Original Research Article

CORRELATION AND PATH COEFFICIENT ANALYSIS OF GRAIN YIELD AND YIELD RELATED TRAITS IN MAIZE (*Zea mays* L.)

ABSTRACT

Based on field experiment carried out at --------------------mean performance of 31 genotypes of maize were worked out. The results revealed that Grain yield per plant was highest in case of, MAKKA-3 (111.60 g), MGC-240 (85.33 g) and GP (84.17 g) genotypes. On the basis of Analysis of variance, significant difference was recorded for all the grain yield and its components indicating presence of large amount of variability in the genotypes. High GCV and PCV, high heritability was recorded in 100 grain weight and cob weight. Cob weight and 100 grain weight are highly and significantly correlated with grain yield in genotypic and phenotypic correlation. genotypic path analysis revealed that cob weight, 100 grain weight, number of rows per cob, cob length, days to 75% maturity, number of grains per row, ear height, in phenotypic path results shown that cob weight, 100 grain weight, number of grain rows per cob, number of grains per row, days to 75% maturity, ear height, highest direct effect on grain yield. It indicates true relationship between these traits and direct selection for these traits will be rewarding for yield improvement.

Key Words: Maize (*Zea mays* L.), Genetic variability, Heritability, Genetic advance, Genotypic correlation, Phenotypic correlation, Genotypic path analysis and Phenotypic path analysis.

INTRODUCTION

Maize (*Zea mays* L.) is a C4 plant that belongs to the family Graminaceae with chromosome number (2n-2x=20). It is an important cereal crop with wider adaptability under varied agro-climatic conditions. It is known as queen of cereals due to its high genetic potential. About 9000 years ago maize originated through a 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 grown in temperate, subtropical and tropical regions of the world. 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 (Downswell et al., 1996).

It can be grown throughout the year, due to availability of thermo and photo insensitive varieties. Usually three crops of maize, viz. Kharif, rabi and spring are grown in the country. It requires adequate moisture and warmth from sowing to end of flowering. The optimum temperature requirement for germination is 21°C; while for growth it is 32° C.

Maize is a tall, deep-rooted, warm weather and annual grass. A single long stalk will develop from seed. Long smooth leaves are attached at 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 termed as tassel. The male flower emerges few days ahead of silk emergence, the condition commonly known as protandry. The pollen is windblown and comes in contact with the emerging silks of the same or different plant imparting 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 million tonnes which is still far below the world average 5.1 tons/ha

(Department of Agriculture Cooperation, 2020). So the present study was undertaken with following objectives:

1. To evaluate thirty-one germplasms for yield and yield contributing characters
2. To study the character association between maize germplasm for yield and yield attributing traits.
3. To study direct and indirect effects of different characters and to provide information on actual contribution of traits on seed yield

MATERIALS AND METHODS

The current study includes forty-five genotypes of maize in *rabi*-2021 at SHUATS, Prayagraj's experimentation centre of Genetics and Plant Breeding. the experiment was conducted in a randomised complete block design with three replications, with the indicated packages and practises for a healthy crop included. observations were recorded on 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) and Grain yield per plant (g). As per established methods, data were statistically analysed to determine 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 (1953)** 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).**

The 31 Genotypes were collected from **(Source Professor Jaya Shankar Telangana State Agriculture University, Hyderabad).**

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 forty-five 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 (45.70 and 39.03), ear height (22.91 and 21.02), Number of grains per row (19.09 and 11.82), 100 grain weight (15.34 and 3.30), Plant height (14.52 and 12.03), Number of grain rows per cob (12.02 and 8.02), Cob length (10.51 and 4.48), Days to 50% tasselling (9.65 and 8.59), Tassel length (7.90 and 3.98), Days to 50% silking (6.23 and 3.59) and Days to 75% maturity (2.36 and 1.96). Similar findings were reported by **Khan *et al.* (2018), Shankar *et al.* (2018), Tedesse *et al*. (2019) and Khulbe *et al*. (2020)**. 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 indicates 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 61.6 percent to 90.2 percent. 100 grain weight (72.90), Ear height (61.00). 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 **Supraja *et al.* (2019) and Mohammed *et al.* (2020)**.

High genetic advance was recorded for Grain yield per plant (31.89), Cob weight (22.86), Ear height (17.11). Similar findings were reported by **Al-Amin *et al*. (2019) and Khulbe *et al*. (2020).**

High genetic advance as percent mean was recorded for Grain yield per plant (68.67), Cob weight (37.38) and Ear height (28.81). Similar findings were reported by **Shankar *et al.* (2018), Supraja *et al.* (2019) and Khulbe *et al.* (2020)**.

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 31 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 (0.8958**,0.6974**), 100 grain weight (0.8496**,0.7183**), no.of grain rows per cob (0.7338**,0.6083**), cob length (0.6941**,0.5735**), days to 75% maturity (0.4896**,0.4129**), no.of grains per row (0.4672**,(0.4638**), ear height (0.4470**,0.3813**). are positively and significantly correlated with grain yield per plant in both genotypic and phenotypic correlation. Similar findings were reported by **Varalakshmi *et al.* (2018), Barrtaula *et al.* (2019) and Dash *et al.* (2020).**

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 12 different quantitative characters. In genotypic Cob weight (0.8958**), 100 grain weight (0.8496**), Number of grain rows per cob (0.7338**), Cob length (0.6941**), Days to 75% maturity (0.4896**), Number of grains per row (0.4672**), Ear height (0.4470**). Similar findings were reported by **Sharma RK *et at.*, (1987), Kumar S *et al.*, (2006) Hemavathy AT *et al.*, (2008) Gazal A *et al.*, (2018)**

In Phenotypic 100 grain weight (0.7183**), Cob weight (0.6974**), Number of grain rows per cob (0.6083**), Cob length (0.5735**), Number of Grains per row (0.4638**), Days to 75% maturity (0.4129**), Ear height (0.3813**). Similar findings were reported by **Sharma RK *et at.*, (1987), Kumar S *et al.*, (2006) Hemavathy AT *et al.*, (2008) Gazal A *et al.*, (2018), Sood BC *et al.*, (2006), Ulaganathan V et al., (2015).**

CONCLUSION:

1. Among thirty-one genotypes MAKKA-3 (111.60 gm), MGC-240 (85.33 gm), GP (84.17 gm), are the superior lines.
2. Grain yield per plant, cob weight had shown High GCV and PCV, high heritability recorded in Grain yield per plant, Ear height. Cob weight, 100 grain weight are highly and significantly correlated with grain yield in genotypic and phenotypic correlation.
3. Genotypic path analysis revealed that cob length, ear height, in phenotypic path results shown that cob weight,100 grain weight has highest direct effect on grain yield.
4. Therefore, these characters should be given previously during selection for yield improvement in maize

REFERENCES

Matsuoka H, et al. (2002) Single-cell viability assessment with a novel spectro-imaging system. *J Biotechnol* 94(3):299-308

Abdelmula, A. A. and Sabiel, S. A. I. (2007) Genotypic and differential responses of growth and yield of some maize (*Zea mays* L.) genotypes to drought stress. *International Conference on Impact of Agricultural Research* **1**: 1-6.

Abhirami, S., Vanniarajan, C. and Amrugachamy, S. (2005) Genetic variability studies in Maize (*Zea mays* L.) germplasm. *Plant Archieves.* **5** (1): 105-108.

Agriculture at a Glance - DAC&FW (2020) *Department of Agriculture, Cooperation and Farmer's Welfare, Ministry of Agriculture, GOI, India.*

Ahmad, S. Q., Khan, S., Ghaffar, M. and Ahmad, F. (2011) Genetic diversity analysis for yield and other parameters in Maize (*Zea mays* L.) genotypes. *Asian Journal of Science.* **3** (5): 385-388.

Al-Amin, Md., Azad, A. K. Md., Shovon, S. R. and Haque, F. (2019) Genetic variability and character association in Maize (*Zea mays* L.) inbred lines. *Turkish Journal of Agriculture-Food Science and Technology*. **7** (8): 1125-1131.

Al-Jibouri, H. A., Miller, P. A. and Robinson, H. F. (1958) Genotypic and environmental variation and correlation in upland cotton cross of interspecies origin. *Agronomy Journal*. **50**: 633-637.

Allard, R. W. (1960) Principles of Plant Breeding. *John Wiley and Sons Inc. New York.* 185 p.

Arun, K. S., Mishra, S. P. and Roshan, P. (2015) Studies on genetic variability parameters on grain yield and its yield attributing traits in Maize (*Zea mays* L.) *International Journal of Current Microbiology and Applied Sciences.* ISSN: 2319-7706, **7** (9).

Awasthi, R. N., Singh, H. C., Tripathi, Mishra, D. K. and Shukla, N. S. (2009) Genetic variability and selection parameters in Fodder Maize (*Zea mays* L.). *Range Management and Agroforestry.* **30** (1): 59-61.

Burton, G. W. (1952) Quantitative inheritance in grasses. *Proceedings of 6th Intern, Grasslands Congress.* **1**: 277-283.

Burton, G. W. and Devane, E. H. (1953) Estimating heritability in tall fescue (*Festuca arundinaceae*) from replicated clonal material. *Agronomy Journal.* **51**: 515-518.

Dewey, D. R. and Lu, K. H. (1959) A correlation and path coefficient analysis of component of crested wheat grass seed production. *Agronomy Journal.* **51** (2): 515-518.

Fisher, R. (1918) The correlation between relatives on the supposition of Mendelian Inheritance. *Transactions of the Royal Society of Edinburgh.* **52**: 399-433.

Gazal A, Dar ZA, Lone AA, Yousuf N, Gulzar S. (2018) Studies on maize yield under drought using correlation and path coefficient analysis. *International Journal of Current Microbiology and Applied Sciences.* **7**(1):516-521.

Hemavathy AT, Balaji K, Ibrahim SJ, Anand G, Deepa S. (2008) Genetic variability and correlation studies in maize (Zea mays L.). *Agricultural Science Digest.* **28**(2): 112-114.

Johnson HW, Robinson HF, Comstock RE. **(1955)** Genotypic and phenotypic correlations in soybeans and their implication in selection. *Agronomy Journal*. **47**:477-483.

Khan, A. S., Ullah, H., Shahwar, D., Fahad, S., Khan, N., Yasir, M., Wahid, F., Adnan, M. and Noor, M. (2018) Heritability and correlation analysis of morphological and yield traits in maize. *Journal of Plant Biology and Crop Research.* 2: 1008.

Khulbe, R. K., Sharma, D., Pattanayak, A. and Kant, L. (2020) Genetic variability, association and contribution of different characters towards grain yield in sweet corn (*Zea mays* var. saccharata) in North Western Hills. *Indian Journal of Hill.* **33**(2) 254- 260.

Kumar S, Shahi JP, Singh J, Singh SP. (2006) Correlation and path analysis in early generation inbreds of maize (*Zea mays* L.). *Crop Improvement.* **33**(2):156- 160.

Lush JL. **(1947)** Heritability off quantitative characters in farm animals. Proc. *Amer. Soc. Animal Prod.* **35**:293-301.

Mohammed, A. Md., Omer, A. Md., Abdalla, G. Md., Kamaleldin, A. M. A. T. and Ahmed, E. M. M. (2020) Genetic variability, heritability and genetic advance estimates in some Maize (*Zea mays* L.) Varieties in Sudan. *International Journal of Food Science and Agriculture.* **5**(1): 85-90.

Mushtaq MA, Bajwa MM, Saleem M. (2013) Estimation of genetic variability and path analysis of grain yield and its components in chickpea (*Cicer arietinum* L.). International Journal of Science and Engineering Research. **4**(1):1-4.

Shankar, M., Singh, R. and Shahi, J. P. (2018) Studies on genetic variability, heritability and genetic advance in maize (*Zea mays* L.) for yield and its components. *Maize Journal.* **7**(1): 23-26.

Sharma, J. R. (1988) Statistical and biometrical techniques in plant breeding. New age international (Pvt) Ltd., New Delhi. Reprint: 2008: P. 35.

Sharma RK, Kumar S. (1987) Association analysis for grain yield and some quantitative traits in popcorn. Crop Improvement. **14**(2):201-204.

Shikha, B., Manpreet, J. and Ramanjit, K. (2019) Nutritive value of Maize. *Maize – Production and Use, IntechOpen.* 1-14.

Sood BC, Khajuria V. (2006) Genetic and anatomical characterization of land races of maize (*Zea mays* L.) for lodging and yield related traits. *Indian Journal of Genetics.* **66**(4):337-338.

Supraja, V., Sowmya, H. C., Kuchanur, P. H. and Kisan, B. (2019) Genetic variability and character association studies in maize (*Zea mays* L.) inbred lines. *International Journal of Current Microbiology and Applied Sciences.* **8**(10): 646-656

Tedesse, J. and Leta, T. (2019) Association and path coefficient analysis among grain yield and related traits in Ethiopian maize (*Zea mays* L.) inbred lines. *African Journal of Plant Science.* **13**(9): 264-272.

Ulaganathan V, Ibrahim SM, Gurusamy A. (2015) Path analysis studies in maize genotypes. Ecology, *Environment and Conservation.* **2**(21):909-913.

Varalakshmi, S., Wali, M. C., Deshpande, S. K. and Harlapur, S. I. (2018) Correlation and Path coefficient analysis in single cross hybrids in maize. *International Journal ofCurrent Microbiology and Applied Sciences.* **7**:1840-1843.

Wright S. (1921) Correlation and causation. *Journal of Agriculture Research.* **20**:557-587.

Table 1: Analysis of variance for 12 quantitative characters of 31 Maize genotypes.

S.No.	source	Replication	Genotypes	Error
	Degrees of freedom (df)	2	30	60
1	**Days to 50% tasselling**	7.11	16.321**	8.12
2	**Days to 50% silking**	3.18	49.645**	10.91
3	**Plant height (cm)**	29.345	119.954**	21.46
4	**Ear height (cm)**	7.295	4.676**	5.98
5	**Tassel length (cm)**	15.09	4.952**	0.48
6	**Days to 75% maturity**	100.18	71.34**	14.56
7	**Cob weight (g)**	7.29	22.109**	1.19
8	**Cob length (cm)**	9.325	3.339**	6.28
9	**Number of grain rows per cob**	28.145	23.485**	0.09

10	**Number of Grains per row**	24.3825	4.841**	0.24
11	**100 grain weight (g)**	32617.14	33.508**	0.34
12	**Grain yield per plant (g)**	7.0435	170.771**	24.78

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

Table 2: Genetic parameters for 12 quantitative characters in Maize genotypes

TRAITS	GCV	PCV	Heritability (Broad sense) %	GA 5%	GAM 5%
Days to 50% tasselling	8.59	9.65	12.90	1.63	1.44
Days to 50% silking	3.59	6.23	40.90	2.26	1.94
Plant height (cm)	12.03	14.52	35.12	1.14	0.75
Ear height (cm)	21.02	22.91	61.00	17.11	28.81
Tassel length (cm)	3.98	7.90	20.69	0.38	1.17
Days to 75% maturity	1.96	2.36	16.50	1.23	0.80
Cob weight (gm)	23.72	31.00	58.50	22.86	37.38
Cob length (cm)	4.48	10.51	18.20	0.48	3.94
Number of grain rows per cob	8.02	12.02	44.50	1.31	11.02
Number of Grains per row	11.82	19.09	38.30	2.76	15.06
100 grain weight (gm)	3.30	15.34	14.58	0.46	1.46
Grain yield per plant (gm)	39.03	45.70	72.90	31.89	68.67

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

TRAITS		Days to 50% tasselling	Days to 50% silking	Plant height (cm)	Ear height (cm)	Tassel length (cm)	Days to 75% maturity	Cob weight (gm)	Cob length (cm)	Number of grain rows per cob	Number of Grains per row	100 grain weight (gm)	Grain yield per plant (gm)
Days to 50% tasselling	G	1.0000**	0.9856**	-0.0648	0.3388	-0.9617**	0.2822	-0.2691	-0.3652*	-0.7423**	-0.6445**	-0.4536**	-0.1616
	P	1.0000**	0.7382**	-0.1796	-0.1053	-0.4563**	0.0126	0.0787	-0.6453**	-0.238	-0.072	-0.3591*	-0.0126
Days to 50% silking	G		1.0000**	0.2559	-0.2348	-0.8691**	0.3085	-0.5547**	0.2336	-0.5852**	-0.6545**	-0.5731**	-0.3807**
	P		1.0000**	-0.1013	-0.1533	-0.4521**	0.2196	-0.3562*	-0.1001	-0.3863**	-0.1122	-0.18	-0.3126
Plant height (cm)	G			1.0000**	-0.8456**	-0.1349	0.9154**	-0.7196**	-0.4532**	-0.8419**	-0.6482**	-0.8921**	-0.6491**
	P			1.0000**	-0.5629**	0.0561	-0.1041	0.0219	0.1095	0.0726	0.1027	0.104	-0.5489**
Ear height (cm)	G				1.0000**	-0.9828**	-0.5407**	0.4649**	0.4816**	0.3151	0.6667**	0.7057**	0.4470**
	P				1.0000**	-0.4862**	-0.116	0.3232	0.3963**	0.188	0.2916	0.2551	0.3813**
Tassel length (cm)	G					1.0000**	-0.6457**	0.5694**	0.6562**	0.7518**	1.068	-0.8064**	0.0382
	P					1.0000**	-0.1609	-0.1141	0.3812**	0.1288	-0.0095	0.0068	-0.028
Days to 75% maturity	G						1.0000**	-0.4008**	0.064	-0.7317**	0.0916	-0.5062**	0.4896**
	P						1.0000**	-0.3128	0.0259	-0.1805	-0.0206	-0.0034	0.4129**
Cob weight (gm)	G							1.0000**	0.5321**	0.7145**	0.6522**	0.8660**	0.8958**
	P							1.0000**	0.3963**	0.4645**	0.2837	0.0881	0.6974**
Cob length (cm)	G								1.0000**	0.1938	0.5492**	0.7968**	0.6941**
	P								1.0000**	0.1118	0.0335	0.1568	0.5735**
Number of grain rows per cob	G									1.0000**	0.4415**	0.8193**	0.7338**
	P									1.0000**	0.2288	0.1434	0.6083**
Number of Grains per row	G										1.0000**	0.3769*	0.4672**
	P										1.0000**	0.0769	0.4638**
100 grain weight (gm)	G											1.0000**	0.3769*
	P											1.0000**	0.7183**
Grain yield per plant (gm)	G												1.000
	P												1.000

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

G*: genotypic correlation, P*: phenotypic correlation

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	Plant height (cm)	Ear height (cm)	Tassel length (cm)	Days to 75% maturity	Cob weight (gm)	Cob length (cm)	Number of grain rows per cob	Number of Grains per row	100 grain weight (gm)	Grain yield per plant (gm)
Days to 50% tasselling	G	**-0.96**	-1.1677	0.0622	-0.3253	0.9232	-0.2709	0.2583	0.3506	1.0686	0.6187	0.4354	-0.1616
	P	**-0.0224**	-0.005	0.004	0.0024	0.0061	-0.0003	-0.0018	0.0039	0.0053	0.0016	0.0012	-0.0126
Days to 50% silking	G	-1.4444	**-1.1874**	-0.3039	0.2788	1.032	-0.3663	0.6586	-0.2774	0.6949	0.7772	0.6805	-0.3807**
	P	0.0191	**0.0857**	-0.0087	-0.0131	0.0044	0.0188	-0.0249	-0.0086	-0.0245	-0.0096	-0.0154	-0.3126
Plant height (cm)	G	-0.0224	0.0884	**0.3456**	-0.4601	-0.0466	0.3164	-0.2487	-0.9067	-0.2909	-0.7429	-1.7881	-0.6491**
	P	-0.0167	-0.0094	**0.0932**	0.0305	0.0052	-0.0097	0.002	0.0102	0.0068	0.0096	0.0097	-0.5489**
Ear height (cm)	G	0.4192	-0.2905	-1.6471	**1.2371**	-1.2159	-0.6689	0.5751	0.5958	0.3899	0.8247	0.873	0.4470**
	P	0.0081	0.0118	-0.0252	**-0.0769**	-0.0063	0.0089	-0.0249	-0.0169	-0.0145	-0.0224	-0.0196	0.3813**
Tassel length (cm)	G	-0.0363	-0.0328	-0.0051	-0.0371	**0.0377**	-0.0244	0.0215	0.0247	0.0284	0.0403	-0.0304	0.0382
	P	0.0018	-0.0001	-0.0001	-0.0002	**-0.0024**	0.0004	0.0003	-0.0002	-0.0003	0.0048	0.0045	-0.028
Days to 75% maturity	G	-0.1625	-0.1776	-0.527	0.3113	0.3717	**-0.5757**	0.2307	-0.0368	0.4212	-0.0527	0.8984	0.4896**
	P	-0.0019	-0.033	0.0156	0.0174	0.0242	**-0.1503**	0.0081	-0.0039	0.0271	0.0031	0.0005	0.4129**
Cob weight (gm)	G	-0.2318	-0.4779	-0.62	0.4005	0.4905	-0.3453	**0.8615**	0.4584	0.6155	0.5619	0.746	0.8958**
	P	0.0511	-0.1891	0.0142	0.2099	-0.0741	-0.035	**0.6494**	0.0811	0.3017	0.1842	0.0572	0.6974**
Cob length (cm)	G	-0.802	0.5131	-5.7618	1.0577	1.441	0.1406	1.1685	**2.1961**	0.4256	1.2062	2.3212	0.6941**
	P	-0.0087	-0.005	0.0055	0.0109	0.0043	0.0013	0.0062	**0.0499**	0.0056	0.0017	0.0078	0.5735**
Number of grain rows per cob	G	1.653	0.869	1.2501	-0.468	-1.1164	1.0866	-1.061	-0.2878	**-1.485**	-0.6557	-1.2166	0.7338**
	P	-0.0298	-0.0359	0.0091	0.0236	0.0161	-0.0226	0.0582	0.014	**0.1253**	0.0287	0.018	0.6083**
Number of Grains per row	G	1.2848	1.3048	4.2858	-1.329	-2.1292	-0.1825	-1.3002	-1.0949	-0.8802	**-1.9935**	-0.7513	0.4672**
	P	-0.0028	-0.0043	0.0039	0.0111	-0.0004	-0.0008	0.0108	0.0013	0.0087	**0.0382**	0.0029	0.4638**
100 grain weight (gm)	G	0.1407	0.1778	1.605	-0.2189	0.2502	0.4841	-0.2686	-0.3279	-0.2542	-0.1169	**-0.3102**	0.8496**
	P	-0.0028	-0.0043	0.0039	0.0111	-0.0004	-0.0008	0.0108	0.0013	0.0087	**0.0382**	0.0029	0.4638**

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

fig 1 Genotypic path diagram for grain yield per plant

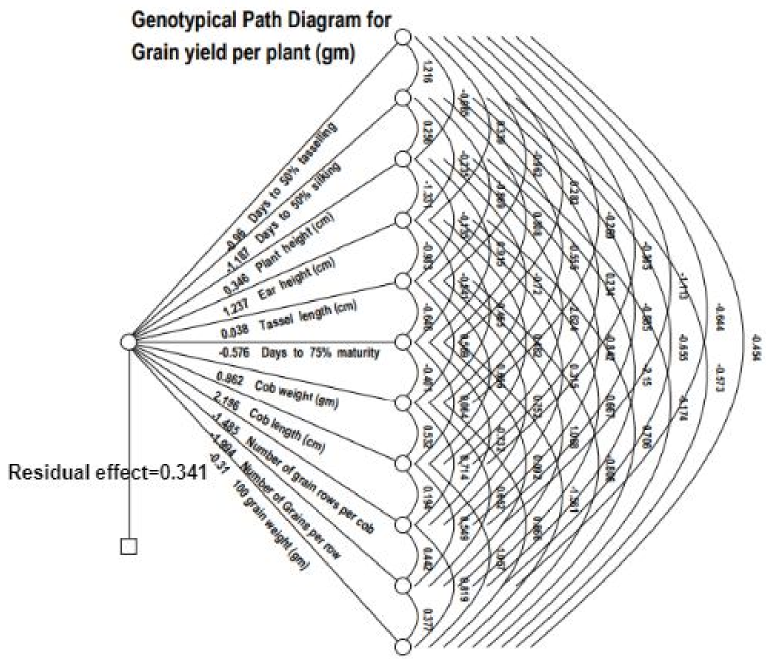

fig.2 Phenotypic path diagram for grain yield per plant