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ORIGINAL ARTICLE

Studies on Correlation and Path analysis in durum wheat (*Triticum durum* Desf.) in organic conditions

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ABSTRACT
The experiment was laid-out with 25 durum wheat genotypes in randomized block design with three replication at the Organic Research Farm, Karguanji, Institute of Agriculture Science, Bundelkhand University, Jhansi (U.P.) during rabi season 2020-21. In this study, the genotypes EC299335, EC299189, EC577624, EC592592 and EC276887 were identified as better genotypes for seed yield and its component characters. The characters viz., number of tillers per plant, plant height, flag leaf length, number of seed per spike, number of spike per plant showed positive and significant correlation with yield both at phenotypic and genotypic levels. The correlation study indicated that seed yield per plant could be improved by selecting genotypes having more plant height, flag leaf length and leaf width. from the results of path analysis revealed that ten characters viz., number of spike per plant, 1000 seed weight, number of seed per spike, biological yield per plant, flag leaf length, flag leaf width, plant height, days to 50% flowering, showed positive direct effect on yield indicating the effectiveness of these traits for selection.
Keywords: *Organic, durum wheat, GCV, PCV, Heritability.*

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INTRODUCTION

Durum wheat (*Triticum durum* Desf.) is a number of the Gramineae family, which belongs to the Triticeae tribe. It is an allotetraploid (two genomes: AABB) with 28 chromosomes (2m=4x=28). The global acreage of durum wheat is estimated at 17 million hectare (ha) and the most important growing areas are situated in the North America, North and East Africa and South West Asia [16]. India is the only country where durum is grown in 3 million hectare among the far eastern countries. the nutritional composition indicated that 100g of Durum wheat provides 339 calories and it consisted carbohydrate 71g, protein 14g, fat 2.5g, minerals 2g and considerable proportions of vitamins (thiamine and vitamin-B) and minerals (zinc, iron). It is also a good source of trace minerals like selenium and magnesium, which are essential nutrients for good health [13]. Quality is an important aspect of durum wheat. Knowledge of the genetic relationship between grain yield and its component can help breeders improve the efficiency of selecting superior genotypes. The presence of genetic variability in breeding materials is critical for broadening the gene pool and thus the success of plant breeding programmes. Heritability is a widely used indicator in breeding programmes for the transfer of desirable traits from parents to their offspring [3]. Heritability estimation provides information about the degree of genetic control over a trait's expression as well as phenotypic reliability in predicting breeding values. The genetic advance (GA) is another important parameter that determines the expected response to selection [10].

MATERIAL AND METHODS

The experimental materials consisted of 25 durum wheat genotypes obtained from ICAR-NBPGR, New Delhi (India), raised in Randomized Block Design with three replication at the Organic Research Farm, Karguanji, Institute of Agricultural Sciences, Bundelkhand University, Jhansi (U.P.) during *rabi* season

2020-21. A basal dose of FYM 15 t/ha was applied. The crop was sown on 6th November 2020 and harvested during first week of March 2021 at maturity. The genotypes were raised following spacing of 20x05 cm^2 and other recommended cultural practices as per organic management requirement. Observations were recorded on five randomly selected plants from each plot and replication. The data collected on thirteen quantitative traits like days to 50% flowering, number of tillers, plant height, flag leaf length, flag leaf width, flag lead sheath, spike length, number of spike per plant, days to maturity, biological yield, number of weed per spike, test weight, harvest index and seed yield per plant were subjected to statistical analysis as per [8]. The genetic association among the traits was estimated according to the formulae described by [7, 14]. The genotypic, phenotypic, environmental variance and broad heritability were calculated based on the method described by [3]. The path coefficient analysis was performed according to [1,4] to assess the direct and indirect effects of each trait on grain yield.

RESULTS AND DISCUSSION

In this study an attempt was made to assess the mean performance and extent of variability in twenty-five durum wheat genotypes (Table-1). The mean performance of fourteen characters along with standard error of difference and critical differences were calculated. The results show that genotypes EC 299335 (31.95) followed by EC 299189 (31.33), EC 577624 (25.21), EC 299155 (24.40), EC 592592 (20.21), EC 11360 (19.53) and EC 276887 (18.51), identified as desirables genotypes with high total grain yield, 1000 seed weight, number of seed per spike, days to maturity and plant height respectively. Similar trend were also reported by [2].

The estimates of GCV and PCV revealed (Table-2) that phenotypic coefficient of variations were higher than genotypic coefficient of variations, which indicates less effect of environment on the expression of characters studies. Highest estimates of GCV and PCV were observed for leaf length (cm) (GCV 43.50 and PCV 43.55), seed yield per plant (GCV 32.37 and PCV 34.81) followed by number of seeds per spike (GCV 27.72 and PCV 28.31), biological yield (GCV 26.44 and PCV 26.54), number of spike per plant (GCV 24.97 and PCV 26.61), 1000 seed weight (GCV 24.85 and PCV 24.86 and PCV 24.86), flag leaf width (GCV 24.59 and PCV 24.72) and harvest index (GCV 22.17 and PCV 24.47) respectively. These findings are completely consistent with those reported by [5,9].

Heritability estimates revealed that 1000 seed weight (g) (99.85) had the highest heritability, followed by leaf length (cm) (99.75), number of spikelet (93.0), biological yield (99.24), flag leaf width (98.92), spike length per plant (98.79), plant height (97.30), days to 50% flowering (94.73) and flag leaf length (93.34). In that order, genetic advance revealed that biological yield (21.73), number of seed per spike (21.04), plant height (19.77), 1000 seed weight (17.61), harvest index (16.52), seed yield per plant (10.87), leaf length (cm) (10.34) and days to maturity (9.90), days to 50 percent flowering (9.08), flag leaf length (5.23), number of ear per plant (5.22), spike length per plant (3.52), tillers per plant (2.80) were moderate estimates (0.72). These findings are consistent with the findings reported by [6, 11].

The data given in talbe-3 showed that the characters like plant height, flag leaf length, number of tillers per plant, number of seed per spike, number of spike per plant, showed positive and significant correlation with yield both at phenotypic and genotypic level. The correlation study indicate that seed yield per plant could be improved by selecting genotypic having more plant height, flag leaf length, flag leaf width, from the results of path analysis revealed that ten characters number of spike per plant, 1000 seed weight, number of seed per spike, biological yield per plant, flag leaf length, flag leaf width, plant height, days to 50% flowering had a positive direct effect on yield indicating the effectiveness of these traits for selection. The results are similar to the findings of [12,15].

CONCLUSION

It may be concluded that the genotype genotypes EC299335, EC299189, EC577624, EC592592 and EC276887 were identified as better genotypes for seed yield and its components characters having scope for improvement of durum wheat yield through selection further testing of these genotypes is required to confirm the consistency of performance.

Table1 Mean performance of durum wheat genotypes for yield and attributing characters.

Genotypes	Days to 50% flowering	Tillers per plant (No)	Plant height (cm)	Flag leaf length (cm)	Flag leaf width (cm)	Leaf length (cm)	Spike length per plant (cm)	Spikes per plant (No)	Days to maturity (No)	Biological yield per plant	Seeds per spike (No)	1000 seed weight (g)	Harvest Index (%)	Seed yield per plant (g)
G1	72.67	7.87	88.49	21.09	1.45	10.33	17.21	7.20	120.33	40.73	39.27	38.33	31.18	12.69
G2	75.67	11.80	115.14	22.01	1.20	9.97	16.75	11.20	130.00	58.00	40.13	47.17	34.83	20.21
G3	73.67	14.07	97.63	29.59	2.47	17.57	21.15	13.07	123.00	27.77	30.80	52.73	51.62	18.02
G4	75.33	9.93	124.74	27.48	1.51	28.95	23.19	9.20	118.00	24.73	29.53	33.27	49.54	12.26
G5	77.33	11.80	103.47	24.10	1.29	12.81	19.68	11.00	118.33	36.47	21.07	31.63	28.45	10.38
G6	70.33	12.47	94.99	28.75	1.17	11.19	18.71	11.93	121.67	47.80	46.93	45.00	42.91	25.21
G7	78.33	11.40	84.68	26.75	1.23	10.20	15.25	10.80	128.00	49.23	33.47	37.33	35.13	17.30
G8	77.67	9.60	100.23	23.59	1.29	21.38	17.52	15.27	123.00	52.40	35.67	38.00	46.55	24.40
G9	76.00	11.73	100.40	25.15	1.48	11.04	19.46	14.67	124.00	41.87	47.53	48.33	54.88	31.33
G10	86.00	9.67	103.11	26.76	1.30	5.99	20.41	14.80	130.00	31.10	23.93	25.23	48.81	16.20
G11	73.00	9.93	92.95	25.65	1.26	8.78	18.26	9.47	125.33	51.57	45.53	28.17	37.40	19.32
G12	80.33	12.00	104.45	24.35	1.08	10.62	19.08	15.67	126.33	26.83	58.93	30.33	42.78	19.53
G13	80.33	8.13	85.95	24.67	1.28	8.73	18.95	16.40	129.67	34.70	20.60	23.33	43.38	15.06
G14	72.67	9.00	104.53	27.99	1.27	13.23	18.45	8.60	129.00	43.33	46.00	43.20	41.84	18.12
G15	82.67	8.53	85.12	25.65	1.44	5.23	17.67	7.87	118.00	55.07	42.40	26.47	27.29	15.05
G16	84.33	8.67	97.99	22.87	1.23	10.51	17.79	8.13	129.33	35.80	36.13	27.27	36.87	13.19
G17	74.00	9.27	90.50	22.25	1.53	7.89	17.27	8.93	127.33	25.23	19.00	33.33	29.89	7.55
G18	81.00	9.40	98.54	27.28	1.30	9.28	18.42	9.13	120.67	37.30	37.27	22.00	40.93	15.27
G19	82.00	9.40	88.78	25.18	1.57	10.10	18.51	8.87	131.33	26.53	26.67	24.00	40.31	10.69
G20	85.33	13.40	108.49	29.38	2.14	6.43	15.90	12.57	131.33	39.80	56.47	40.57	23.52	31.92
G21	74.67	8.13	109.86	25.32	1.00	13.27	21.48	7.60	132.00	55.27	44.20	42.27	27.61	15.26
G22	75.67	8.87	89.73	24.48	1.47	8.75	17.59	8.47	130.33	53.23	45.93	34.13	32.92	17.54
G23	77.33	9.80	104.81	30.57	2.27	15.12	18.68	9.13	130.67	29.20	40.13	28.33	56.59	16.53
G24	85.00	11.33	102.41	28.77	1.37	10.82	18.79	10.53	131.67	44.57	39.07	27.27	41.48	18.51
G25	83.33	10.67	94.67	21.35	1.29	10.62	18.14	9.87	119.00	32.73	33.80	33.07	51.00	16.74
GM	78.19	10.27	98.87	25.64	1.44	11.55	18.57	10.81	125.93	40.05	37.62	34.43	39.91	17.53
SE	0.62	0.57	0.94	0.41	0.02	0.15	0.11	0.57	0.47	0.54	1.25	0.19	2.38	1.30
CD5	1.75	1.63	2.66	1.15	0.06	0.41	0.31	1.63	1.33	1.53	3.54	0.55	6.78	3.69
CD1	2.34	2.18	3.55	1.54	0.08	0.55	0.42	2.18	1.77	2.04	4.73	0.73	9.04	4.92
CV	1.37	9.68	1.64	2.74	2.57	2.18	1.03	9.21	0.64	2.32	5.73	0.97	10.34	12.81

Table 2 Genetic variability of selected genotypes.

SN	Characters	GCV	PCV	ECV	h^2	GA	GG
1	Days to 50% Flowering	5.79	5.95	1.37	94.73	9.08	11.62
2	Number of tillers per plant	15.56	18.33	9.68	72.10	2.80	27.22
3	Plant height (cm)	9.84	9.98	1.64	97.30	19.77	19.99
4	Flag leaf length (cm)	10.26	10.62	2.74	93.34	5.23	20.41
5	Flag leaf width (cm)	24.59	24.72	2.57	98.92	0.72	50.38
6	Leaf length (cm)	43.50	43.55	2.18	99.75	10.34	89.49
7	Spike length per plant (cm)	9.25	9.31	1.03	98.79	3.52	18.94
8	Spikes per plant(No)	24.97	26.61	9.21	88.03	5.22	48.26
9	Days to maturity(No)	3.87	3.92	0.64	97.32	9.90	7.86
10	Biological yield per plant (g)	26.44	26.54	2.32	99.24	21.73	54.26
11	Seeds per spike (No)	27.72	28.31	5.73	95.90	21.04	55.93
12	1000 seed weight (g)	24.85	24.86	0.97	99.85	17.61	51.14
13	Harvest Index (%)	22.17	24.47	10.34	82.13	16.52	41.39
14	Seed yield per plant (g)	32.37	34.81	12.81	86.46	10.87	62.00

Table-3 Direct and Indirect effect component traits on seed yield genotypes of Durum wheat in *rabi* season phenotypic level

Characters	Days to 50% flowering (No)	Tillers per plant (No)	Plant height (cm)	Flag leaf length (cm)	Flag leaf width (cm)	Leaf length (cm)	Ear length per plant (cm)	Spikes per plant (No)	Days to maturity (No)	Biological yield per plant	Seeds per spike (No)	1000 seed weight (gm)	R
Days to 50% flowering(No)	0.14	0.00	-0.00	0.00	0.00	-0.00	0.02	0.09	-0.02	-0.05	-0.04	-0.13	0.02
Tillers per plant (No)	0.00	0.03	0.01	0.04	0.04	0.00	0.00	0.25	0.01	-0.02	0.11	0.11	0.57**
Plant Height (cm)	-0.00	0.01	0.05	0.03	0.01	0.01	-0.07	0.04	-0.00	-0.02	0.08	0.06	0.19
Flag leaf length (cm)	0.00	0.01	0.01	0.13	0.06	0.00	-0.03	0.04	-0.01	-0.03	0.09	0.02	0.29
Flag leaf width (cm)	0.00	0.01	0.00	0.07	0.11	0.00	-0.01	0.00	-0.00	-0.09	-0.01	0.05	0.13
Leaf length (cm)	-0.05	0.00	0.03	0.02	0.02	0.01	-0.08	0.02	0.02	-0.05	-0.06	0.06	-0.05
Spike length per plant (cm)	-0.02	-0.00	0.03	0.03	0.01	0.01	-0.14	0.04	0.02	-0.09	-0.10	0.01	-0.20
Spikes per Plant(No)	0.03	0.01	0.00	0.01	0.00	0.00	-0.01	0.50	-0.00	-0.03	0.00	0.03	0.54**
Days to Maturity(No)	0.03	-0.00	0.00	0.02	0.01	-0.00	0.03	0.03	-0.08	0.02	0.06	-0.01	0.10
Biological yield per plant (g)	-0.03	-0.00	-0.01	-0.01	-0.04	-0.00	0.05	-0.07	-0.01	0.23	0.18	0.07	0.35
Seeds per spike (No)	-0.01	0.01	0.01	0.03	-0.00	-0.00	0.03	0.00	-0.01	0.09	0.45	0.07	0.66**
1000 seed weight (g)	-0.08	0.01	0.01	0.01	0.02	0.00	-0.00	0.06	0.00	0.07	0.14	0.23	0.48*

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