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Evaluation of Wheat (*Triticum aestivum* L.) germplasm under late sowing conditions in Ballia District.

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Abstract
A field investigation was carried out during the rabi season of 2022-2023 under late sowing conditions. The experiment was laid out in a Randomized Block Design with three replications. Wheat was sown on 8 January 2023. Present discoveries show that each trait of wheat genotype, especially grain yield, affects late sowing and decreases the grain yield of every wheat genotype. So, it is recommended that the breeder should sow Wheat genotypes at an ideal time from 15 October to 15 November, but some wheat genotypes resist better and show less effect of late sowing conditions on grain yield.
Keywords:- *Triticum aestivum, Wheat, late sowing, Grain yield*

I. INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most important and strategic cereal crop for the majority of the world's populations and has been described as the 'King of cereals' of its large area cultivation, high production, good nutritional profile, and prominent position in international food grain trade. Temperature has potential impacts on the phasic development and grain yield of crops. Wheat, being a winter cereal, requires particular environmental conditions for better emergence, growth and flowering (Dabre *et al*., 1993) and is more vulnerable if exposed to high temperatures during the reproductive stage (Kalra *et al.*,2008). Temperatures above 30°C, during floret formation, may cause complete sterility (Saini and Aspinal,1983) with delayed planting, the development of plant organs and transfer mechanism from source to sink were remarkably affected, which was reflected by overall shortening of plant height, reduction in number of internodes, days to flowering, days to maturity and grain filling period and ultimately in the reduction of yield and components (Sial *et al.*, 2005; Singh *et al.*, 2011). Therefore, when temperatures are elevated between anthesis to grain maturity, grain yield is reduced because of the reduced grain filling time to captures resources. To minimize the production losses due to high temperature, future wheat varieties must have enhanced adaptability to high temperature. Thus, this study is for assessing the genetic variability of heat-adaptive traits along with important yield-related traits in wheat. Late sowing of of wheat crop poses a serious problem to us at the stage of crop loading with grain, e.g., high temperature. When the temperature is high, it will reduce crop yield (Aslam *et al.*, 1989). It was discovered that the intensity of 35°C to 37°C for 3 to 4 days reduces the grain size and modifies grain morphology (Wardlaw and Wrigley 1994). In order to feed the projected population of 9.1 billion by 2050, crop production and productivity should be increased significantly (P.B. Poudel & Poudel, 2020). Keeping this in mind, the present study was carried out to evaluate the wheat genotypes under late sowing conditions.

II. MATERIAL AND METHODS

A field experiment entitled "Evaluation of wheat (*Triticum aestivum)* germplasm under late sowing conditions in Ballia District" was conducted at Nidharia Agriculture Farm of Shri Murli Manohar Town Post Graduate College, Ballia (UP) during the *Rabi* season of 2022-2023. The geographical situation of the Ballia district is the easternmost part of Uttar Pradesh state. This place is situated between 25° 87' 07" N latitude and 84° 18' 57" longitude and comprises the western half of the district and 25 varieties obtained from "Department of Genetics and Plant Breeding from S.M.M. Town P.G. College, Ballia (UP). The experiment consisted of 25 varieties laid out in a Randomized Block Design, and optimum plot size and shape detect the appropriate number of 3 replications for a field research trial on wheat. The spacing between row to rows and plant to plants was 20 cm and 15 cm. The data were collected from randomly selected plants and tagged for recording observation in each and every replication for quantitative characters days to 50% flowering, days to 50% maturity, number of effective tiller per plant, plant height (cm), flag leaf area (cm^2), peduncle length (cm), spike length (cm), number of grain per spike, biological yield (g), test weight (g), harvest index (%), and grain yield per plant (g). The

number of days to flowering and maturity were counted from the date of sowing to when 50% of the plants in a plot had their spikes emerge completely from the flag leaf and were visible, and when glumes had lost chlorophyll and turned yellow in all the spikes, respectively. For measuring average plant height and spike length, five plants were selected randomly from each plot. The effective number of spikes in each plot were counted at the time of maturity. After harvesting and sun drying, 1000 random seeds from each plot were counted and weighed.

III. RESULT AND DISCUSSION

Effective tillers per plant

Tillering mainly depends upon the green photosynthesis area is responsible for carbohydrate formation, grain filling, and final grain yield. The wheat crop sown late recorded more tiller production as compared to the very late sown crop; however, the differences were found to be non-significant, but different varieties showed significant differences in tiller production. Among the varieties, SAWYT 331 produced the maximum number of tillers, which were at par with varieties SAWYT 336, SAWYT 349, SAWYT 327 and SAWYT 337. The differential variation for tiller production among genotype might be due to their genetic variability (Aslam *et al,* 2003, Khaliq, 2004 and Shah *et al,* 2006) The interactive effects between data of sowing and varieties were non-significant.

Number of grain per spike

Number of grains per spike is an important yield-attributing character. Data regarding the number of grains per spike revealed that sowing dates did not significantly affect the number of grains per spike, but significant differences were observed among varieties. The interaction between sowing dates and varieties was found to be significant. The variety SAWYT 345 produced the highest grain (49.93) per spike and it remained significantly superior over all other varieties. Variety SAWYT 335 recorded the lowest number of grains per spike in late sowing conditions. Differences in the number of grains per spike among varieties might be due to their genetic variability. Similar results were reported by Haider (2004), Singh *et al.* 2021.

Test Weight (g)

The data regarding 1000 grain weight revealed that sowing conditions and different varieties and even the interaction of both did not significantly affect the 1000 grain weight. However, the crop sown under late sowing conditions recorded among varieties the maximum 1000 grain weight was observed in SAWYT 350, SAWYT 347, SAWYT 331, whereas as least (29.20 g) was observed in variety SAWYT 350. This is because, delay in sowing shortens the duration of each development phase which ultimately reduces the grain filling period, leading to lower grain weight (Sink *et al*;2006 and Verma *et al,*2019). Biological yield is reflected by growth parameters like leaf area, tiller production and plant height. It is evident from the data that biological yield was not significantly affected by date of sowing, but different varieties showed a significant effect on biological yield. The variety SAWYT 335 recorded the highest biological yield where whereas the least was observed in variety SAWYT 349. The interaction between date of sowing and variety was found to be non-significant.

IV. Conclusion

From the above study, it can be concluded that late sowing significantly affects the yield and yield components of wheat. In late sown condition, there were significant and non-significant differences among genotypes for all the traits.

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Table 1 - Analysis of variance (ANOVA) for 12 characters in Wheat (*Triticum aestivum L.)*

Characters / Sources of variation	d.f	Days to 50% flowering	Days to 50% maturity	Tillers per plant	plant height (cm)	Flag leaf area (sq)	Peduncle length (cm)	Spike length (cm)	Number of grains /spike	Biological yield /plant (g)	Test weight (g)	Harvest Index (%)	Grain yield /plant (g)
Replication	2	160.67**	1.31	2.932	16.78*	63.366**	17.9	13.1**	9.67	3.2	20.182**	13.46	5.047
Treatment	24	448.67**	455.33**	78.666**	2155.82**	181.16	1802.24**	3224.8**	1671.16**	4073.9**	68.427**	2897.34**	165.133**
Error	48	393.33	82.03	28.588	102.31	139.495	839.29	32.5	90.96	277.3	59.937	411.63	49.299

Table:2 - Variability parameters of various characters in Wheat (Triticum aestivum L.)

Variability parameters / Characters	All over mean	Range		C.D		Standard error of mean	Genotypic Coefficient of Variance (%)	Phenotypic Coefficient of Variance (%	Heritability (h2)	Genetic advance	Genetic Advance in % of min
		Minimum	Maximum	1	5						
Days to 50% flowering	69.73	65	75	6.2	4.6	1.65	2.68	4.9	29.94	2.1	3.02
Plant height (cm)	74.25	63.65	82.21	3.19	2.39	0.84	7.28	7.54	93.2	10.75	14.48
Tillers per plant	4.42	2.57	6.47	1.69	1.26	0.44	21.38	27.6	60.02	1.5	34.13
Flag leaf area (cm2)	16.36	13.2	19.3	3.73	2.79	0.98	7.6	12.9	34.74	1.51	9.23
Peduncle length (cm)	28.75	9.7	36.09	9.15	6.86	2.41	15.24	21.07	52.34	6.53	22.71
Spike length (cm)	11.3	8.83	43.2	1.8	1.35	0.47	59.45	59.9	98.5	13.64	121.56
Days to maturity	99.53	96.33	102.33	2.86	2.14	0.75	2.41	2.74	77.1	4.33	4.35
Biological yield	74	54.6	86.4	5.26	3.94	1.38	9.99	10.5	90.44	14.48	19.57
Num. of grains per spike	44.59	33.6	49.93	3.01	2.25	0.79	10.65	0.92	92.26	9.4	21.08
Test weight	30.83	29.2	33.33	2.44	1.83	0.64	2.37	4.33	29.96	0.82	2.67
Harvest index	40.43	31.66	55.26	6.41	4.8	1.69	15.12	16.76	81.34	11.35	28.09
Grain yield per plant (g)	8.2	5.87	12.27	2.21	1.66	0.58	17.04	21.05	65.51	2.32	28.41

Table 3- Genotypic and phenotypic correlation among 12 characters in Wheat *(Triticum aestivum)*

Characters		Days to 50% flowering	Days to maturity	Tillers per plant	Plant height (cm)	Flag leaf area (cm2)	Peduncle length (cm)	Spike length (cm)	Num. of grains per spike	Biological yield (g)	Test weight (g)	Harvest index (%)	Grain yield per plant (g)
Days to 50% flowering	rg		0.106	-0.277*	-0.475**	-0.202	-0.375**	0.366**	-0.272*	0.279*	-0.073	-0.234*	-0.596**
	rp		0.135	-0.211	-0.331**	-0.098	-0.346**	0.186	-0.191	0.171	-0.024	-0.118	-0.322**
Days to maturity	rg			-0.035	-0.291*	0.203	-0.136	0.127	-0.691**	-0.349**	-0.079	0.001	0.056
	rp			-0.011	-0.253*	0.105	-0.114	0.095	-0.588**	-0.281*	-0.064	-0.012	0.064
Tillers per plant	rg				0.458**	0.322**	0.172	-0.285*	0.031	-0.065	0.422**	0.490**	0.372**
	rp				0.369**	0.102	0.230*	-0.222	0.047	-0.026	0.107	0.309**	0.552**
Plant height (cm)	rg					0.247*	0.558**	-0.251*	-0.113	0.105	0.337**	-0.203	0.049
	rp					0.144	0.437**	-0.236*	-0.101	0.096	0.15	-0.18	0.07
Flag leaf area (cm2)	rg						0.362**	-0.243*	-0.148	0.112	0.364**	0.276*	0.239*
	rp						0.183	-0.119	-0.166	0.03	0.196	0.129	0.062
Peduncle length (cm)	rg							-0.891**	-0.131	0.187	-0.327**	0.028	0.072
	rp							-0.649**	-0.086	0.114	-0.221	0.1	0.154
Spike length (cm)	rg								-0.019	-0.056	0.401**	-0.282*	-0.361**
	rp								-0.021	-0.057	0.221	-0.258*	-0.289*
Num. of grains per spike	rg									0.330**	0.316**	0.316**	0.198
	rp									0.304**	0.16	0.255*	0.206
Biological yield	rg										0.012	0.153	0.131
	rp										0.044	0.101	0.143
Test weight	rg											0.081	0.147
	rp											0.017	-0.028
Harvest index	rg												0.555**
	rp												0.362**

Table 4- Direct and indirect effects of 12 quantitative traits at the Phenotypic level in wheat *(Triticum aestivum L.)*

Characters	Days to 50% flowering	Plant height (cm)	Tillers per plant	Flag leaf area (cm2)	Peduncle length (cm)	Spike length (cm)	Days to maturity	Biological yield (g)	Num. of grains per spike	Test weight (g)	Harvest index (%)	Grain yield per plant (g)
Days to 50% flowering	-0.32025	0.04585	-0.11062	-0.0006	0.06499	-0.04573	0.03177	0.04341	-0.02901	0.00195	-0.00365	-0.322**
Plant height (cm)	-0.04323	0.03503	-0.00582	0.00064	0.02137	-0.02336	0.2353	-0.07107	-0.08953	0.00515	-0.00038	0.064
Tillers per plant	0.06751	-0.05117	0.52486	0.00063	-0.04314	0.0546	-0.00261	-0.00671	0.00715	-0.00862	0.00961	0.552**
Flag leaf area (cm2)	0.106	-0.13852	0.19384	0.00089	-0.0813	0.05822	-0.05951	0.02443	-0.01531	-0.01201	-0.0056	0.07
Peduncle length (cm)	0.03138	-0.01997	0.05385	0.00614	-0.03434	0.02939	0.02461	0.00759	-0.02521	-0.01569	0.00401	0.062
Spike length (cm)	0.11071	-0.06052	0.12043	0.00112	-0.18798	0.15989	-0.02675	0.02893	-0.01315	0.01771	0.00312	0.154
Days to maturity	-0.05944	0.03273	-0.11628	-0.00073	0.12198	-0.2464	0.02231	-0.01445	-0.00314	-0.01777	-0.00802	-0.289*
Biological yield	0.06104	0.01393	0.02466	-0.00102	0.01624	0.00508	-0.13841	0.07697	0.15222	-0.01282	0.0079	0.206
Num. of grains per spike	-0.05492	-0.01337	-0.01391	0.00018	-0.02149	0.01407	-0.06607	0.25311	0.04629	-0.00355	0.00315	0.143
Test weight	0.007778	-0.02072	0.05636	0.0012	0.04147	-0.05453	-0.01511	0.01119	0.02431	-0.08029	0.00053	-0.028
Harvest index	0.03766	0.025	0.16241	0.00079	-0.01889	0.06364	-0.00289	0.02567	0.03875	-0.00138	0.03104	0.362**

Residual 0.478