Original Research Article

CORRELATION AND PATH COEFFICIENT ANALYSIS IN MAIZE (ZEA MAYS L.)

ABSTRACT

Maize is (Zea mays L.) is one of the most versatile and diversified crop grown worldwide under different agro-climatic conditions. Twenty-eight experimental hybrids along with eight inbred lines and one commercial check were evaluated at agricultural polytechnic, Polasa, jagtial to determine correlation and path analysis for yield and yield attributing traits. The experiment was conducted in randomized block design with three replications. Correlation studies revealed that ear girth and 100 grain weight had showed highest positive significant correlation with grain yield per plant. Path coefficient analysis revealed that days to 50% silking had highest positive direct effect on grain yield per plant followed by hundred grain weight, ear girth, number of kernels per row, number of kernels per row and plant height at phenotypic level and genotypic levels.

Comment [H1]: Please explain what is the contribution of the findings obtained. Who will benefit from the study and what is recommended?

Key words: Maize, Correlation, Path coefficient analysis

1. INTRODUCTION

Maize (Zea mays L.) is one of the most popular food, feed and industrial crop among all the cereals in present world agriculture scenario due to its several uses and wider adaptability to different environments. It is a member of grass family Poaceae, tribe Maydeae and is highly cross-pollinated crop. It is considered as 'queen of cereals' due to its high adaptability and genetic potentiality. It is the third most important cereal crop after wheat and rice as it provides raw materials for agriculture-based industries in most growing regions of the world [1]. Maize has high nutritive value it contains 10% protein, 72% starch, 4.80% oil, 8.50% fiber, 1.70% ash and 30% sugar [2]. It is also used as basic raw materials in numerous industrial products including starch, oil, protein, alcoholic beverages, food sweeteners, pharmaceuticals, cosmetics, films, textiles, gums, packages, paper industries and so on [3].

Comment [H2]: Data on maize production is readily available from FAO to reinforce the narrative and indicate its economic importance.

Selection based on grain yield is not reliable because yield is a complex quantitative trait and it is governed by polygenes and also influenced by environmental factors in which the crop is grown.

Correlation gives information about the nature and extent of association between pairs of metric traits and helps in selection for the improvement of the character [4]. The path analysis provides the effective measures of direct and indirect causes of association and depicts the relative importance of each factor involved in contributing to the final product [5]. Correlation gives only the relation between two variables while path coefficient analysis allows separation of the direct effect and their indirect effects through other attributes by partitioning the correlations [6].

Comment [H3]: If there is literature on the subject, please add it.

2. MATERIAL AND METHODS

The present research work was conducted at Agricultural Polytechnic, Polasa, jagtial, Telangana during Kharif, 2020-2021, Rabi, 2021-2022. In Kharif, 2020-2021, twenty-eight (28) experimental hybrids were developed by crossing eight inbred lines in half-diallel mating design. These 28 experimental hybrids along with eight inbred lines and one commercial check were evaluated in Rabi, 2021-2022 for yield and yield attributing traits. These experimental hybrids were sown in Randomized Block Design with three replications. Each genotype was sown in three rows of three meters length with a spacing of 75 cm x 20 cm. The recommended dose of fertilizers N, P and K were applied in the ratio of 180: 60: 40 kg ha^{-1}. The total P and K and half dose of nitrogen was applied as basal, whereas the remaining half dose of N in two equal split doses at knee height and tasseling stages. Weeding operations, as well as necessary plant protection measures to protect the crop from pests and diseases, were carried out in accordance with the recommendations, as well as timely irrigation schedules to ensure a healthy crop. Observations were recorded i.e., days to 50% anthesis, days to 50% silking, anthesis silking interval, days to maturity, plant height (cm), ear height (cm), ear length (cm), ear girth (cm), number of kernel rows per ear, number of kernels per row, 100 grain weight and grain yield per plant. Genotypic and phenotypic correlations coefficients were worked out by adopting method described by Singh and Chaudhary [7]. Path coefficient analysis was done according to the procedure suggested by Dewey and Lu [8].

3. RESULTS AND DISCUSSION

Grain yield is the ultimate product desired in any resource programme which is dependent on various component traits. However, extent of association among various component traits and also with the grain yield is highly essential for selection of traits which aid the improvement in grain yield.

Genotypic correlation proved stable which brings in genetic improvement of a trait through the selection of genetically correlated traits. Observable association between two variables which is due to the genotypic and environmental effects which varies with the set of environmental conditions.

Persual of data presented indicated that genotypic values are higher than phenotypic values proved that the two characters are strongly correlated genotypically (table1). These findings are in close proximity with the results Begum et al. [9], Reddy and Jabeen [10], Dash et al. [11]. Phenotypic correlation values provide the useful information on phenotypic expression of the traits which are very useful tools to discuss under set of environmental conditions.

Comment [H4]: Table 1

Plant height was positive and significantly correlated with ear height, ear length, ear girth, number of kernels per row and 100 grain weight while, positive and non-significantly correlated with grain yield per plant. These results of significant and positive association are in consonance with findings of Kumar et al. [12] for ear length, ear girth and 100 grain weight; Chaurasia et al. [13], for ear length, ear diameter, number of kernels per row and 100 grain weight.

Ear height was positively and significantly associated with ear length, ear girth and number of kernels per row and 100 grain weight while, positive and non-significantly associated with number of kernel rows per ear with grain yield per plant.

Ear length was positively and significantly correlated with ear girth, number of kernels per row and 100 grain weight while, positive and non-significantly correlated with number of kernel rows per ear and grain yield per plant. These results collaborate the findings of Hosamani et al. [14] for Ear girth, number of kernels per row and 100-grain weight; Lenka et al. [15], for ear girth, number of kernels per row, number of kernel rows per ear and 100-grain weight.

Ear girth was positive and significantly correlated with number of kernel rows per ear, number of kernels per row and 100 grain weight while, positive and non-significantly correlated with grain yield per plant. Similar results were also reported by Amin et al. [16] for number of kernels per row, 100-grain weight and number of kernel rows per ear; Dash et al. [11] for number of kernels per row and number of kernel rows per ear.

Number of kernel rows per ear was positively and significantly correlated with number of kernels per row and 100 grain weight while, positive and non-significantly correlated with grain yield per plant. These results of significant and positive association were earlier reported by Sandeep et al. [17], Hosamani et al. [14] for number of kernel rows ear.

Number of kernels per row was positive and significantly correlated with 100 grain weight while, positive and non-significantly correlated with grain yield per plant. 100 grain weight positive and non-significantly correlated with grain yield per plant. These results of significant and positive association were earlier reported by Kumar et al. [12], Rajwade et al. [18] for 100-grain weight.

Perusal of the data on days to 50 per cent anthesis, days to 50% silking and days to maturity revealed that early maturing hybrids performed well under the situation which might be attributed to the escape from the higher temperatures in the later stages of the crop growth. In addition, tall growing hybrids also recorded higher grain yield due to their ability to synthesize higher photosynthetic assimilates and subsequent partitioning.

PATH COEFFICIENT ANALYSIS

Correlation coefficient cannot depict the true association between traits as it will not provide information on direct and indirect effects which can obtained by path coefficient analysis, which is a kind of standardized partial regression coefficient. Further, it is difficult to identify the particular traits when multiple effects of genes are associated where the total correlation between yield and components are under estimated or overestimated and hence the association will be misleading. Keeping in view of the above, path analysis was also worked out for the purpose.

Direct effects of days to 50% tasseling was negative (-0.5336) and it was estimated significantly negative correlation with grain yield (-0.6041) which was mainly due to the indirect negative contribution exerted through days to 50% silking and days to maturity. The results of direct negative effect of days to 50 per cent tasseling on grain yield are in agreement with the earlier findings of Raghu et al. [19].

Days to 50% silking exhibited positive direct effect (0.5901) on grain yield was showed significantly negative correlation (-0.5758) which has been mainly attributed to the indirect negative contribution through anthesis silking interval, plant height, ear height, ear girth, ear length, number of kernel rows per ear, number of kernels per row and 100 grain weight. Anthesis silking interval exhibited direct positive effect on grain yield with positive significant correlation (0.3866) which was due to indirect contribution through days to 50% tasseling, days to 50% silking and days to maturity. The similar results reported by Matin et al. [20] for days to 50% silking and anthesis silking interval.

Days to maturity exhibited negative direct effect (-0.0050) with grain yield and was recorded significantly negative correlated (-0.5819) which was due to negative indirect effect through days to 50% tasseling and days to 50% silking.

Plant height exhibited direct positive effect (0.1763) on grain yield with positive correlation (0.6040) was due to indirect positive effects through anthesis silking interval, ear height, ear length, ear girth, number of kernels per row and 100 grain weight. Ear height showed positive direct effect (-0.0760) on grain yield with positive correlation (04114) was due to indirect positive effects through days to 50% tasseling, days to 50% silking and days to maturity. The similar findings reported by Dash et al. [11] for plant height and ear height.

Ear length registered positive direct effect (0.0760) on grain yield with positive correlation (0.7255) was due to indirect positive effects via plant height, ear height, ear girth, number of kernel rows per ear, number of kernels per row and 100 grain weight. The similar results accordance with Singh et al. [21].

Ear girth exhibited positive direct (0.3063) on grain yield with positive correlation (0.8109) was due to indirect positive effects through anthesis silking interval, plant height, ear height, ear length, number of kernel rows per ear, number of kernels per row and 100 grain weight. The same results reported by Gokulakrishnan et al. [22], Kanna et al. [23],

Number of kernel rows per ear had positive direct effect (0.1787) on grain yield with positive correlation (0.5182) was due to indirect positive effects through ear height, ear length, anthesis silking interval, number of kernels per row and 100 grain weight. The similar findings reported by Ahmed et al. [24], Chaurasia et al. [13].

Number of kernels per row showed positive direct effects (0.2403) on grain yield with positive correlation (0.6550) was due to indirect contribution through plant height, anthesis silking interval, ear height, ear girth, ear length, number of kernel rows per ear and 100 grain weight. For this trait Shikha et al. [25] reported same results.

Hundred grain weight showed positive direct effect (0.4391) on grain yield with positive correlation (0.7229) was due to indirect positive effect through anthesis silking interval, plant height, ear height, ear length, ear girth, number of kernel rows per ear and number of kernels per row. The same results reported by Dash et al. [11].

CONCLUSION:

Correlation and Path analysis revealed that the traits ear girth and 100 grain weight exhibited the highest positive correlation and direct effect on the grain yield per plant both at phenotypic and genotypic levels. These characters play a major role in development of high yielding genotypes in future breeding programmes.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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Table 1 phenotypic and genotypic correlation coefficient for yield and yield attributing traits

Character		DT	DS	ASI	DM	PH	EH	EL	EG	KRE	KPR	100GW	GY
DT	P	**1.000**	0.9895***	-0.3780***	0.8110***	-0.4418***	-0.1424	-0.5993***	-0.6136***	-0.2298*	-0.6170***	-0.4462***	-0.6041
	G	**1.000**	0.9917	-0.4063	0.8184	-0.4446	-0.1472	-0.6061	-0.6275	-0.2379	-0.6648	-0.4577	-0.6082
DS	P		**1.000**	-0.2532**	0.8154***	-0.4214***	-0.1370	-0.5738***	-0.5898***	-0.1954*	-0.5894***	-0.4392***	-0.5758
	G		**1.000**	-0.2911	0.8236	-0.4234	-0.1414	-0.5825	-0.6041	-0.2010	-0.6369	-0.4516	-0.5797
ASI	P			**1.000**	-0.1968*	0.2199*	0.1041	0.3353***	0.4415***	0.3985***	0.3887***	0.1618	0.3866
	G			**1.000**	-0.2192	0.2418	0.1038	0.3573	0.4781	0.4387	0.4417	0.1806	0.4237
DM	P				**1.000**	-0.5008***	-0.2433*	-0.5873***	-0.4794***	-0.1438	-0.5708***	-0.5003***	-0.5819
	G				**1.000**	-0.5071	-0.2472	-0.5952	-0.4944	-0.1448	-0.6109	-0.5208	-0.5890
PH	P					**1.000**	0.6525***	0.8210***	0.3377***	-0.0508	0.6529***	0.4433***	0.6040
	G					**1.000**	0.6699	0.8334	0.3462	-0.0510	0.7037	0.4574	0.6064
EH	P						**1.000**	0.5300***	0.1907*	0.0401	0.4786***	0.3756***	0.4114
	G						**1.000**	0.5383	0.2006	0.0392	0.5237	0.4000	0.4260
EL	P							**1.000**	0.5352***	0.1282	0.7327***	0.5225***	0.7255
	G							**1.000**	0.5521	0.1345	0.7933	0.5382	0.7403
EG	P								**1.000**	0.7022***	0.5168***	0.5213***	0.8109
	G								**1.000**	0.7302	0.5564	0.5470	0.8260
KRE	P									**1.000**	0.2060*	0.2425*	0.5182
	G									**1.000**	0.2206	0.2638	0.5383
KPR	P										**1.000**	0.3129***	0.6550
	G										**1.000**	0.3377	0.7030
100GW	P											**1.000**	0.7729
	G											**1.000**	0.7965

* Significance at 0.05, ** significance at 0.01 and *** significance at 0.005

Table 2 phenotypic and genotypic path coefficient analysis for traits

Character		DT	DS	ASI	DM	PH	EH	EL	EG	KRE	KPR	100GW	GY
DT	P	**-0.5336**	-0.5280	0.2017	-0.4328	0.2358	0.0760	0.3198	0.3274	0.1226	0.3293	0.2381	-0.6041
	G	**-1.7364**	-1.7220	0.7055	-1.4211	0.7719	0.2557	1.0524	1.0895	0.4130	1.1543	0.7948	-0.6082
DS	P	0.5839	**0.5901**	-0.1494	0.4812	-0.2487	-0.0808	-0.3386	-0.3480	-0.1153	-0.3478	-0.2592	-0.5758
	G	1.7823	**1.7972**	-0.5232	1.4802	-0.7609	-0.2541	-1.0468	-1.0858	-0.3612	-1.1447	-0.8116	-0.5797
ASI	P	0.0355	0.238	**-0.0939**	0.0185	-0.0206	-0.0098	-0.0315	-0.0415	-0.0374	-0.0365	-0.0152	0.3866
	G	0.1099	0.0788	**-0.2706**	0.0593	-0.0654	-0.0281	-0.0967	-0.1294	-0.1187	-0.1195	-0.0489	0.4237
DM	P	-0.0041	-0.0041	0.0010	**-0.0050**	0.0025	0.0012	0.0029	0.0024	0.0007	0.0029	0.0025	-0.5819
	G	0.0230	0.0232	-0.0062	**0.0281**	-0.0143	-0.0070	-0.0167	-0.0139	-0.0041	-0.0172	-0.0147	-0.5890
PH	P	-0.0779	-0.0743	0.0388	-0.0883	**0.1763**	0.1150	0.1447	0.0595	-0.0090	0.1151	0.0781	0.6040
	G	-0.0492	-0.0468	0.0268	-0.0561	**0.1107**	0.0741	0.0922	0.0383	-0.0056	0.0779	0.0506	0.6064
EH	P	0.0108	0.0104	-0.0079	0.0185	-0.0496	**-0.0760**	-0.0403	-0.0145	-0.0030	-0.0364	-0.0286	0.4114
	G	0.0171	0.0164	-0.0121	0.0287	-0.0778	**-0.1161**	-0.0625	-0.0233	-0.0045	-0.0608	-0.0464	0.4260
EL	P	-0.0456	-0.0436	0.0255	-0.0447	0.0624	0.0403	**0.0760**	0.0407	0.0097	0.0557	0.0397	0.7255
	G	-0.0149	-0.0143	0.0088	-0.0146	0.0205	0.0132	**0.0245**	0.0136	0.0033	0.0195	0.0132	0.7403
EG	P	-0.1880	-0.1807	0.1353	-0.0468	0.1034	0.0584	0.1639	**0.3063**	0.2151	0.1583	0.1597	0.8109
	G	-0.1925	-0.1854	0.1467	-0.1517	0.1062	0.0616	0.1694	**0.3068**	0.2240	0.1707	0.1678	0.8260
KRE	P	-0.011	-0.0349	0.0712	-0.0257	-0.0091	0.0072	0.0229	0.1255	**0.1787**	0.0368	0.0433	0.5182
	G	-0.0397	-0.0335	0.0732	-0.0241	-0.0085	0.0065	0.0224	0.1218	**0.1667**	0.0368	0.0440	0.5383
KPR	P	-0.1483	-0.1416	0.0934	-0.1371	0.1569	0.1150	0.1760	0.1242	0.0495	**0.2403**	0.0752	0.6550
	G	-0.2756	-0.2640	0.1831	-0.2532	0.2917	0.2171	0.3288	0.2307	0.0915	**0.4145**	0.1400	0.7030
100GW	P	-0.1959	-0.1929	0.0710	-0.2197	0.1947	0.1649	0.2294	0.2289	0.1065	0.1374	**0.4391**	0.7729
	G	-0.2324	-0.2293	0.0917	-0.2644	0.2322	0.2031	0.2733	0.2777	0.1339	0.1715	**0.5077**	0.7965

DT: days to 50% tasseling, DS: days to 50% silking, ASI: anthesis silking interval, DM: days to maturity, PH: plant height, EH: ear height, EL: ear length, EG: ear girth, KRE: number of kernel rows per ear, KPR: number of kernels per row, 100GW: hundred grain weight, GY: grain yield