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Direct selection parameter estimates for yield and its contributing traits in maize (*Zea mays* L.)

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Abstract
Heritability and Genetic advance are the direct selection parameters. Information on such parameters has great importance in enhancing the selection efficiency. Therefore, in the present investigation 77 maize genotypes including 54 F1s, 18 lines, 3 testers and 2 check varieties were evaluated in relation to direct selection parameters for different quantitative traits. All the genotypes showed significant variability for all the characters studied. High values (>20%) of genotypic coefficient of variance (GCV) and phenotypic coefficient of variance (PCV) were recorded for the traits, grain yield per plant, kernels per cob, cob weight and kernels per row. The traits such as seed vigour index, seedling length, cob length, cobs per plant 100-kernel weight, plant height and kernel rows per cob showed moderate values (10-20%) of GCV and PCV. For almost all the traits the values of GCV and PCV were almost similar but for cob diameter GCV was low while PCV was high indicated that all the traits had low environmental influence except cob diameter that had high environmental influence. High estimates of heritability coupled with high estimates of genetic advance as percent of mean were recorded for the traits grain yield per plant, kernels per cob, cob weight, kernels per row, seed vigour index, seedling length, 100-kernel weight, cob length, plant height, cobs per plant and kernel rows per cob. This indicated the role of additive gene effect in the inheritance of these traits; therefore, such traits could be improved through simple selection.

Keywords: Direct selection parameters, heritability, genetic advance, quantitative traits and maize (*Zea mays* L.)

Introduction
Maize (*Zea mays* L.) is one of most important cereal crops, which ranks third after wheat and rice in the world. It's a versatile crop which provides food for humans, feed for animals particularly poultry and livestock. Population improvements of a crop is the primary objective of a plant-breeding program. However, the success of any breeding programme depends upon the existing variability in the population and the proportion of variability which has high transmissibility from parents to their offspring. Heritability is one of the most important direct selection parameters which determines whether the phenotypic differences observed among the various individuals are due to differences in their genetic make-up or simply the result of environmental factors. Robinson *et al*., 1949 [17] emphasized the importance of heritability in efficient selection strategy. Taking above pints under consideration the present investigation was carried out to find out the estimates of direct selection parameters for yield and its contributing traits.

Materials and Methods
The experimental material for this study consists of 54 F1s (obtained through the crossing of 18 lines (females) with 3 testers (males) in line x tester design during *Kharif* 2018), 18 lines (females), 3 testers (males) and 2 check varieties. All the seventy-seven treatments were evaluated at Student Instructional Farm CS Azad University of Agriculture and Technology, Kanpur-208002 (U.P.), India during *Rabi* 2018-19 in Randomized complete block design (RCBD) in one row plots of 4m length with 60x25cm spacing and replicated three times. Observations on plant height, number of cobs/plant, number of kernel rows/cob, number of kernels/row, cob length (cm), cob diameter (cm), cob weight (g), number of kernels/cob,

100-kernel weight (g), grain yield/plant (g) and shelling percentage (%) were recorded on 5 randomly selected plants per entry per replication while, data on days to 50% tasselling, days to 50 % silking, days to 75% dry husk, were recorded on plot basis. Data on germination percentage (%), seedling length (cm) and seed vigour index were recorded by following standard seed laboratory protocols. All the recommended cultural practices were followed to raise a good crop. The mean values of recorded data were used for Analysis of variance for Randomized Complete Block Design (Panse and Sukhatme, 1985) [15], Phenotypic, genotypic, and environmental coefficients of variation for different characters (Burton and de Vane, 1953) [4], heritability in broad sense (h^2b) (Hanson, 1963) [6], the expected genetic advance (Ga) and genetic advance as percent of mean (Johnson *et al.*, 1955) [9].

Result and Discussion

The first requirement of any breeding programme is variability because if there are no variability in the population there will be no chance of selection. However, efficiency of selection depends on such variability which is highly transmissible from parents to their offspring. Thus, finding of heritability estimates for yield and its component traits is much more important. The estimates of heritability alone are unable to provide information regarding to genetic progress in various characters. The estimates of heritability along with genetic advance provide more reliable information regarding to such aspects. It is therefore, necessary to utilize heritability estimates in conjunction with genetic advance which would then indicate the expected genetic gain from the selection.

Analysis of variance for yield and its component traits was done and presented in table 1. All the genotypes showed significant variability for all the characters studied. Significant difference among the genotypes for studied characters have also been reported by Mhoswa *et al*. (2016) [11], Thakur *et al*. (2016) [21], Shengu (2017) [19], Bisen *et al*. (2018) [3], Beulah *et al*. (2018) [2], Bartaula *et al*. (2019) [1], Prakash *et al.* (2019) [16], Ubi *et al.* (2019) [22], Devi (2020) [5], Islam *et al.* (2020) [8] and Taiwo *et al*. (2020) [20]. The estimates of genotype coefficient of variance (GCV) and phenotypic coefficient of variance (PCV) are presented in table 2. High values (>20%) of GCV and PCV were recorded for grain yield per plant, kernels per cob, cob weight and kernels per row. Prakash *et al.*, 2019 [16] has also reported High PCV and GCV for the same characters. Maruthi and Rani, 2015 [10] has reported high GCV and PCV for grain yield per plant and kernels per row. High value of GCV and PCV for cob weight has also reported by Ogunniyan and Olakojo, 2015 [13]. The traits such as seed vigour index, seedling length, cob length, cobs per plant 100-kernel weight, plant height and kernel rows per cob showed moderate values (10-20%) of GCV and PCV. Sandeep *et al*., 2015 [18] has also reported moderate values of GCV and PCV for cob length, 100-kernel weight and plant height. Low values of GCV and PCV (<10%) were recorded for days to 50% tasseling, days to 50% silking, days to 75% dry husk, shelling (%) and germination (%). Pandey *et al*., 2017 [14] has also reported low estimates of GCV and PCV for days to 50% tasseling, days to 50% silking, days to 75% dry husk, shelling (%).

The estimates of heritability and genetic advance are presented in table 2. High estimates of heritability (>61%) were showed by almost all the traits except germination percentage and cob diameter which showed moderate estimates of heritability (31-60%). Ogunniyan and Olakojo, 2015 [13], Mohammad *et al*. (2017) [12], Maruti and Rani 2015 [10], Islam *et al*., 2020 [8] have also reported high heritability for all the traits studied by them. High estimates of genetic advance as percent of mean (>20%) were reported for grain yield per plant, kernels per cob, cob weight, kernels per row, seed vigour index, seedling length, 100-kernel weight, cob length, plant height, cobs per plant, kernel rows per cob. High estimates of heritability coupled with high estimates of genetic advance as percent of mean were reported for grain yield per plant, kernels per cob, cob weight, kernels per row, seed vigour index, seedling length, 100-kernel weight, cob length, plant height, cobs per plant and kernel rows per cob. The findings of this study are in broadly agreement with the findings of Maruthi and Rani (2015) [10], Sandeep *et al* (2015) [18], Thakur *et al.* (2016) [21], Prakash *et al.* (2019) [16], Hussain *et al.* (2019) [7], Ubi *et al.* (2019) [22], Devi (2020) [5], and Islam *et al.* (2020) [8]. The characters that showed high heritability coupled with high genetic advance could be improved through simple selection.

Table 1: Analysis of variance for yield and its component traits in maize

Source of variation	d.f.	Days to 50% tasseling	Days to 50% silking	Days to 75% dry husk	Plant height (cm)	Number of cobs/plant	Cob length (cm)	Cob diameter (cm)	Cob weight (g)	Number of kernel rows/cob
Replication	2	2.09	1.09	3.65	3.43	0.030	0.84	0.92	2.09	1.09
Treatment	76	22.11**	23.80**	27.55**	1319.21**	0.095**	15.02**	2.55**	22.11**	23.80**
Error	152	1.55	1.63	4.53	48.93	0.013	1.04	0.93	1.55	1.63

Source of variation	d.f.	Number of kernels / row	Number of kernels /cob	100-Kernel weight (g)	Shelling percentage (%)	Grain yield/plant (g)	Germination percentage (%)	Seedling length (cm)	Seed vigour index
Replication	2	1.44	0.11	0.10	9.04	0.02	1.62	0.40	-0.08
Treatment	76	2219.28**	5.51**	96.20**	23783.10**	34.17**	160.79**	2481.90**	30.52**
Error	152	2.02	0.03	0.06	7.75	0.05	2.20	15.87	12.98

*, ** significant at 5% and 1% level, respectively

Table 2: Estimates of GCV, PCV, heritability and genetic advance for yield and its component traits in maize

Genotypes	Mean	Min	Max	Heritability (%)	Ga	Ga as % mean	GCV (%)	PCV (%)
Days to 50% tasseling	123.34	117.33	130.33	81.50	4.87	3.95	2.12	2.35
Days to 50% silking	127.11	121.22	133.33	81.89	5.07	3.99	2.14	2.36
Days to 75% dry husk	164.85	157.00	168.67	62.80	4.52	2.74	1.68	2.12
Plant height (cm)	172.87	114.00	215.82	89.64	40.14	23.22	11.90	12.57

Number of cobs/plant	1.21	1.00	1.90	67.07	0.28	23.09	13.68	16.71
Cob length (cm)	15.62	10.35	20.93	81.70	4.02	25.72	13.81	15.28
Cob diameter (cm)	11.71	9.37	13.91	36.57	0.91	7.80	6.26	10.35
Cob weight (g)	96.99	42.95	156.41	99.73	55.93	57.66	28.03	28.07
No of kernel rows/cob	13.08	10.06	15.33	98.33	2.76	21.12	10.34	10.43
No of kernels / row	22.92	10.13	34.46	99.82	11.65	50.84	24.70	24.72
No of kernels /cob	302.06	104.50	483.74	99.90	183.30	60.68	29.47	29.49
100-Kernel weight (g)	25.24	14.65	32.44	99.54	6.93	27.46	13.36	13.39
Shelling (%)	77.73	55.38	88.77	96.00	14.68	18.88	9.35	9.55
Grain yield/plant (g)	90.46	27.98	164.39	98.11	58.50	64.67	31.70	32.00
Germination (%)	91.23	84.67	97.67	31.06	2.78	3.04	2.65	4.76
Seedling length (cm)	27.60	17.28	37.90	94.62	9.49	34.39	17.16	17.64
Seed vigour index	2522.45	1460.35	3522.30	95.03	926.74	36.74	18.30	18.77

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