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EVALUATION OF WHEAT LANDRACES AND MODERN CULTIVERS FOR MORPHO YIELD TRAITS

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Abstract

The current research was conducted with the objective to estimate agronomic traits of wheat landraces and modern cultivars the heritability, variability among different agronomic characters in bread wheat genotypes in wheat Triticum aestivum L. Total of 36 advance wheat lines were evaluated in an alpha lattice design with two replications during 2025-26 at Cereal Crop Research Institute (CCRI), Pirsabak Nowshera Pakistan. Analysis of variance revealed significant differences among genotypes for majority of the traits. The study evaluated 36 advanced wheat lines for various agronomic traits, including days to heading, days to maturity, plant height, and spikelets per spike, 1000-grain weight and biological yield. Analysis of variance revealed significant differences among genotypes for most traits. High heritability was observed for traits like biological yield (0.99) and plant height (0.97) indicating strong genetic control and potential for improvement through selective breeding. Minimum values of days to heading, days to maturity and plant height is preferred in wheat breeding programs. Minimum desirable values for days to heading (104) were recorded for Gulzar-19 while minimum days maturity (141) were reported for Khaista- 17, Pirsabak-15 and khyber-23. Similarly, minimum desirable plant height (54cm) was observed for wheat land race i.e. Land-85. Moreover, maximum spikelets per spike (25.35) was noted for Land-85, while maximum thousand grain weight (56.85g) were recorded for modern wheat cultivars Abaseen-21 and Khaista-17, respectively. Likewise, maximum biological yield (15075.08 kg/ha) was reported for wheat genotypes Land-96. Wheat cultivar Abaseen-21 produced maximum grain yield i.e. 5321 kg/ha. For all the studied traits genetic variance was greater than environmental variance which indicated the greater role of genetic effects than environmental impacts. High heritability was observed for traits for all studied parameters, indicating strong genetic control and potential for improvement through selective

breeding. Overall, different genotypes showed best performance for different studied traits, therefore these genotypes could be used for improving specific trait in wheat breeding programs

INTRODUCTION

Wheat is a well-known grain with a long history. It is a very important crop because it is the main source of calories, protein, and necessary nutrients like zinc (Zn) and iron (Fe) for many people in developing countries (Saltzman *et al.*, 2017). More land is used to grow wheat than any other crop. In 2024, the global cultivation area was 31.4 million hectares, producing 791 million tonnes .The top 10 wheat-producing countries worldwide are China, India, Russia, the United States, France, Canada, Germany, Pakistan, Australia, and Ukraine (FAO 2023).

In Khyber Pakhtunkhwa during 2021-22, wheat crop production was 1.38 million tons from an area of 0.761 million hectares with an average yield of 1813.4 kg ha-1. The major wheat-producing districts in Khyber Pakhtunkhwa are Swat, Mansehra, D.I Khan, Mardan, Charsadda, Swabi, Peshawar, and Bunner (ASP, 2022). Local, traditional types of wheat land races are a valuable genetic resource. Landraces have been grown for a long time in harsh environments and with low fertilizer because they have adapted to survive there. Measuring their physical and growth traits (like plant height or harvest time) is very important for sorting and understanding different wheat types (Gharib *et al.,* 2021).

These observable traits are very useful for studying genetic differences. This process is vital for the improvement of better wheat (Gharib *et al.,* 2021). Giving recent plant material with unique heredity is also beneficial for enhancing modern varieties (Mansour *et al.*, 2018). When two parent plants are very genetically different from each other, their offspring can have much higher yields (Sajjad *et al.,* 2018). This is important because many modern wheat types are genetically very similar, which makes their gene pool very narrow. Therefore, it is necessary to study the physical and genetic diversity of local and modern wheat types. This helps breeders work more efficiently to increase food production (Abaza *et al.,* 2020). Genetic variability is the measure of the tendency of individual genotypes in a population to vary from one another for certain traits of interest which is the base of crop improvement (Chimdesa Bekana, 2014). The presence of genetic variability in a population can be divided into heritable and non-heritable variation. Knowledge about heritability helps to the plant breeder in predicting the behaviour of successive generation and making desirable selections which is the important tool in crop improvement. Genetic variability among tetraploid wheat genotypes can be estimated based on quantitative traits (Azene *et al.*, 2020). As it is in all over the world, erosion of genetic resources has been steadily increasing in our country as well and this condition forces researchers to establish gene banks by collecting material from these regions in order to provide genetic material (Eser *et al.*, 2024).

The demand for wheat has increased as a result of the rapid increase in world population. All present forms of life have evolved as a result of three key factors: mutation, which is the primary cause of heritable, variation; environment which is influenced by the selection of mutations that survive and grow in number and time, when evolution takes place as a result of ongoing interactions between the environment and the genotype (Czyczyo-Mysza *et al.*, 2013). To understand genetic relationships within pairs of quantitative traits, the idea of coheritability is presented High genetic progress and broad heritability show an important contribution that demonstrates an important role of additional genetic variation to the production of the traits (Laghari *et al.*, 2010).

OBJECTIVES

The objective of this study was to:

1. Explore variability among different wheat landraces for various agronomic traits i.e. plant height, 1000 grain weight and biological yield collected from different area of Pakistan.
2. Study phenological traits i.e. days to heading and maturity of landraces in comparison with newly developed wheat varieties.
3. Studied the genetic and phenotypic coefficient of variation for phenological, grain yield and yield related traits of wheat.

Materials and Methods

Crop Management

The research activity was carried out by sowing wheat cultivars in comparison of landraces for morpho-yield traits in (2024-2026) at the Cereal Crop Research Institute (CCRI), Pirsabak, Nowshera during the rabi season. Experimental material was consists of 36 diverse genotypes (27 local landraces and 9 modern wheat cultivars) was sown in alpha lattice design using with two replications. The evaluation of the morpho-physiological impact was analyzed in selected wheat traits. Four plants from middle rows of plot were selected randomly and tagged to record the data of different morpho- agronomical traits *viz.*, days to heading, days to maturity, plant height, spikelet per spike, 100 grains weight , grain yield and biological yield.

Table 1: List of genotypes (1to 27 local landraces and 9 modern cultivars)

S.no	Genotypes	S.no	Genotypes
1	LND-7	19	LND-94
2	LND-13	20	LND-95
3	LND-9	21	LND-96
4	LND-16	22	LND-100
5	LND-17	23	LND-104
6	LND-22	24	LND-109
7	LND-23	25	LND-110
7	LND-25	26	LND-112
9	LND-26	27	LND-113
10	LND-28	28	Khaista-17
11	LND-33	29	Pirsabak-15
12	LND-35	30	Pirsabak-19
13	LND-37	31	Pirsabak-21
14	LND-56	32	Abaseen-21
15	LND-72	33	Paseena-17
16	LND-83	34	Taskeen-22
17	LND-85	35	Khyber-23
18	LND-91	36	Gulzar-19

Statistical Analysis

The statistical analysis was carried out as per the method based on the Steel and Torri (1980). Mean separation was determined using the Least Significant Difference, and ANOVA for all studied traits was calculated by using the MSTATC.

RESULTS AND DISCUSSION

Table: 2 Mean performance of days to heading, days to maturity, plant height, spikelet per spike, thousand grain weight and biological yield.

Genotypes	Days to heading	Days to maturity	Plant height	Spikelet per spike	1000-grain weight (g)	Grain yield kg/h	Biological yield
LND-7	117.57	147	85.56	21.35	30.10	2341	11,035.08
LND-13	112.57	148	90.39	22.35	36.85	1931	5,545.08
LND-9	113.07	146	108.89	22.02	49.60	3961	12,955.08
LND-16	112.07	146	112.23	15.68	43.10	2311	8,555.08
LND-17	110.57	148	117.23	21.35	38.10	2501	11,975.08
LND-22	108.07	142	113.06	17.68	35.35	2711	10,205.08
LND-23	106.07	143	122.23	19.35	53.10	3961	12,045.08
LND-25	108.57	145	118.06	20.02	42.10	3591	11,505.08
LND-26	109.57	147	115.06	18.68	43.10	3261	11,505.08
LND-28	112.07	149	108.89	21.02	40.60	2501	10,875.08
LND-33	114.07	150	110.56	22.35	42.60	2811	10,735.08
LND-35	115.07	152	113.89	20.02	28.85	2151	8,335.08
LND-37	110.07	152	116.39	22.35	43.60	3261	13,465.08
LND-56	112.57	159	113.89	21.02	34.10	2901	11,845.08
LND-72	119.57	158	72.23	21.02	46.35	1741	7,345.08
LND-83	116.07	163	101.73	22.68	54.85	2751	9,165.08
LND-85	120.57	162	53.89	25.35	32.85	2411	6,845.08
LND-91	114.57	159	112.23	25.02	31.85	3111	11,445.08
LND-94	108.57	152	109.73	22.35	39.85	4151	11,975.08
LND-95	108.57	169	111.39	21.68	32.40	3701	11,385.08
LND-96	113.07	164	116.39	21.35	41.60	3951	15,075.08
LND-100	124.57	166	85.56	24.02	23.60	3811	6,045.08
LND-104	127.07	174	98.89	17.52	28.85	2411	9,265.08
LND-109	108.07	176	115.56	22.52	40.10	3941	13,375.08
LND-110	118.57	178	117.23	20.35	36.60	2471	9,985.08
LND-112	116.07	156	101.56	23.52	43.35	3331	11,395.08
LND-113	116.57	146	131.39	22.02	53.35	3891	11,035.08
KHAISTA-17	109.07	141	93.89	23.35	56.85	4921	11,165.08
PS-15	105.07	141	88.06	23.18	38.10	4946	11,375.08
PS-19	110.57	145	86.39	22.68	45.60	4101	10,045.08
PS-21	106.07	146	88.89	22.68	38.35	5031	10,895.08
ABASEEN-21	106.07	145	93.89	21.68	44.85	5321	12,255.08
PASEENA-17	110.57	147	85.56	24.02	42.10	4026	11,345.08
TASKEEN-22	112.07	142	79.73	22.02	45.35	4046	9,635.08
KHYBER-23	107.57	141	74.73	22.35	49.60	4281	8,575.08
GULZAR-19	104.07	147	76.39	21.02	52.35	4401	9,555.08
CV	1.42	1.06	2.89	5.54	3.09	4.17	1.50
LSD 5%	3.28	3	6.04	2.46	2.62	293.29	325.47

Table 3: Genetic components of different studied traits.

Traits	GV	VE	VP	H^2	GG	GCV	PCV
Days to heading	27.72	2.54	30.25	0.92	7.05	4.69	4.90
Days to maturity	88.89	2.64	91.53	0.97	13.01	6.18	6.27

Plant height	273.73	8.61	282.34	0.97	22.81	16.31	16.57
1000 grain weight	58.24	1.62	59.86	0.97	10.54	18.52	18.77
Spikelets per spike	3.28	1.43	4.70	0.70	2.11	8.39	10.05
Grain yield	660,263.08	16,793.39	677,056.47	0.98	1,123.40	27.66	28.01
Biological yield	4,168,238.31	24,973.33	4,193,212	0.99	2,849.75	19.33	19.38

GV=Genotypic variance, VE= Environmental variance, VP= Phenotypic variance, H^2= Heritability, GG= Genetic gain, GCV= Genotypic coefficient of variance, PCV= Phenotypic coefficient of variance.

Days to Heading

Analysis of variance (ANOVA) exhibited highly significant ($P \leq 0.05$) variation among wheat landraces and modern cultivars for days to heading (Table 1).

The LSD value for days to heading was 3.28 and coefficient of variation (CV) was 1.42%, which showed the validity of the experiment. Mean values for days to heading ranged from 104 to 127 days. The maximum number of days to heading was recorded for LND-104 (127 days), while the minimum was recorded for modern wheat cultivar Gulzar-19 (104 days).

Variation in days to heading among landraces was mainly due to genetic differences and adaptation to local environments. Landraces like LND-104 headed late at 127 days because they are adapted to cooler high-altitude areas of Khyber Pakhtunkhwa, where longer vegetative growth is required before reproductive phase. This late heading trait is important for breeding as it can be used to develop varieties for regions with longer growing seasons and to escape late-season frost. Conversely, early heading landraces like Gulzar-19 at 104 days are valuable for breeding early-maturing varieties in short-season areas. Thus, both early and late heading genotypes provide useful genetic diversity for future wheat improvement programs.

Genetic variance (GV = 27.72) was much greater than environmental variance (EV = 2.54), which indicated that days to heading were more influenced by genetic factors than environmental factors. Phenotypic variance was slightly higher than genotypic variance (Table 3.1.2). Moreover, genotypic coefficient of variation (GCV = 4.69%) was closer to phenotypic coefficient of variation (PCV = 4.90%), which showed that days to heading had greater influence of genetic factors compared to environmental effect (Table 3).

Furthermore, broad-sense heritability (H^2) for days to heading was high (0.92), which showed that environmental influence on days to heading was minimum. Genetic advance (GA) was computed as 7.05 units, which suggested that genetic variance could play an important role in the inheritance and improvement of earliness.

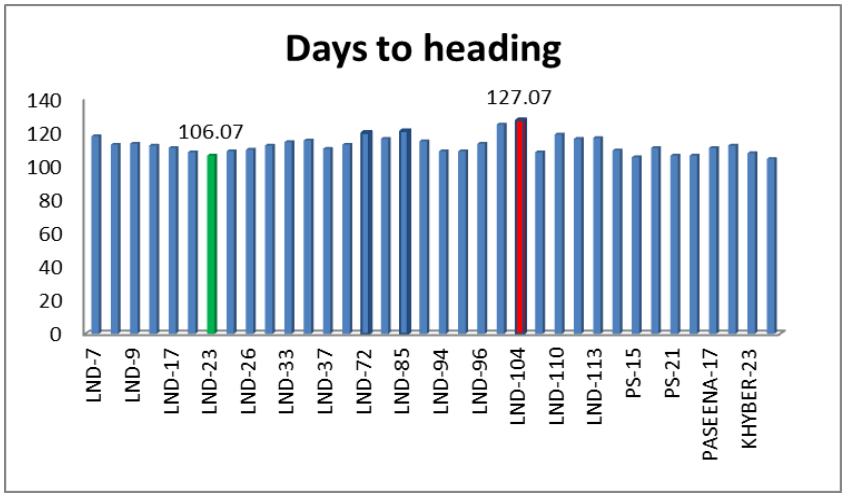




Figure3.1.1: Mean of days to heading of different wheat genotypes under experimental conditions. Genotypes with highest yield are represented by red bar, whereas genotypes with lowest yield are

Days to Maturity

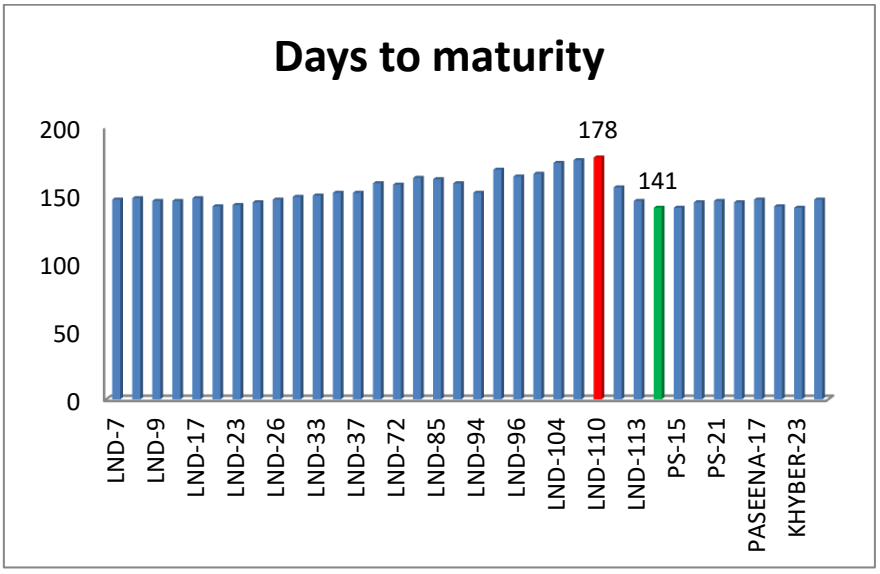
Statistical analysis of variance (ANOVA) revealed highly significant ($P \leq 0.05$) differences among wheat landraces and modern cultivars for days to maturity (Table 1).

The LSD value for days to maturity was 3.34 and coefficient of variation (CV) was 1.06%, which showed the precision of the experiment. Mean values for days to maturity ranged from 141 to 178 days. The maximum number of days to maturity was recorded for LND-110 (178 days), while the minimum was recorded for modern wheat cultivars Khaista-17, Pirsabak-15 and Khyber-23 (141 days).

Variation in days to maturity among landraces was mainly due to genetic differences and adaptation to local environments. Landraces like LND-110 matured late at 178 days because they are adapted to cooler high-altitude areas of Khyber Pakhtunkhwa, where longer vegetative growth is required. This late maturity trait is important for breeding as it can be used to develop varieties for regions with longer growing seasons and to avoid early heat stress. Conversely, early maturing landraces like Pirsabak-15 at 141 days are valuable for breeding drought-escape varieties in water-limited areas. Thus, both early and late maturing genotypes provide useful genetic diversity for future wheat improvement programs.

Genetic variance (GV = 88.89) was much greater than environmental variance (EV = 2.64), which indicated that days to maturity were more influenced by genetic factors than environmental factors. Phenotypic variance was slightly higher than genotypic variance (Table 3). Similarly, genotypic coefficient of variation (GCV = 6.18%) was closer to phenotypic coefficient of variation (PCV = 6.27%), which showed that days to maturity had greater influence of genetic factors compared to environmental effect (Table 3.1.3).

Furthermore, broad-sense heritability (H^2) for days to maturity was high (0.97), which showed that environmental influence on days to maturity was minimum. Genetic advance (GA) was computed as 13.01 units, which suggested that selection based on genotype could be effective for improving this trait.



Plant Height

The analysis of variance (ANOVA) demonstrated significant ($P \leq 0.05$) variation among wheat landraces and modern cultivars for plant height (Table 1).

The LSD value for plant height was 6.04 cm and coefficient of variation (CV) was 2.89%, which demonstrated the credibility of the experiment. Mean values for plant height ranged from 54 to 131 cm. The maximum plant height was recorded for LND-113 (131 cm) followed by LND-23 (122 cm), while the minimum plant height was noted for LND-85 (54 cm) followed by LND-72 (72 cm).

Variation in plant height among landraces was mainly due to genetic differences and adaptation to local environments. Landraces like LND-113 at 131 cm were tall because they are adapted to high-altitude areas of Khyber Pakhtunkhwa where tall stature helps in better light interception and competition with weeds. Tall genotypes are also useful for breeding dual-purpose wheat for grain and fodder. Conversely, dwarf landraces like LND-85 at 54 cm are valuable for breeding high-yielding, lodging-resistant varieties suitable

for high fertilizer input and irrigated conditions. Thus, both tall and dwarf genotypes provide useful genetic diversity for future wheat improvement programs.

Genetic variance (GV = 273.73) was much greater than environmental variance (EV = 8.61), which indicated that plant height was greatly influenced by genetic factors. Phenotypic variance (VP = 282.34) was slightly higher than genotypic variance (Table 3). Similarly, genotypic coefficient of variation (GCV = 16.3%) and phenotypic coefficient of variation (PCV = 16.57%) were very close, which indicated that variation in plant height was largely due to genetic factors rather than environmental factors.

Furthermore, broad-sense heritability (H^2) of 0.97 was recorded for plant height, which showed that environmental influence was minimal. Moreover, genetic advance (GA) was computed as 22.81 units, which suggested that selection based on genotype could be effective for improving this trait.

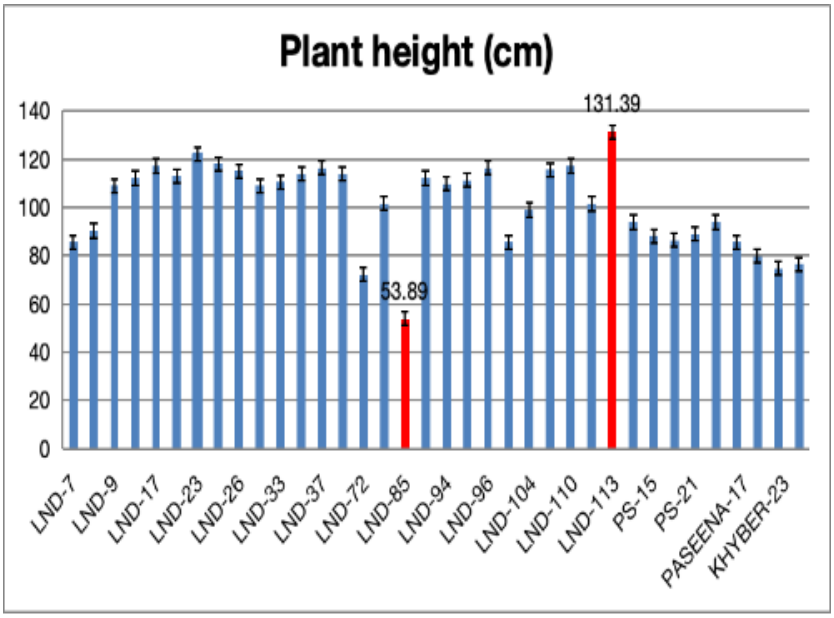


Figure 3.1.4: Bar graph showing variation in plant height



Figure Field view of wheat crop at plant height stage, plant height was recorded from soil surface to tip of tallest spikes, excluding awns.

Spikelets Per Spike

Analysis of variance (ANOVA) showed highly significant ($P \leq 0.05$) differences among wheat landraces and modern cultivars for spikelets per spike (Table 1).

The LSD value for spikelets per spike was 2.46 and coefficient of variation (CV) was 5.54%, which demonstrated the correctness of the experiment. Mean values for spikelets per spike ranged from 15.68 to 25.35. The maximum number of spikelets per spike was noted for LND-85 (25.35) followed by LND-91 (25.05) and LND-100 (24.02), while the minimum number of spikelets per spike was recorded for LND-16 (15.68) followed by LND-104 and LND-22 (17.52).

Variation in spikelets per spike among landraces was mainly due to genetic differences. Landraces like LND-85 with 25.35 spikelets per spike had more spikelets because they possess genetic potential for higher sink capacity, which is important for breeding high-yielding wheat varieties. Genotypes with more spikelets per spike can produce more grains per spike and contribute directly to grain yield. Conversely, landraces like LND-16 with 15.68 spikelets per spike may be adapted to stress environments where fewer but larger grains are advantageous. Thus, both high and low spikelet number genotypes provide useful genetic diversity for future wheat improvement programs.

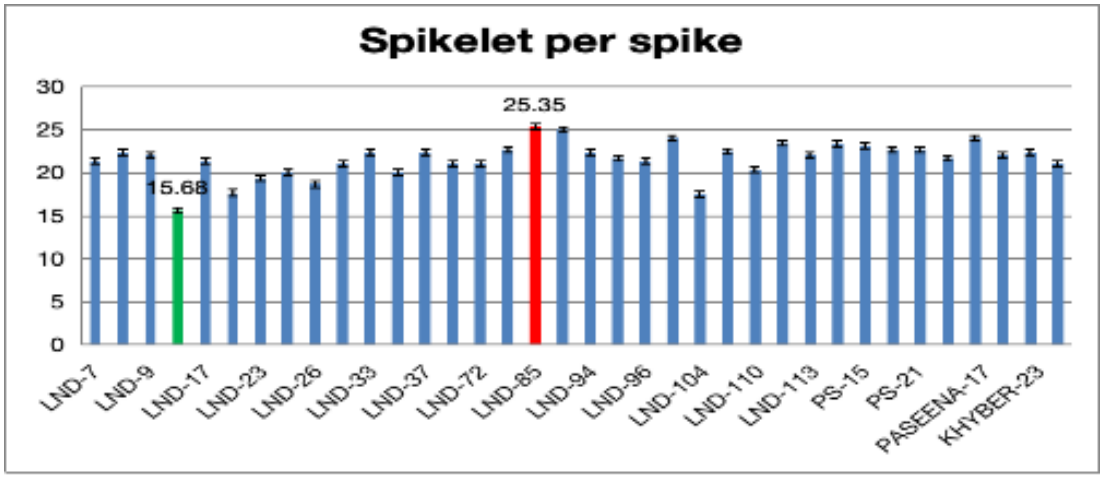


Figure 3.1.6: Spikelets per spike of wheat genotypes variation in number of spikelets per spike among tested wheat lines. The red bar indicates the genotype with the maximum value, recorded as 22.50. Data are means with standard deviation.

The genetic analysis estimated greater genetic variance (GV = 3.28) than environmental variance (EV = 1.43), which showed a greater genetic influence, though it was slightly less than the overall phenotypic variance (VP = 4.70) for spikelets per spike (Table 3). Similarly, genotypic coefficient of variation (GCV = 8.39%) was slightly less than phenotypic coefficient of variation (PCV = 10.05%), which indicated a narrow range of variability. Moreover, broad-sense heritability (H^2) for spikelets per spike was high (0.70), which showed minimum environmental influence on this trait. Furthermore, genetic advance (GA) was computed as 2.11, which ranged in the low category and suggested that improvement for spikelets per spike would be restricted through simple selection.

1000-Grain Weight (g)

The statistical analysis showed highly significant ($P \leq 0.05$) variation among hexaploid wheat landraces and modern cultivars for 1000-grain weight (Table 1).

The LSD value for 1000-grain weight was 2.62 g and coefficient of variation (CV) was 3.09%, which showed the correctness of the experiment. The mean values for 1000-grain weight ranged from 23.60 to 56.85 g. The maximum 1000-grain weight was observed for cultivar Khaista-17 (56.85 g), while the minimum 1000-grain weight was noted for LND-100 (23.60 g).

Variation in 1000-grain weight among landraces was mainly due to genetic differences. Cultivars like Khaista-17 with 56.85 g 1000-grain weight had heavier grains because they possess genetic potential for

better grain filling and source-sink relationship, which is important for breeding high-yielding wheat varieties. Higher 1000-grain weight contributes directly to grain yield and market value. Conversely, landraces like LND-100 with 23.60 g 1000-grain weight may be adapted to stress environments where smaller grains with more grains per spike are advantageous. Thus, both high and low grain weight genotypes provide useful genetic diversity for future wheat improvement programs.

The genetic variance (GV = 58.24) was much greater than environmental variance (EV = 1.62) and slightly less than that of the phenotypic variance (VP = 59.86) (Table 3), which indicated that 1000-grain weight was greatly influenced by genetic factors than environmental factors. Moreover, genotypic coefficient of variation (GCV = 18.52%) was closer to phenotypic coefficient of variation (PCV = 18.77%), which suggested the greater role of genetic component than environmental influence.

Furthermore, broad-sense heritability (H^2) for 1000-grain weight was high (0.97), which demonstrated the major role of genetic control with minimal environmental impact. Moreover, genetic advance (GA) was high (10.54), which suggested that improvement for 1000-grain weight was possible through effective selection.

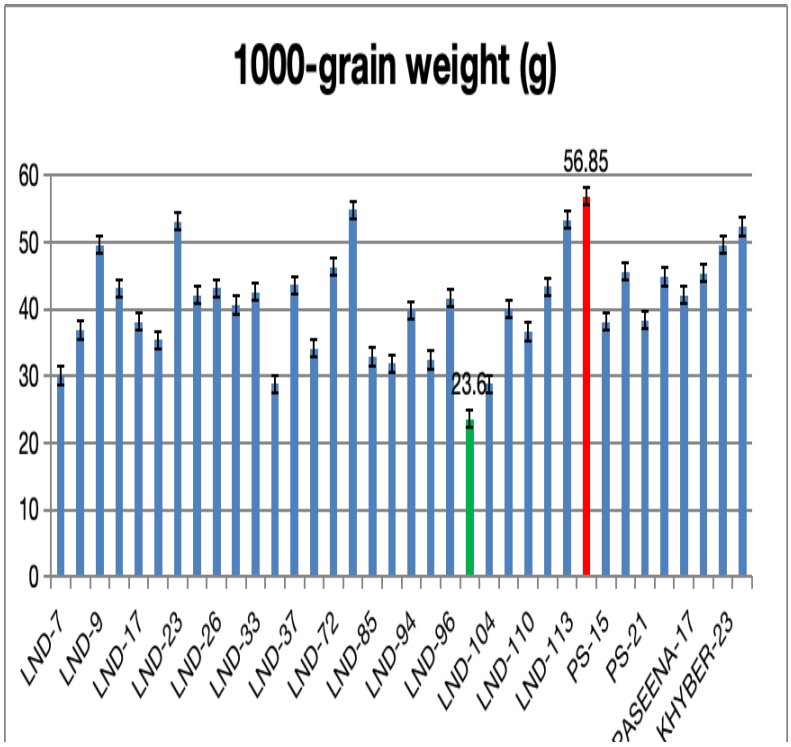


Figure 3.1.11: 1000-grain weight (g) of wheat genotypes variation in 1000-grain weight among tested wheat lines. The red bar indicates the genotype with the highest value.



Figure: Electronic balance displaying the weight of 1000 wheat grains during 1000 grain weight measurement.

Grain yield (kg/ha)

Analysis of variance (ANOVA) showed highly significant ($P \leq 0.05$) differences among wheat landraces and modern cultivars for grain yield (Table 1).

The LSD value for grain yield was 293.29 kg/ha and coefficient of variation (CV) was 4.17%, which showed the correctness of the experiment. The mean values for grain yield ranged from 1741 to 5321 kg/ha. The maximum grain yield was reported for Abaseen-21 (5321 kg/ha), while the minimum grain yield was recorded for LND-72 (1741 kg/ha).

Variation in grain yield among landraces was mainly due to genetic differences and their yield potential. Cultivars like Abaseen-21 with 5321 kg/ha grain yield performed best because they possess genetic potential for higher tillering, more grains per spike, and better grain filling, which are important traits for breeding high-yielding wheat varieties. High-yielding genotypes are valuable for food security and farmer income. Conversely, landraces like LND-72 with 1741 kg/ha grain yield may be adapted to marginal environments with low input conditions where stability is more important than maximum yield. Thus, both high and low yielding genotypes provide useful genetic diversity for future wheat improvement programs.

The genetic variance (GV = 927846.41) was much greater than environmental variance (EV = 20278.72), which indicated that grain yield was greatly influenced by genetic factors. Phenotypic variance (VP = 948125.14) was slightly higher than genotypic variance (Table 3). Moreover, genotypic coefficient of variation (GCV = 28.21%) was closer to phenotypic coefficient of variation (PCV = 28.52%), which demonstrated that grain yield was largely influenced by genetic components compared to environmental factors.

Furthermore, broad-sense heritability (H^2) for grain yield was high (0.98), which indicated that grain yield was mainly influenced by genetic factors with minimal environmental impact. Moreover, genetic advance (GA) was computed as 13.34%, which suggested that genetic components could play an important role in the inheritance and improvement of grain yield.

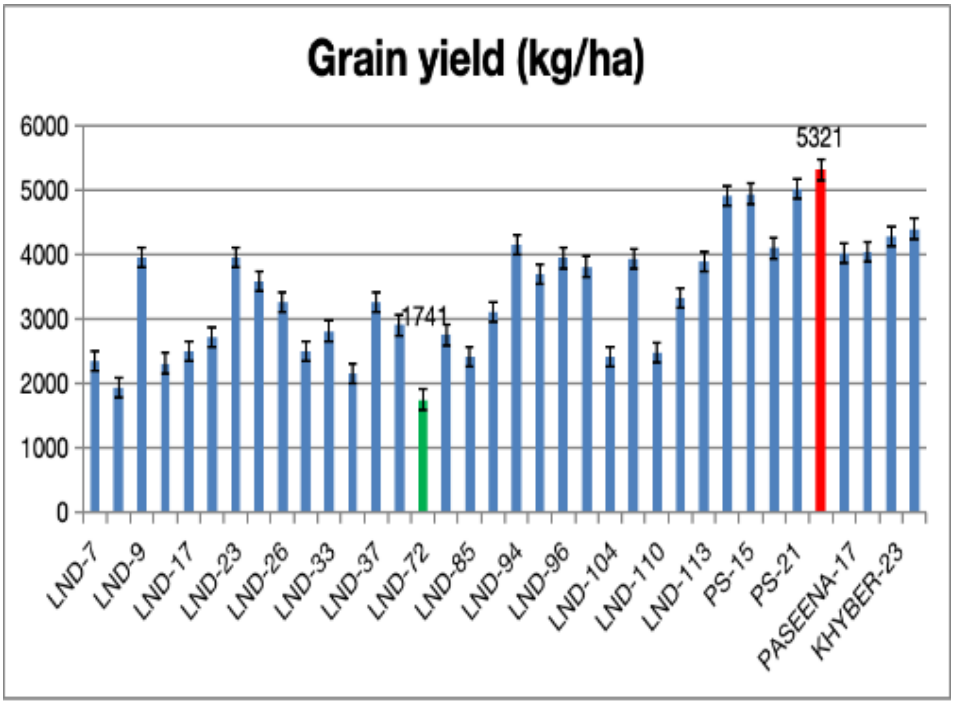




Figure 3.1.13: Bar graph showing grain yield (kg/ha) across wheat lines, with PS-21 recording the highest yield (5821 kg/ha). Bottom: Representative wheat grain sample from harvested plots. Error bars indicate standard deviation.
Figure 3.1.14: Comparative view of wheat grain sample of wheat landraces and modern cultivars

Biological Yield

Analysis of variance (ANOVA) showed highly significant ($P \leq 0.05$) differences among wheat landraces and modern cultivars for biological yield (Table 1).

The LSD value for biological yield was 325.47 kg/ha and coefficient of variation (CV) was 1.50%, which showed the correctness of the experiment. The mean values for biological yield ranged from 5545.08 to 15075.08 kg/ha. The maximum biological yield was reported for LND-96 (15075.08 kg/ha) followed by

LND-109 (13375.08 kg/ha), while the minimum biological yield was recorded for LND-13 (5545.08 kg/ha) followed by LND-100 (6045.08 kg/ha).

Variation in biological yield among landraces was mainly due to genetic differences in total biomass production. Landraces like LND-96 with 15075.08 kg/ha biological yield produced more biomass because they possess genetic potential for higher plant height, more tillers, and better vegetative growth, which is important for breeding dual-purpose wheat for grain and fodder. High biological yield genotypes are valuable for livestock feed. Conversely, landraces like LND-13 with 5545.08 kg/ha biological yield may have higher harvest index and partition more assimilates to grain rather than vegetative parts. Thus, both high and low biomass genotypes provide useful genetic diversity for future wheat improvement programs.

The genetic variance (GV = 4168238.31) was much greater than environmental variance (EV = 24973.33), which indicated that biological yield was greatly influenced by genetic factors. Phenotypic variance (VP = 4193211.64) was slightly higher than genotypic variance (Table 3). Moreover, genotypic coefficient of variation (GCV = 19.33%) was closer to phenotypic coefficient of variation (PCV = 19.38%), which confirmed that biological yield was largely influenced by genetic components compared to environmental factors.

Furthermore, the estimates of broad-sense heritability (H^2) for biological yield was high (0.99), which showed that it was largely influenced by genetic factors with minimal environmental impact. Moreover, genetic advance (GA) was computed as 2849.75 kg/ha, which suggested that genetic variance could play an important role in the inheritance and improvement of biological yield.

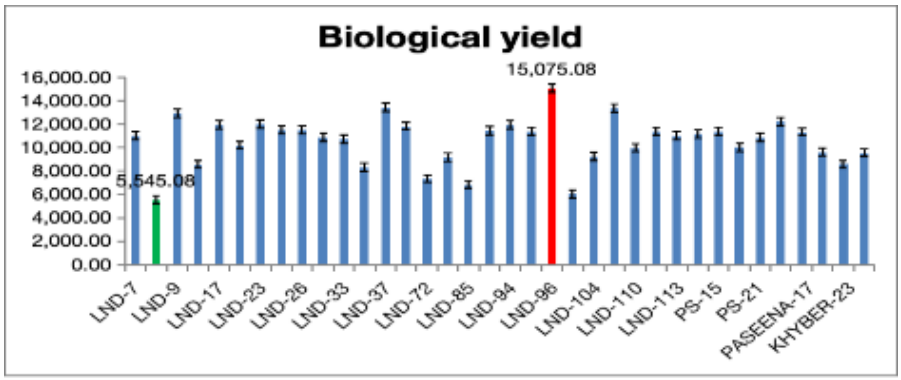


Figure 3.1.18: Field view of mature wheat crop showing phenotypic variation among wheat landraces of modern cultivars.



DISCUSSION

The present study evaluated the wheat landraces of modern wheat cultivars and genetic variability, heritability, genetic advance of important agronomic and yield-related traits in wheat genotypes. Understanding the magnitude of genetic and environmental contributions to trait expression is essential for developing effective breeding strategies and selecting superior genotypes. In general, the observed phenotypic variance (Vp) was higher than genotypic variance (Vg) for most traits, indicating some degree of environmental influence on trait expression. However, the relatively high values of Vg compared to environmental variance (Ve), along with moderate to high broad-sense heritability estimates for several traits, suggested that genetic factors played a predominant role in controlling these characteristics. Similar findings have been reported by various researchers, supporting the reliability of the present results and highlighting the potential for effective selection and genetic improvement in wheat. The trait-wise comparison of the current findings with previous studies is discussed below.

Days to heading

The outcomes of Devesh et al., (2018) was similar to the results of present studies for days to heading with greater Vg than Ve and high heritability showed minimum influence of the environmental factor.

Days to maturity

Babar *et* al. (2022), Dagnaw *et* al., (2022), Azene *et al.,* (2020), reported similar results like the present research work with greater genetic factor, phenotypic variance than environmental variance and high broad-sense heritability among wheat varieties for days to maturity which showed minimum influence of the environmental factZAor.

Plant height

Moreover, Meles *et al.*, (2017) also reported high heritability which showed minimum influence of the environmental factor.

Spikelets per spike

Johnson et al., (2021) reported similar result like the current study with high broad-sense heritability for spikelets per spike. However, he reported greater genetic gain for wheat varieties which was in contrast with current investigation with low genetic gain for spikelets per spike. Moreover, the results of Yadav et al.,(2021) was in support of current research work with high PCV than GCV and low genetic gain for spikelets per spike. However, he mention low heritability for spikelet per spike which was in contrast with the current investigation.

1000 Grain weight

Fikir Desalew (2024), and Kaddem *et* al. (2014)) recorded greater Vg than Ve and lesser value than VP with high heritability and genetic gain for 1000 grain weight which supported the results of present study that indicated the favorable conditions for effective selection and genetic improvement.

Grain Yield

Fikir Desalew (2024)) recorded greater Vg than Ve and lesser value than Vp with high heritability and genetic gain for grain yield which supported the results of present study that indicated the favorable conditions for effective selection and genetic improvement. However, Dagnaw *et* al., (2022) demonstrated moderate broad-sense heritability (0.42) and Genetic gain for wheat grain yield.

Biological Yield

Ahmad and Gupta (2023) and Rauf *et* al., (2023) observed high Vg than Ve and slightly less than Vp values and high heritability for biological yield of wheat, which was matching with results of this study. However, Parkash *et* al., (2020) reported greater Ve than Vg and low heritability which showed the greater environmental influence on biological yield of wheat.

CONCLUSION

The study at CCRI, Pirsabak (2024–2026) showed that both local landraces and modern wheat cultivars had significant differences in important yield-related traits such as days to heading, days to maturity, plant height, spikelets per spike, 1000-grain weight, grain yield and biological yield. In nearly all cases, genetic variance was much higher than environmental variance, and heritability values were very high (often above 0.90). This indicates that these traits are strongly controlled by genetic factors rather than environmental influences. Traits like plant height, 1000-grain weightand biological yield showed high genetic gain, meaning they can be effectively improved through selection. Overall, the results confirm that genetic diversity among landraces and cultivars can be exploited for wheat improvement. Form evaluation of wheat land races and modern cultivars for morpho yield traits it was concluded that different genotypes showed best performance for different studied traits, therefore these genotypes could be used for improving specific trait in wheat breeding programs i.e. modern cultivar Abaseen-21 could be used to improve grain yield while land race Land-113 could be used to improved spike length in newly developed wheat cultivars.

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