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Study on Variability, Correlation Coefficient and Path Analysis of Yield, its Components and Quality Traits in Wheat

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ABSTRACT: A study was carried out on a total of eighty different types of wheat to explore the relationships between yield and its contributing traits. This research used a special design method called Augmented Block Design, along with four comparison checks. Various physical and physiological characteristics of the wheat were carefully observed and recorded. The results from the analysis of the collected data showed that the different treatments had a significant impact on all the observed traits.

There was a wide range of variation among the different traits, and when the average values of the different types of wheat were compared, it became clear that there is a high level of diversity in traits such as the time it takes for the plant to flower by 50%, the size of the flag leaf, the amount of yield per plant, the time it takes for the plant to mature, the height of the plant, the number of shoots per plant, the protein content, and the harvest index. These variations could be very useful for breeding efforts aimed at improving the natural types of wheat.

Moreover, a strong and positive relationship was found between the amount of grain produced per plant and important factors like the weight of the grains, the yield per plant, the harvest index, the time it takes for the plant to mature, the time it takes for the plant to flower by 50%, the number of shoots per plant, and the height of the plant. Path coefficient analysis also revealed that there is a highly positive connection between the amount of yield per plant and the harvest index with the amount of grain produced per plant. This information provides valuable insights into how these traits are interconnected and affect the overall grain production.

Keywords: Genetic variability, correlation coefficient, path analysis, yield components, wheat.

INTRODUCTION

Triticum aestivum L. em. Thell., commonly known as wheat, is taxonomically classified within the Poaceae family, characterized by its propensity for autogamous reproduction (Johonson *et al*., 1955). In the context of the 2019-20 rabi season, the agricultural landscape of India witnessed an extensive cultivation of wheat, spanning an impressive 31.36 million hectares, which contributed to a substantial 24.94% of the total crop acreage (Directorate of Statistics and Economics, Year). This temporal epoch stands as a monumental milestone in Indian agriculture, exemplified by an astounding wheat yield of 107.86 million metric tons and an impressive average national productivity of 3508 kg/ha for the aforementioned period (Directorate of Statistics and Economics, 2021). The innate genetic attributes, characterized by high heritability and evolutionary genetic advancement, synergistically converge to establish a pivotal foundation for strategic selection initiatives (Johonson *et al.,* 1955). Within the intricate choreography of traits that govern grain production, analytical frameworks such as correlation and path analysis emerge as indispensable tools for elucidation. Correlation serves as an analytical compass, traversing the intricate web of associations and elucidating the strength and direction of relationships binding various yield-contributing traits to the ultimate yield outcome (Ali *et al.,* 2015). Simultaneously, the path coefficient, a quantifier of significance, distinguishes direct determinants from indirect influences, a conceptual framework introduced by Dewey and Lu (1959).

In this dynamic landscape, the crucible of hybridization endeavors mandates a rigorous assessment of the genetic tapestry within the available genotypic repertoire, as stipulated by Rahman *et al*. (2016). This foundational evaluation provides a scaffold for subsequent breeding pursuits, unveiling the contours of genetic variability and propitious trajectories for agricultural enhancement.

At the experimental site of Acharya Narendra Deva University of Agriculture and Technology in Ayodhya, Uttar Pradesh, a field study was undertaken during the Rabi season to investigate genetic diversity and trait associations in wheat. The experiment utilized an augmented block design, dividing the field into five blocks, each accommodating 20 plots comprising 16 test genotypes and 4 reference checks. Each plot consisted of three rows, spaced at 0.25 meters intervals, and spanning 2.5 meters in length. Within this structured setup, various traits were meticulously evaluated, including days to 50% flowering, flag leaf area, spike length, plant height, tillers per plant, peduncle length, days to maturity, 1000-grain weight, biological yield per plant, grain yield per plant, harvest index, and protein content. This systematic arrangement allowed for a comprehensive exploration of genetic variability and the intricate relationships among these traits, contributing to a deeper understanding of wheat cultivation dynamics.

The analytical framework employed for processing the collected data and conducting a comprehensive analysis of variance was the WINDOSTAT version 9.2 statistical program. This software facilitated a meticulous statistical assessment of the recorded data. The focal point of this analytical endeavor was to derive insights into genetic diversity and ascertain correlation coefficients within the context of morphological attributes among the various wheat genotypes.

RESULT AND DISCUSSION

The practice of relying solely on yield as the primary selection criterion in crop improvement strategies can yield suboptimal outcomes due to the intricate nature of yield, which emerges as a multifaceted trait influenced by an array of interconnected factors, further compounded by environmental nuances (Manjunatha *et al.,* 2017). To unravel this complexity, a comprehensive evaluation of diverse parameters was undertaken, culminating in a meticulous examination of their correlations with grain yield per plant and their interrelations, elucidated through calculated correlation coefficients. The results of these analyses are succinctly presented in Table 1.

Noteworthy among the parameters, biological yield per plant (0.943), tillers per plant (0.957), grain per spike (0.936), test weight (0.927), days to maturity (0.911), and harvest index (0.910) exhibited robust and statistically significant positive correlations with grain yield per plant. These empirical revelations resonate with corroborative observations by Laei *et al.* (2012); Meles *et al*. (2017); Singh *et al.* (2019); Manivelan *et al*. (2022); Tripathi *et al*. (2023); Sreekanth *et al*. (2023), collectively Accentuating the potential of these attributes as potent proxies for indirect selection, orchestrating improvements in grain production dynamics. Implicit in this perspective is the prospect of augmenting yield via strategic enhancements in these attributes.

Embarking on a more intricate inquiry, the analytical trajectory transitions to the realms of direct and indirect effects, encompassing the manifold influences of the twelve distinct attributes on grain production per plant. These insights are eloquently encapsulated within the trajectory coefficients, meticulously investigated at both the phenotypic and genotypic echelons, their synthesis and articulation thoughtfully rendered in the corpus of Table 2. Unveiled through this matrix is the affirmative nexus between grain yield per plant and biological yield per plant (0.901) alongside the pivotal harvest index (1.103), as substantiated by the corpus of path coefficient analysis. This nexus elucidates a clear conduit for enhancing grain yield per plant by judiciously leveraging these attributes, potentially shaping the landscape of breeding programs to cultivate varietals endowed with enhanced yield dynamics.

The resonance of these findings with antecedent scholarly endeavors conducted by Kashif *et al*. (2004); Khaliq *et al.* (2004); Mohsin *et al.* (2009); Laei *et al*. (2012); Baye *et al*. (2020); Kalimullah *et al*. (2012) underscores a robust confluence of empirical insights. This collective intellectual tapestry fortifies the observed linkages and fortifies the rationale for harnessing these attributes as beacons guiding high-yield cultivar development trajectories.

The investigation unveiled remarkably substantial disparities at both the ($P < 0.01$) and ($P < 0.05$) levels among the various genotypes across all considered traits. Demonstrating an array of average to high mean performance values in relation to yield-contributing traits, the genotypes exhibited promising potential. This collective performance positions these genotypes as compelling candidates for deployment as formidable genetic contributors in forthcoming hybridization initiatives, strategically aimed at the augmentation of high-yielding wheat cultivars.

Intriguingly, the application of path coefficient analysis unfurled a cogent narrative, spotlighting a robustly positive affiliation between biological yield per plant and the harvest index with grain yield per plant. This insight underscores a nuanced yet potent interrelationship, implying that the judicious employment of these traits as selection markers could wield substantive efficacy in the context of bolstering grain yield for bread wheat. In essence, these findings lay a persuasive foundation for considering these traits as discerning touchstones for informed selection strategies, thereby offering tangible prospects for the refinement of future hybridization programs with the overarching goal of enhancing wheat yield performance.

Table 1: Phenotypic correlation of twelve agro-morphological traits.

Traits	DF	FLA	PH	DM	TP	SL	GS	BYP	TW	HI	PC	GYP
DFF	**1.000**	0.823**	0.960**	0.985**	0.825**	0.925**	0.961**	0.843**	0.951**	0.948**	0.961**	0.873**
FLA		**1.000**	0.777**	0.795**	0.755**	0.752**	0.778**	0.753**	0.727**	0.708**	0.798**	0.691*
PH			**1.000**	0.958**	0.814**	0.958**	0.926**	0.880**	0.927**	0.914**	0.950**	0.881**
DM				**1.000**	0.850**	0.904**	0.976**	0.853**	0.969**	0.976**	0.958**	0.911**
TP					**1.000**	0.693*	0.882**	0.934**	0.868**	0.835**	0.871**	0.957**
SL						**1.000**	0.848**	0.781**	0.859**	0.849**	0.903**	0.761**
GPS							**1.000**	0.888**	0.990**	0.953**	0.932**	0.936**
BYP								**1.000**	0.871**	0.787**	0.857**	0.943**
TW									**1.000**	0.954**	0.935**	0.927**
HI										**1.000**	0.950**	0.910**
PC											**1.000**	0.908**

*,**Significant at 1% &5% level of significance respectively

Table 2: Path coefficient direct and indirect effect of all other characters on grain yield.

Traits	DFF	FLA	PH	DM	TP	SL	GS	BYP	TW	HI	PC	GYP
DFF	**-0.174**	-0.024	-0.122	-0.337	-0.044	-0.112	-0.033	0.759	-0.077	1.045	-0.009	0.873**
FLA	-0.143	**-0.029**	-0.098	-0.272	-0.041	-0.091	-0.027	0.678	-0.059	0.780	-0.007	0.691*
PH	-0.167	-0.023	**-0.127**	-0.328	-0.044	-0.116	-0.032	0.793	-0.076	1.008	-0.009	0.881**
DM	-0.172	-0.023	-0.121	**-0.342**	-0.046	-0.109	-0.033	0.769	-0.079	1.077	-0.009	0.911**
TP	-0.144	-0.022	-0.103	-0.291	**-0.054**	-0.084	-0.030	0.841	-0.071	0.921	-0.008	0.957**
SL	-0.161	-0.022	-0.121	-0.309	-0.037	**-0.121**	-0.029	0.704	-0.070	0.936	-0.008	0.761**
GS	-0.167	-0.023	-0.117	-0.334	-0.047	-0.103	**-0.034**	0.800	-0.081	1.051	-0.009	0.936**
BYP	-0.147	-0.022	-0.111	-0.292	-0.050	-0.095	-0.030	**0.901**	-0.071	0.868	-0.008	0.943**
TW	-0.166	-0.021	-0.117	-0.331	-0.047	-0.104	-0.034	0.784	**-0.081**	1.052	-0.009	0.927**
HI	-0.165	-0.021	-0.116	-0.334	-0.045	-0.103	-0.033	0.709	-0.078	**1.103**	-0.009	0.910**
PC	-0.167	-0.023	-0.120	-0.328	-0.047	-0.109	-0.032	0.772	-0.076	1.047	**-0.009**	0.908**

Bold values shows direct and normal values shows indirect effect

CONCLUSION

A strong and positive correlation between the amount of grain produced per plant and critical elements including the weight of the grains, yield per plant, harvest index, maturation period, 50% flowering period, number of shoots per plant, and plant height was also discovered. According to path coefficient research, there is a strong correlation between the quantity of yield per plant and the harvest index and the amount of grain produced per plant. This knowledge offers insightful understandings of how these characteristics interact and impact total grain output.

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