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GENETIC PARAMETERS OF VARIABILITY IN MAIZE (*ZEA MAYS* L.) VARIETIES FOR GROWTH AND YIELD TRAITS

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ABSTRACT

The present study was carried out in *rabi* season in 2023 at agricultural farm department of genetics and plant breeding Lovely professional university, Jalandhar, Punjab in randomized block design with three replication and data were recorded on various yield and yield components to estimate variability and genetic parameter among 28 maize genotypes (*Zea mays* L.) for eleven yield and yield attributing characters There all treatments are highly significance were the biggest error being found in grain yield per plant and the lowest error found in ear girth respectively. Moderate estimates of coefficients of variation were recorded for Plant height followed by ear height, ear length, number of kernels per row, ear girth Grain yield per plant and number per kernels per ear. The heritability estimates were found to be high (more than 60 percent) for 100 kernel weight followed by ear height plant height ear length number of kernels per row ear girth grain yield per plant Number of kernels per ear days to maturity Days to 50% silking and Days to 50% tasseling. As well high genetic advance as percent of mean was recorded for 100 kernel weight followed by Plant height, ear height, ear length, number of kernels per row ear girth, grain yield per plant, number of kernels per ear days to maturity, days to 50 % silking, and days to 50 % tasseling. That all research to conclude that a Green farm, Hybrid makka 1 as well bajaura popcorn are significantly better performance that's why those are used to early mature variety for breeding programme as well high yield better parents are considering to this research Hybrid makka 1, Hemma NAH 1137to bee better all of listed genotypes Therefore, the traits number of grains per row, ear length, ear girth and 100-grain weight could be considered as the major yield contributing characters in maize and hence, emphasis should be made on these traits in the selection programme to evolve high yielding genotypes in maize.
Keywords**:** variability, maize, variation, heritability, genetic advance.

Introduction

Maize (*Zea mays* L. 2n = 20) is the third most important cereal grain in the world after wheat and rice. Maize is believed to be originated in Gautemala and Southern Mexico. Most researchers believed that the progenitor of cultivated maize is teosinte. Maize belongs to Family Poaceae and Genus Zea. Globally maize covers an area of 159 million hectares with a production of 796.46 million tonnes (USDA, 2010) and in India maize occupies an area of 7.27 million hectares with a production of 15.86 million tonnes and productivity of 2181 kg ha-1 (Ministry of Agriculture, 2011 - 12). In Andhra Pradesh, it covers an area of 7.44 lakh hectares with a production of 39.53 lakh tonnes and productivity of 5317 kg ha^{-1}. Among the major maize producing states, Andhra Pradesh tops the list with a contribution of 21% to the total Indian maize production followed by Karnataka (15.4%) and Rajasthan (14%) (MOA, Agriculture statistics at a glance, 2010).

Though maize has been used as a staple food crop, now it is gaining importance as livestock feed. Also, due to the high yield potentiality, versatile uses like the grain, leaves, stalks, tassel and can be used to produce a large variety of food and non-food products and provides nutrients for humans and animals and serves as a basic raw material for the production of starch, oil and protein alcoholic beverages, food sweeteners and more recently fuel. Almost year-round growth ability and higher per acre yield than the other cereals, area and production of maize is increasing day by day in the state as well as in the country. Though, many synthetics and composites have contributed to maize production in India in the initial stages of maize improvement programme, of late, hybrids are playing a vital role due to their high yielding potential.

Maize research in India has started during late 1950's and was hybrid oriented till mid-seventies. Later, due to late maturity of hybrids and lack of productive and vigorous inbred lines, population improvement programme started leading to development of synthetics and composites. But again, since a decade or two, hybrid breeding programmes are receiving greater importance. Since the hybrids are more uniform, early maturing, productive and more importantly because of population improvement programme, the productive inbred lines are available. Now a day's great advancement has been achieved in maize production, but this is not sufficient to meet the challenge which led upon on us due to opening of our agriculture mark*et al*ong with changing food behaviour of large population. Though many constraints are still confronting which creates a challenging job for the researcher. With the introduction of heterosis concepts in maize by Shull (1952) there has a breakthrough in yield of this crop. Hence it may be viewed with optimism that there is wide scope for further yield improvement and breaking the yield plateau in India through appropriate genetic manipulation, but the choice of appropriate genotypes is of great concern.

Thus, utmost requirement of any breeding programme is genetic variability. It is the most essential pre-requisite for successful improvement through conventional and advanced breeding techniques. The genetic improvement of crop species to improve the production and productivity through selection strategies are chiefly influenced by the choice of germplasm. Variability refers to the presence of difference among the individuals of plant population. Variability results due to difference either in the genetic constitution of the individuals of a population or in the environment in which they are grown. The existence of variability is essential for resistance to biotic and abiotic factors as well as for wide adaptability. Selection is also effective when there is genetic variability among the individuals in a population. 16 Hence, insight into the magnitude of genetic variability present in a population is of paramount importance to a plant breeder for stating a judicious breeding programme.

Knowledge of heritability and genetic advance of the character indicate the scope for the improvement through selection. Heritability estimates along with genetic advance are normally more helpful in predicting the gain under selection then heritability estimates alone. However, it is not necessary that a character showing high heritability will also exhibit high genetic advance (Johnson *et al*., 1955). The present research was conducted to estimate genetic variability among seed yield and its components.

Materials and Methods

The experiment was conducted out under school of agriculture research farm, Department of genetics and plant breeding, Lovely Professional University, Jalandhar, Punjab. Experimental site is located under Kapurthala district. The experiment was conducted with twenty-eight genotypes with a three replication and those conducted experiment was designed using a randomized complete block design (RCBD). Observations on yield and yield attributing characters were recorded, leaving border plants in each replication. In each plot, five randomly selected competitive plants were tagged to record observations except for days to 50% tasselling and days to maturity which were recorded on plot basis.

In the present study 28 genotypes of the maize (*Zea mays* L.) cultivars as the material was used those are collected from the department of genetics and plant breeding, Lovely professional university, Jalandhar, Punjab and used cultivars for experiment tabulated in Table 1.

Table 1: List of genotypes used in present investigation

Sr. No.	Genotypes	Sr. No.	Genotypes
1	Ginija composite	15	Hg 55
2	Bajaura sarutm	16	Hybrid Makka 1
3	Bajaura popcorn	17	Hybrid Makka 22
4	lasty composite	18	Sonmati
5	palam sankar makka 2	19	Greenfarm
6	Him palam	20	Gajraj
7	VI-78	21	Palan shankar
8	Bajaura makka	22	Makka 2 CSK
9	Haryali	23	DKC 9164
10	Cbs 568	24	CP 838
11	Ganga	25	Hemma NAH 1137
12	Green makka	26	Shalimar sweetcorn 1
13	Laxmi	27	Shalimar popcorn 1
14	kranti makka	28	PMH-1

Observations on yield and yield attributing characters were recorded for days to 50 per cent tasseling, days to 50 per cent silking, 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-kernel weight (g), grain yield per plant (g).

The data collected on various morphological characters were subjected to following statistical analysis based on replication mean values. Analysis of variance (Fisher, 1936), Genetic variability (Burton, 1952)- Genotypic Coefficient of Variation (GCV), Phenotypic Coefficient of Variation (PCV), Heritability (Broad sense) (Burton and Devane, 1953), Genetic advance (Johnson *et al.*, 1955).

Result and Discussion

Analysis of variance

The eleven characters which were included in this experiment work showed highly significant differences through the analysis of variance are shown in the Table 2. There all treatments are highly significance were the biggest error being found in grain yield per plant and the lowest error found in ear girth respectively.

Table 2 : Analysis of variance for various quantitative characters in maize

	Replication	Treatments	Error
Source	2	24	54
DFT	7.641	19.921**	7.600**
DFS	2.035	43.179**	13.212**
DM	21.092	135.645**	29.898**
PH	62.761	1348.667	28.856**
EH	41.053	360.665**	7.582**
EL	1.049	12.505**	0.448**
EG	0.283	6.543**	0.420**
NKPE	0.025	7.096**	1.462**
NKPR	4.244	36.477**	1.794**
100-KW	0.883	66.510**	1.000**
GYP	25.092	947.346**	93.263**

DFT-days to 50 per cent tasseling, **DFS** -days to 50 per cent silking, **DM**-days to maturity, **PH**-plant height (cm), **EH-**ear height (cm), **EL**-ear length (cm), **EG**-ear girth (cm), **NKPE** - number of kernel rows per ear, **NKPR** - number of kernels per row, **100-KW** - 100-kernel weight (g), **GYP** -grain yield per plant (g).

Mean performance

The mean performance of 28 maize genotypes evaluated in the present study is presented in Table 3. Days to 50% tasselling ranged from 50.00 to 62.16 days with an overall mean of 55.80 days, where G19 and G25 exhibited the earliest tasselling and BML-6 the latest. A total of 10 genotypes flowered earlier than the overall mean. Days to 50% silking ranged from 54.00 to 68.78 days, with a mean of 57.73 days. G3 was the earliest to silk, while G25 showed the longest duration. Fifteen genotypes silked earlier than the mean. Days to maturity varied from 96.50 to 116.00 days with a mean of 108.58 days. G16 matured earliest, whereas G9 was the latest maturing genotype; 14 genotypes matured earlier than the mean. Plant height ranged from 80.47 cm (G25) to 167.13 cm (G13), with a mean of 122.22 cm; 9 genotypes surpassed this average height. A similar trend was observed for ear height, which ranged from 42.90 cm to 86.23 cm (mean 63.84 cm), again with G25 having the lowest and G13 the highest; 9 genotypes were taller than the average. Ear length ranged from 9.84 cm (5158) to 18.84 cm (CM 131), with a mean of 13.13 cm; 19 genotypes had longer ears than the mean. Ear girth ranged from 9.66 cm (G23) to 15.66 cm (G13), with a mean of 11.79 cm; 7 genotypes showed superior girth. Number of kernel rows per ear ranged from 10.11 (G28) to 16.19 (G16) with a mean of 12.50; 9 genotypes were above this mean. Number of kernels per row ranged from 21.00 (G27) to 31.40 (G9) with a mean of 25.35, where 12 genotypes exceeded the average. 100-kernel weight ranged from 11.67 g (G24) to 29.38 g (G16) with a mean of 19.42 g; 6 genotypes recorded higher kernel weight than the mean. Kernel yield per plant ranged from 106.87 g to a maximum of 198.73 g, with a mean yield of 151.14 g. The lowest yield was recorded in G3, while G4 recorded the highest; 14 genotypes surpassed the average kernel yield

Table 3 : Mean performance of 28 genotypes used in the present study.

	DFT	DFS	DM	PH	EH	EL	EG	NKPE	NKPR	100-KW	GYP
G1	52.8367	57.3333	112.5033	125.78	65.5567	12.7033	11.47	11.9033	30.3333	23.17	149.8967
G2	54.6667	54.3333	114	144.25	79.9033	14.03	12.35	12.8833	30.4	19.67	145.0133
G3	57.8367	54	115	113.85	59.5933	12	10.3033	10.5367	22.33	18.05	106.8667
G4	57.3367	61.8333	114.5033	117.2	61.2667	12.3333	11.49	11.47	23.17	18.17	176.0833
G5	55.5033	61.5	113	124.11	64.7233	11.2	11.68	11.5267	21.27	17.43	171.07
G6	56.6667	57.0167	115	141.87	73.6033	11.33	10.3033	10.6267	22	15.87	143.8667
G7	55.8367	56	113.5033	134	69.6667	11.83	11.5033	11.6133	21.3333	24.69	150.9067
G8	58.6667	68.6267	111.5033	157	81.1667	15.39	13.14	14	21.67	27.25	164.8667
G9	53.3367	63.3233	116	133.3333	69.3333	13.5033	14.6667	13.9433	31.4	17.4	157.8667
G10	54.67	60.16	113	102.2	50.6167	13.23	11.73	11.8067	27.83	12.18	123.2
G11	53	61.4967	112.5033	124.6667	65	12.3333	12.19	11.9233	28.95	16.91	166.5933
G12	51.17	55.3333	111.5033	123.73	64.5333	12.69	10.84	11.4267	26.46	18.59	155.2
G13	56.1667	61.4367	114.5033	167.13	86.2333	17.53	15.6667	15.8833	31	26.62	174.2
G14	61.6667	61.47	114.5033	111.6667	58.5	13.07	10.4	11.3333	26.73	16.41	157.2
G15	55	63.99	115	155.53	80.4333	18.53	10.37	12.9533	31	17.4	155.5333
G16	57	64.7933	96.5033	152.3333	78.8333	18.84	14.87	16.1933	30.3333	29.38	171.2
G17	56.83	59.51	100.5033	111.6667	58.5	12.5033	11.23	13.8	25.3333	15.53	145.0333
G18	55	61.7667	101	127.3333	66.3333	12.3333	10.54	11.29	23.3333	21.3033	157.4967
G19	51	62.9567	102.5033	90.93	48.1333	12.3333	12	12.68	24.3333	22.6	163.74
G20	54.8367	63.1033	100	116.2	60.77	15.18	11.15	13.93	23	16.2	145.0967
G21	58.17	61.67	101.5033	106.8	56.0667	12.6667	11.2	12.18	25.3333	18.47	153.23
G22	55.3367	59.61	97.5033	121.67	63.5033	15.83	13.7033	14.47	22	22.53	163.8667
G23	54.3367	60.6367	102.5033	113.3333	59.3333	11.48	9.66	14.07	22	13.57	122.5333
G24	56.5033	57.28	103.5033	97.47	51.4033	12.41	10.29	12.82	24.3333	11.67	144.9533
G25	62.1667	68.7667	97.75	80.47	42.9033	13.8	11.57	11.47	25.3333	27.53	114.5333
G26	53.8367	61.1467	105	86.33	45.8333	12.6667	12.6667	11.27	23	15.83	132.8667
G27	55.67	61.4033	115.5033	123.07	64.2033	13.33	12	12.07	21	16.2	152.8667
G28	57.1667	66.6267	110.5033	118.3333	61.8333	12.7333	11.28	10.11	24.6667	23.25	166.0367
Mean	55.7933	60.9687	108.5824	122.2234	63.8493	13.4932	11.7951	12.5065	25.3527	19.424	151.1363
C.V.	4.9411	5.9619	5.0358	4.3951	4.3127	4.9606	5.4983	9.6706	5.2836	5.149	6.3898
F ratio	2.6213	3.2682	4.5369	46.7367	47.5668	27.9127	15.5585	4.8512	20.3292	66.492	10.1578
C.D. 5%	4.5128	5.9502	8.9509	8.7935	4.5075	1.0957	1.0616	1.9798	2.1928	1.6372	15.8087

DFT-days to 50 per cent tasseling, **DFS** -days to 50 per cent silking, **DM**-days to maturity, **PH**-plant height (cm), **EH-**ear height (cm), **EL**-ear length (cm), **EG**-ear girth (cm), **NKPE** - number of kernel rows per ear, **NKPR** - number of kernels per row, **100-KW** - 100-kernel weight (g), **GYP** -grain yield per plant (g).

Estimation of genetic parameters

The estimate of coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (h^2) in broad sense and genetic advance as present of mean were estimated for eleven characters and furnished in Table 4 and Fig. 1.

Table 4 : Estimation of genetic parameters

	GCV	PCV	Heritability	Genetic advance
DFT	4.1073	6.6406	61.85	3.2833
DFS	9.9892	14.3932	69.4	5.424
DM	35.2491	45.2153	77.96	10.7987
PH	439.9369	449.5558	97.86	42.7431
EH	117.6945	120.2219	97.9	22.1122
EL	4.0191	4.1685	96.42	4.0552
EG	2.0411	2.1813	93.57	2.8469
NKPE	1.8778	2.3654	79.39	2.5152
NKPR	11.561	12.1591	95.08	6.8299
100-KW	21.8367	22.1702	98.5	9.5537
GYP	284.6945	315.7823	90.16	33.0029

DFT-days to 50 per cent tasseling, **DFS** -days to 50 per cent silking, **DM**-days to maturity, **PH**-plant height (cm), **EH-**ear height (cm), **EL**-ear length (cm), **EG**-ear girth (cm), **NKPE** - number of kernel rows per ear, **NKPR** - number of kernels per row, **100-KW** - 100-kernel weight (g), **GYP** -grain yield per plant (g).

Genotypic and phenotypic coefficient of variance

In the present investigation the highest estimates of coefficients of variation were registered for 100 kernel weights (PCV: 24.06 %; GCV: 24.24 %) are in the decreasing order of their magnitude, indicating the presence of large variation among the genotypes for these characters. Therefore, simple selection can be practiced for further improvement of these characters. These findings agree with the findings of Debnath (1987), Saikia *et al.* (2000), Kumar and Satyanarana (2001), Satyanarayana and Sai Kumar (1996), Singh *et al.* (2003) and Abirami *et al.* (2005) reported high GCV and PCV values for100 kernel weight.

Moderate estimates of coefficients of variation were recorded for Plant height (PCV: 17.16 %; GCV: 17.35 %) followed by ear height (PCV:16.99 %; GCV: 17.17 %), ear length (PCV: 14.86 %; GCV: 15.13 %), number of kernels per row (PCV: 13.41 %; GCV: 13.75 %), ear girth (PCV: 12.11 %; GCV:12.52 %), Grain yield per plant (PCV: 11.16 %; GCV:11.76 %), and number per kernels per ear (PCV: 10.96 %; GCV:12.30 %). These findings agree with the findings of Singh *et al.* (2003) reported moderate PCV values for ear girth, ear length and number of grain rows per ear; for ear girth Manal hefny (2011) reported moderate GCV. Low estimates of coefficients of variation were recorded for days to 50 percent silking (PCV: 7.11 %; GCV: 6.20 %), days to 50 percent tasseling (PCV: 6.74 %; GCV: 5.99 %), days to 50 percent brown husk (PCV: 5.64 %; 75 GCV: 3.15 %) are in the decreasing order of their magnitude indicating the low range of variation found in these characters in the present experimental material, thus offers little scope for further improvement of these characters. A close perusal of genotypic and phenotypic coefficient of variation reveals that the difference between genotypic and phenotypic variability was very less for all the characters studied, which indicates the low effect of environment on the expression of these characters. On an average high to moderate phenotypic coefficient of variation and genotypic coefficient of variation were recorded for anthesis silking interval, grain yield per plant, ear height, harvest index and 100 grain weight suggesting sufficient variability and thus offers scope for genetic improvement through selection of these traits.

Heritability

The estimates of genotypic coefficient of variation (GCV) reflect the total amount of genotypic variability present in material. However, the proportion of this genotypic variability which is transmitted from parents to the progeny is reflected by heritability. Lush (1947) gave the concept of broad sense heritability. It determines the efficiency with which we can utilize the genotypic variability in a breeding programme. The genotypic variance and its components are influenced by the gene frequencies. Because the frequencies of genes differ from one population to another, estimates of heritability also vary from one population to another for a given character. The range of heritability was considered as low (>60%) as proposed by Johnson *et* *al*. (1955). The estimates of heritability from present investigation are presented in Table 4 and Fig. 1.

In the present investigation, the heritability estimates were found to be high (more than 60 percent) for 100 kernel weight (98.5%) followed by ear height (97.9%), plant height (97.86%), ear length (96.42%), number of kernels per row (95.08%), ear girth (93.57%), grain yield per plant (90.16%), Number of kernels per ear (79.39%), days to maturity (77.96%), Days to 50% silking (69.4%) and Days to 50% tasselling (61.85%). Similar results have been reported by Ayala and Churata (1995), Choudhary and Chaudary (2002), Muhammad *et al*. (2008), Tusuz and Balabanli (1997), Sing *et al*. (2003) for grain yield per plant; for plant height by Reddy and Agarwal (1992), Robin and Subramanian (1994) and Chen *et al*. (1996).

Genetic advance

Expected genetic advance as percent of mean indicates the mode of gene action in the expression of a trait, which helps in choosing an appropriate breeding method. The range of genetic advance as per cent of mean was considered as low (<10%), medium (10-20%) and high (>20%) as proposed by Johnson *et al.* (1955). The estimates of genetic advance as percent of mean from present investigation are presented in Table 4. In the present investigation high genetic advance as percent of mean was recorded for 100 kernel weight (49.18%) followed by Plant height (34.97%), ear height (34.63%), ear lengh (30.05%), number of kernels per row (26.94%), ear girth (24.14%), grain yield per plant (21.84%), number of kernels per ear (20.11%), days to maturity (9.95%), days to 50 % silking (8.90%) and days to 50 % tasseling (5.88%).

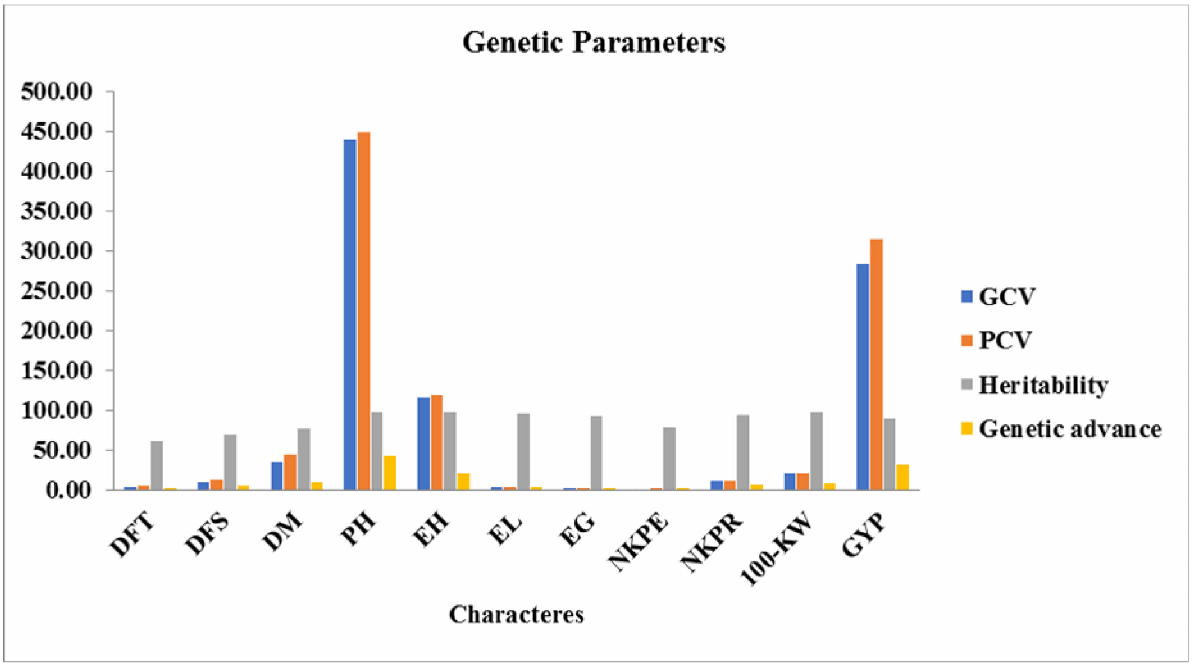

Fig. 1 : Estimation of genetic parameters of maize

Conclusion

There all treatments are highly significance were the biggest error being found in grain yield per plant and the lowest error found in ear girth respectively. Moderate estimates of coefficients of variation were recorded for Plant height followed by ear height, ear length, number of kernels per row, ear girth Grain yield per plant and number per kernels per ear. the heritability estimates were found to be high (more than 60 percent) for 100 kernel weight followed by ear height, plant height, ear length, number of kernels per row, ear girth, grain yield per plant, Number of kernels per ear, days to maturity, Days to 50% silking and Days to 50% tasselling. In the present investigation high genetic advance as percent of mean was recorded for 100 kernel weights followed by Plant height, ear height, ear length, number of kernels per row ear girth, grain yield per plant, number of kernels per ear days to maturity, days to 50 % silking, and days to 50 % tasselling.

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