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Short Communication

Estimation of genetic parameters and heterosis in cytoplasmic male sterility based experimental hybrids for yield and component traits

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Development of hybrids in wheat is an innovative approach for enhancing present productivity levels. Presence of standard or commercial heterosis is essential for successful development of a hybrid cultivar. The discovery of heterosis and its exploitation in modern plant breeding programmes is one of the most important advances in plant improvement (Alghamdi, 2009). Although hybrid development in wheat could not achieve any success in the world but efforts are being made for development of CMS (Cytoplasmic Male Sterility) based hybrids in wheat for marginal land with half seed rate and in this direction, more than 50 diversified cytoplasmic male sterile (CMS) lines were developed in agronomic background of Indian wheat cultivars using backcross breeding at ICAR-IIWBR, Karnal (Singh *et al.*, 2016). These new CMS lines were evaluated for male sterility and 12 CMS lines in agronomic background of DBW 17 (a promising cultivar of NWPZ were crossed with 3 fertility restorer lines (Res 5, Res 37 & Res 38) during 2016-17 crop season to develop 36 experimental hybrids. These CMS based 36 experimental hybrids were evaluated during 2017-18 crop season at half seed rate (50kg/ha) alongwith two check varieties namely, HD 2967 and HD 3086, planted at half seed rate as well as full seed rate (100kg/ha). The randomised block design (RBD) was used with 2 replications and the plot size was paired row of 2.5m length spaced at 20cm. All the recommended agronomic practices were adopted to raise a good crop. The data were recorded on days to heading and maturity, plant height in cm, tiller number per metre row length, spikelet number per spike, 1000-grains weight (g) and grain yield per plot (g). The analysis of variance was done as per Panse and Sukhatme (1967), heritability percentage in broad sense (h2) genetic advance (GA) and GA as percent of mean, correlations were estimated (Burton and Devane, 1953; Johnson *et al,* 1955; Hanson et al. 1956; Miller *et al.,* 1958). Path analysis was also done to know the direct and indirect effects of traits association with yield (Dewey and Lu, 1959). In addition, heterosis over standard check was estimated to identify promising hybrid combinations.

Table. 1: Analysis of variance and estimates of various genetic parameters for different traits

Parameters	Days to heading	Days to maturity	Plant height (cm)	Tillers /m row	Spikelets per spike	1000-gr weight (g)	Grain yield (q/ha)
Analysis of variance for various traits							
Source (df)	Mean sum of squares						
Genotypes (39)	8.36**	8.21**	15.76**	313.48**	4.14**	29.88**	109.51**
Replications (1)	0.01	3.20	10.52*	0.45	1.25	2.45	338.66**
Error (39)	3.40	2.92	2.51	31.78	1.56	6.01	38.39
Estimates of various genetic parameters							
Mean ±SE	91.2±1.84	130.4±1.71	102.3±1.59	100.1±5.64	23.7±1.25	41.4±2.45	43.9±6.20
CD (5%)	4.06	3.760	3.271	11.636	2.576	5.062	12.789
Genetic Advance	2.11	2.31	4.51	22.08	1.58	5.80	8.52
GA as % of mean	2.31	1.77	4.41	22.07	6.66	14.03	19.41
GC (rg) with yield	-0.510**	-0.293**	0.207	0.213	-0.331**	-0.326**	
Direct effect on yield	-0.367	-0.255	0.509	0.059	-0.108	-0.495	Resid-0.423
SH (%)	2.3 to 11.0	0.8 to 6.0	-2.0 to 8.6	-41.1to-3.4	-13.0to17.4	-12.8to 4.4	-42.2 to 20.1

df- degree of freedom, SE-standard error, CD- critical difference, PCV & GCV- Phenotypic & Genotypic coefficients of variation, h2- heritability (%), GA-genetic advance, GC- genotypic correlation, SH- Standard heterosis

Table.2: Estimates of heterosis for grain yield in promising experimental hybrids

S No.	Experimental hybrids	Days to heading	Days to maturity	Pl height (cm)	Tillers /m row	1000-gr wt. (g)	Gr. yield (q/ha)	Standard Heterosis (%) at FSR
1	CMS10A*DBW17/RES37	89	129	106	110	39	61.5	20.1
2	CMS8A*DBW17/RES37	88	127	102	95	41	55.9	9.2
3	CMS3A*DBW17/RES37	89	132	101	89	38	54.5	6.4
4	CMS15A*DBW17/RES37	89	130	100	98	43	54.5	6.4
5	CMS10A*DBW17/RES5	93	127	104	97	44	53.5	4.5
6	CMS22A*DBW17/RES37	93	130	104	90	38	52.3	2.1
7	CMS14A*DBW17/RES37	89	128	108	100	46	52.0	1.6
8	CMS8A*DBW17/RES38	92	131	102	113	42	51.9	1.4
9	CMS15A*DBW17/RES37	90	131	104	103	43	51.4	0.4
10	HD3086(FSR)	90	132	105	105	38	**51.2**	0.0

The analysis of variance (Table.1) indicated significant differences among experimental hybrids for all the major yield attributing traits. Variation in values of genetic advance was observed for various traits (Table.1).. Moderately high coefficient of variation was observed for grain yield, tillers per metre row length and 1000-grains weight whereas low values were recorded for other traits (Sivasubramanian and Madhavamenon, 1973; Sharma *et al.*, 1998; Singh, 2003). The heritability estimates were found high (tillers, plant height and 1000 gr weight) to moderate for other traits (Singh *et al.*, 2001). The genetic advance as per cent of mean was found high for tiller number/m row and moderate for grain yield and 1000-grain weight. These traits may be emphasised while selecting the promising genotypes. The character association study indicated significantly negative association of grain yield with heading, maturity, spikelet number and 1000-grains weight (Table.1). In addition, significantly positive associations of heading days were observed with maturity (0.416) and spikelets number per spike (0.339) and plant height with maturity (0.376) and 1000-grains weight (0.416). Path analysis indicated (table.1) preponderance of high direct effects of all the traits except tiller number in trait association with grain yield (*Janmohammadi et al.*, 2014).

The standard heterosis over check varieties was worked out. Check variety HD 3086 was the highest yielding at full seed rate (FSR) as compared to the half seed rate (HSR) and therefore, standard heterosis was worked out on yield of HD 3086 at FSR. A wide range of standard heterosis was observed for various traits (Table.1). Heterosis for grain yield ranged from -42.2% to 20.1%. as per the reports have provided ample evidence of significant and positive heterosis for yield ranging from 0 to 100% in wheat in F_1s of two cultivars (Singh *et al.,* 2010). Among 36 experimental hybrids, 9 showed positive heterosis over the check variety HD 3086 (Table 2) of which combination CMS10A*DBW17/RES37 was the highest yielding with yield superiority of 20.1%. Hybrid wheat has full potential to be useful in future under marginal land or an area where the average yield of recent cultivars is <4.0q/ha. Wheat area under abiotic stress is also being targeted for hybrid development.

From the above findings, it may be concluded that experimental hybrids also express variability for different traits based on various genetic parameters and this information can be harnessed in identification of promising hybrids. Although the heterosis level is low in most of the higher yielding experimental hybrids than the check, these can be further evaluated for realising higher yield potential.

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