279	0.8333	0.4378	0.7218

G*: genotypic path analysis, P*: phenotypic path analysis.

Fig 2 Genotypic path diagram for grain yield per plant

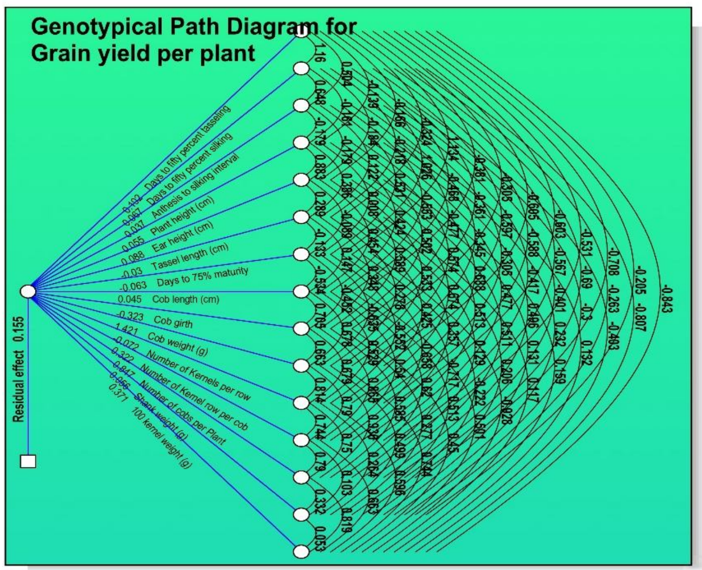

Fig 3 **Phenotypic path diagram for grain yield per plant**