



Analyzing morphological variability in *Phalaris minor*: An in-depth multivariate analysis

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Abstract: *Phalaris minor* Retz. (Littleseed canarygrass), it is a highly invasive annual grassy weed, posing a significant threat to global wheat production by causing yield losses of up to 80%. This study provides a comprehensive analysis of *P. minor*, integrating its botanical characterization, ecological impact, and a detailed morphometric examination. Samples were collected from wheat fields to quantify key morphological traits, including shoot length (84.44 cm), root architecture (15.33 roots per plant), biomass (3.56g fresh shoot weight), and moisture content (80.30% in shoots). Analysis of Variance (ANOVA) revealed significant morphological variations across locations, while correlation analysis uncovered complex inter-trait relationships, such as a strong positive link between leaf area and fresh shoot weight, indicating adaptive vigor. The research confirms the weed's competitive superiority, evidenced by its high moisture retention capacity and robust growth metrics, which enable it to thrive in harsh conditions alongside crops. Despite limited ecological roles as ground cover and bird forage, its primary impact remains severely negative. This study underscores the critical need for effective, sustainable management strategies beyond herbicide reliance to mitigate the substantial agronomic and economic damage caused by this pervasive weed.

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Introduction

In agriculture, weed means any plant growing where it's not wanted and competing with crops for resources like sunlight, water, and nutrients. Even if a plant is naturally harmless (like grass or wildflowers), it's considered a weed if it pops up in the wrong place—like among wheat, rice, or vegetables. Farmers control weeds through methods like hand weeding, tillage, mulching, crop rotation, and herbicides to protect their crops. *Phalaris minor* is a major weed in agriculture, especially in wheat fields. Common name: Canary grass or Gulli danda (in South Asia). Type: Annual grassy weed. Origin: Native to the Mediterranean region, but now widespread in Asia, Africa, and other wheat-growing areas. Appearance: Looks very similar to wheat when young, which makes it hard to spot early. It has flat leaves, a soft texture, and a spike-like seed head. Produces a large number of seeds, leading to rapid spread. Family: Pinaceae (Grass family), Genus: *Phalaris*, Species: *Phalaris minor* Retz. *Phalaris minor* seeds generally have very limited useful applications in agriculture because this plant is considered a harmful weed, especially in wheat fields.

However, there are a few points worth noting: Forage (with caution): In some areas, the green plant (before maturity) is occasionally used as fodder for cattle, but mature seeds and older plants can be toxic to livestock if eaten in large amounts due to alkaloids. Research purposes: Seeds are sometimes used in weed science experiments to study germination, herbicide resistance, and weed-crop competition. No commercial food value: Unlike other *Phalaris* species grown for birdseed, *Phalaris minor* is not recommended for human or poultry consumption because it has no nutritional advantage and can be harmful. Medical uses of *Phalaris minor* weed: *Phalaris minor* is not commonly used in medicine; in fact, it's mostly known as an agricultural weed and potential toxin, not a medicinal herb. Toxicity concerns: The seeds and foliage can contain tryptamine alkaloids and other compounds that may cause neurotoxicity in animals if consumed in high amounts. *Phalaris minor* is not a recognized medicinal plant. Its main significance is as a problematic weed in agriculture, and any potential pharmacological uses are still in research stages. It's

unsafe to self-medicate with it. *Phalaris minor* grows best in conditions that favor wheat, which is why it becomes such a big problem in wheat fields. Optimal Environment for Growth: Climate, Prefers cool season (temperate to subtropical) climates. Best growth in winter months with moderate temperatures (15–25°C). Cannot tolerate extreme heat for long periods. Soil: Grows in a wide range of soils, but thrives in fertile, well-drained loam. Does well in soils with neutral to slightly alkaline pH (6.5–8.0). Moisture: Needs adequate moisture during germination and early growth. Flourishes in irrigated wheat fields due to regular watering. Light: Full sunlight promotes vigorous growth. Shaded areas reduce seed production, but plants can still survive.

Importance of *Phalaris minor*: Although *Phalaris minor* is mainly known as a harmful weed in agriculture, it still has some importance from an ecological and research perspective.

Agricultural importance (negative): Uncontrolled growth of *Phalaris minor* in the wheat (*Triticum aestivum*) crop has remained a problem, leading to a massive reduction in wheat grain production, causing 50-80% yield loss if uncontrolled. Competes for nutrients, water, and sunlight, reducing crop growth. Herbicides are used to control the weed, which leads to the development of frequent resistance in *P. minor* (Yadav2022).

Ecological importance: Acts as ground cover in fallow lands, reducing soil erosion. Provides habitat for some insects and microorganisms in natural ecosystems. Seeds serve as occasional food for some wild birds (though not preferred).

Research importance: Used in weed science to study herbicide resistance mechanisms. Model weed for testing weed–crop competition in wheat. Studied for possible bioactive compounds (antibacterial, antifungal) in laboratories

Disturbing weed, *P. minor*, was examine most worrying periodic lawn weeds in agro ecosystems in many areas, and has an effect in serious yield depletion of most agronomic crops, especially wheat. Right now, the use of chemical treatments is the main system used for control of this weed. Still, long-term action of chemical dressings has led to environmental pollution, pesticide resistance, and life-threatening health problems. Managing this weed using biologically feasible approaches is still a worldwide difficulty.

Phalaris minor is a periodic lawn weed. It's the most worrisome weed in the wheat crop, substantially in a rice–wheat system, which is a main system. Almost 40 percent of the total wheat area of the country is balanced under this system; notable among these areas are heavily overran by *P. minor*, which appears along the cultivating wheat crop, and reduces the grain yield (Bhan and Kumar, 1997). Checks of wheat in the countries of Punjab (Bir and Sidhu, 1979; Singh et al., 1995b) have established the occurrence of *P. minor*. Encyclopedically, *P. minor* has appeared in

more than 60 countries of the world. Both drought and salt stresses reduce the growth of *Phalaris* species (Rezvani, 2021). Because cropping systems can greatly affect the start and spread of non native species, populations, the design of cropping systems to control invasive weeds is an important approach for invasive species management in agro-ecosystems to avoid increases in other control measures such as herbicides, but the development of cropping systems for ecological control of this weed have received limited research attention, seed dormancy, germination characteristics and reproductive responses of *P. minor* to many cropping systems to show how cropping systems could be planed best to control *P. minor* research showed that cropping systems amazing afflicted seed dormancy in submerged paddy fields (Xu et al., 2019).

In the absence of weed management, delaying sowing leads to an increase in wheat yield compared to earlier sowing. Research indicated that utilizing organic mulches can effectively and sustainably control the infestation of *P. minor*, thereby boosting wheat yield (Hadayat, 2024). Seed placement, soil temperature, and soil moisture content impact the process of after-ripening in *Phalaris minor* seeds. Seeds of *P. minor* collected from the soil just after wheat harvesting showed higher germination than seeds from *P. minor* threshed directly. There was a major effect of the seasonal habitation of seed in the soil on sprouting after its dispersal. Germination was notably hindered when seeds were in soil with moisture levels exceeding field capacity (FC) or submerged in water at 30°C (Yadav, 2022).

Control Method: Detect and remove weeds early before they flower. Practice crop rotation to avoid planting wheat continuously. Apply recommended herbicides. For long-term resistance management and to maintain sustainable wheat yields, supplement herbicide use with integrated weed management tactics. These include soil solarization, rotating crops, managing crop residues, planting wheat varieties with strong early growth, applying herbicides at the right time and dose, using optimal seeding rates, planting in closer rows, utilizing microbial herbicides, considering allelochemicals, and using proper spraying methods. These are practical options for farmers to minimize losses from problematic weeds and boost wheat productivity (Hadayat, 2024).

Material and styles Collection of factory materials Samples of *Phalaris minor* were collected from three different fields of the Rice Research Institute, Kala Shah Kaku. **Latitude** 31.7022655 and **Longitude** 74.267278. The entire factory material was also measured subordinated to shade- drying

1. Shoot length(cm) was measured from the point of attachment of the stem to the root (base of the stem), and the longest shoot on each factory, the average shoot length is around 84.44 cm

2. Fresh Weight(g)(Shoot)

Fresh weight was calculated immediately after the weed sample was removed from the field to prevent the sample from drying out. An electronic weight balance was used to measure the weight of the sample. Average fresh weight is around 3.56g

3. Dry Weight of shoot

The sample (Shoot) was dried for 8 days at room temperature to measure the dry weight. Each sample was labeled separately and left to dry for 8 days. After the sample was dried, it was weighed on an electron balance, and the average dry weight was 0.584 g.



*Shoot length of weed at three different locations of RRI

4. No. of Leaves

The number of leaves on a plant can be important for Photosynthesis, Plant health, and growth stage. The average number of leaves is 6.

5. Length of Roots (cm)

The length of the root was calculated to evaluate the plant's ability to absorb water and nutrients from the soil. This measurement provides insights into the plant's root system architecture, and the average root length is 8.33 cm.

6. No. of Roots

The number of roots to comprehend the plant's root system and its potential for nutrient uptake. This parameter is related to plant growth and development; the average number of roots of *Phalaris minor* is 15.33.



*Roots in three different fields of RRI

7. Leaf Length (cm)

Three leaves were randomly selected from each plant, and a cm scale was used to record their length. Then, the average of the three values was calculated average

leaf length of all nine plants at three different locations is 24.83 cm.

8. Leaf Width(cm)

Leaf range was measured at three points on each splint: the base, center, and tip. Three leaves were randomly picked from each plant, and the width at each point was recorded. The average value of three measurements was then calculated, average value is 1.05 cm.

9. Inflorescence length(cm)

The study examined the average influence length, a critical parameter in grasping plant growth patterns. This measurement provides insights into the plant's ability to absorb nutrients and water, ultimately affecting its overall development. The average inflorescence length of all nine plants is 4.66 cm.

10. Inflorescence width(cm)

Inflorescence width was another key parameter evaluated in the study. This trait is essential in controlling the plant's reproductive potential and seed production capacity, which can significantly impact yield and plant propagation average width of the inflorescence is 1.18 cm.

11. Colour of Leaves

The color of leaves was assessed to understand the plant's health and nutritional status. Leaf color can indicate nutrient deficiencies.



*Inflorescence at three different fields of RRI

Stress, or disease, is a vital parameter in plant growth and growth studies, and here, our case colour of all plants at three different locations is light green.

12. No. of Tillers per plant

Number of tillers per plant to assess the plant's growth and productivity. This parameter is crucial in determining the plant's potential for seed or grain production. The average number of tillers per plant is 4.3.

13. Fresh Weight of Root (g)

The root system had an average fresh weight of 0.305 g.

14. Dry Weight of Root (g)

Dry weight of roots to evaluate the plant's root biomass and its potential for nutrient storage and average dry weight of roots is 0.22 g.

15 Fresh Weight of Inflorescence

The fresh weight of inflorescence was calculated to assess the plant's reproductive potential and seed production capacity. This measurement provides awareness into the plant's flowering and seed development and average fresh weight of inflorescence is 0.650 g in assessing plant productivity and seed quality and average dry weight of inflorescence was around 0.300 g.

16. Leaf Area (cm²)

To measure leaf area, leaf length is multiplied by leaf width and a correction factor of 0.74cm. The formula used to find the leaf area was as follows:

Leaf area= leaf width * leaf length x 0.74 Plant

Average leaf area is around 19.41 cm².



*Overview of experimental plant's Root, Shoot, and Inflorescence

17. Inflorescence Area

The inflorescence area was computed to assess the plant's reproductive potential and flowering capacity. This measurement provides valuable insights into the plant's ability to produce seeds and fruits. The average inflorescence area is 4.14 cm².

18. Moisture Percentage (%)

The total moisture percentage of the inflorescence, root, and shoot was recorded using the following formula.

19. Moisture Percentage

(Fresh weight - dry weight)/ fresh weight*100

20. Shoot Moisture

The shoot moisture content was calculated to evaluate the plant's water status and its impact on growth and development. This parameter is essential in understanding plant water relations and stress tolerance. The average shoot moisture percentage is around 80.30 %.

21. Root Moisture

The root moisture content was determined to assess the plant's ability to absorb and retain water. This measurement is critical in understanding plant water uptake and root function. The average root moisture is 27.85%.

22. Inflorescence Moisture

The inflorescence moisture content was calculated to evaluate the plant's water status during the reproductive stage. This parameter provides insights into the plant's ability to keep water balance during flowering and seed development. The average inflorescence moisture is 54.18%.

Results and discussion

The results are presented in the given table 1. Demonstrate statistically indicated outcomes between the studied locations of *Phalaris minor*. The average shoot length was recoded as (84.44 cm), fresh weight (3.56g), Dry weight (90.584g), No. of leaves 6, Inflorescence length (4.66cm), Inflorescence width (1.18cm) ,Length of Roots (8.33cm), No. of Roots (15.33), Leaf length (24.83cm), Colour of Leaves was Light Green, No. of Tillers per plant (4.3), Fresh weight of Root (0.305), Dry weight of Root(0.22g), Leaf width (1.05cm), Fresh weight of Inflorescence (0.650 g), Dry weight of Inflorescence (0.300g), Leaf Area (19.41cm²), Inflorescence Area (4.14 cm²), Shoot Moisture (80.30%), Root Moisture (27.85%), Inflorescence Moisture (54.18%), for *Phalaris minor* Plant Gathered at Three different locations. The Greater the plant's fresh weight, the more vigorous *Phalaris minor* grows under varying environmental conditions. The higher moisture percentage indicates it can bear the harsh, hot, and dry climate. So, removing these plants from crop fields is important due to their competitive nature. The Tukey test revealed a significant difference among the three locations. The comparative analysis revealed that location 1 was best for: Shoot length, Fresh shoot weight, No. of leave, Length of root, No. of tillers per plant, Inflorescence width, Inflorescence length, Width of leaves. Fresh weight of root, Dry weight of root, leaf area, shoot moisture, root moisture, Inflorescence moisture for production and elongation, for the most favorable conditions for number and length of inflorescence, whereas location 2 was superior for Dry shoot weight, and inflorescence area. And location 3 can be regarded as the best for No. of roots, length of root, Fresh weight of inflorescence, dry weight of inflorescence.

Table 1. Genetic components for various traits of *Phalaris minor*

Traits	M.S	G.M	GV	GCV %	PV	PCV %	EV	ECV %	h ² bs%	GA%
SL	160.77	84.44	52.89	79.14	55.00	80.70	2.11	15.81	96.16	104.84
FSW	8.30	3.57	2.70	87.05	2.89	90.01	0.19	22.87	93.55	115.32
DSW	0.05	0.58	0.02	16.76	0.02	18.83	0.00	8.59	79.20	22.20
No. of L	4.11	5.89	1.22	45.56	1.67	53.19	0.44	27.46	73.35	60.35
RL	7588.00	8.33	2529.07	1742.13	2529.86	1742.40	0.79	30.82	99.97	2307.91
No. of R	25.33	15.33	7.72	70.97	9.89	80.31	2.17	37.59	78.09	94.02

LL	1.58	24.83	0.47	13.79	0.64	16.04	0.17	8.19	73.92	18.27
LW	0.05	1.06	0.01	11.46	0.02	13.76	0.01	7.61	69.41	15.18
IL	2.33	4.67	0.72	39.34	0.89	43.64	0.17	18.89	81.25	52.11
IW	0.01	1.19	0.00	6.10	0.01	6.82	0.00	3.05	79.96	8.08
TPP	0.58	4.33	0.17	19.61	0.25	24.02	0.08	13.87	66.68	25.98
FWR	0.08	0.31	0.03	28.95	0.03	29.56	0.00	6.00	95.89	38.35
DWR	0.00	0.16	0.00	5.77	0.00	7.64	0.00	5.00	57.14	7.65
FWI	0.12	0.65	0.04	24.14	0.04	25.47	0.00	8.13	89.81	31.98
DWI	0.06	0.29	0.02	26.04	0.02	26.70	0.00	5.87	95.16	34.50
LA	19.60	19.42	5.66	53.97	8.29	65.33	2.63	36.81	68.25	71.49
IA	2.87	4.14	0.92	47.24	1.02	49.54	0.09	14.90	90.95	62.59
SM	309.68	80.30	96.73	1.10	116.22	0.13	19.49	49.27	83.23	145.40
RM	1251.60	39.80	417.08	3.24	417.45	0.51	0.37	9.64	99.91	428.85

SL =Shoot Length, FSW=Fresh Shoot Weight, DSW=Dry Shoot Weight, No. L=No. of Leaves, RL=Root Length, No. R=No. of Root, LL= Leaves Length, LW=Leaves Width, IL=Inflorescence Length, IW=Inflorescence Width, TPP=Tillers Per Plant , FWR=Fresh Weight of Root, DWR=Dry Weight of Root, FWI=Fresh weight of Inflorescence, DWI=Dry Weight if Inflorescence, LA=Leaf Area, IA=Inflorescence Area, SM=Shoot Moisture, RM=Root Moisture, IM=Inflorescence Moisture

Table 2: Correlation coefficients among morphological traits of *Phalaris minor*

	SL	FSW	DSW	No. L	RL	No. R	LL	LW	IL	IW	TPP	FWR	DWR	FWI	DWI	LA	IA	SM	RM
FSW	0.47																		
DSW	*-	*-																	
No. L	-0.04	*0.76	-0.53																
RL	0.09	*0.73	-0.62	*0.79															
No. R	0.51	-0.34	0.06	*-0.67	-0.63														
LL	*0.84	0.32	-0.41	-0.16	0.02	0.62													
LW	0.40	*0.90	*-0.76	*0.82	*0.74	-0.31	0.31												
IL	-0.46	0.25	0.02	0.5	0.31	*-0.89	*-0.66	0.16											
IW	*-	-0.13	0.39	0.25	-0.16	-0.55	*-0.78	-0.05	*0.74										
TPP	0.32	*0.88	-0.61	*0.70	*0.72	-0.51	0.28	*0.77	0.43	-0.06									
FWR	0.19	*0.86	*-0.72	*0.75	*0.82	-0.59	-0.03	*0.81	0.47	0.08	*0.75								
DWR	0.001	0.55	-0.54	0.52	0.57	-0.51	-0.24	*0.60	0.48	0.31	0.44	*0.86							
FWI	*0.80	-0.01	-0.24	*-0.43	-0.22	*0.75	*0.87	-0.05	*-	*-0.8	-0.04	-0.35	-0.52						
DWI	0.56	-0.40	0.06	-0.70	-0.55	*0.85	0.62	-0.43	*-	*-	-0.43	*-	*-	*0.90					
LA	0.55	*0.89	*-0.78	*0.71	*0.68	-0.14	0.50	*0.97	0.007	-0.22	*0.77	*0.73	0.49	0.13	-0.25				
IA	*-	0.15	0.12	*0.45	0.20	*-0.85	*-0.73	0.11	*0.98	*0.84	0.31	0.40	0.46	*-	*-0.76	-0.06			
SM	*0.54	0.96	*-0.89	*0.69	*0.65	-0.22	0.35	*0.85	0.15	-0.20	*0.81	*0.81	*0.56	0.04	-0.31	*0.85	0.05		
RM	0.030	*0.85	-0.56	*0.86	*0.85	*-0.73	-0.10	*0.80	0.57	0.18	*0.82	*0.94	*0.71	-0.44	*-0.76	*0.71	0.50	*0.74	
IM	-0.08	*0.79	-0.43	*0.82	*0.83	*-0.71	-0.07	*0.77	0.52	0.19	*0.82	*0.86	*0.66	-0.48	*-0.80	*0.68	0.45	*0.68	*0.96

*Significant at 5% probability level

SL =Shoot Length, FSW=Fresh Shoot Weight, DSW=Dry Shoot Weight, No. L=No. of Leaves, RL=Root Length, No. R=No. of Root, LL= Leaves Length, LW=Leaves Width, IL=Inflorescence Length, IW=Inflorescence Width, TPP=Tillers Per Plant, FWR=Fresh Weight of Root, DWR=Dry Weight of Root, FWI=Fresh weight of Inflorescence, DWI=Dry Weight if Inflorescence, LA=Leaf Area, IA=Inflorescence Area, SM=Shoot Moisture, RM=Root Moisture, IM=Inflorescence Moisture

Correlation analysis checks out the Relationship between various morphological traits of Table 2 presents for *Phalaris minor*, revealing significant and positive correlations among many of the studied traits. These values specify the plant’s ability to survive in harsh and hot conditions. It was observed from Table 2 that a significant correlation was found between No. of leaf and fresh weight of shoot (0.769), Length of root and fresh weight of shoot(0.732), Leaf length and shoot length(0.84), Length and No. of leaf (0.79), Leaf width and fresh weight of shoot(0.90), leaf width and No. of leaf (0.82), leaf width and length of Root

(0.74), Inflorescence width and Inflorescence length (0.746), No. of Tillers per plant and fresh weight of shoot(0.889),no. of tillers per plant and No. of leaf (0.701), No. of tillers per plant and length of Root (0.721), No. of Tillers per plant and leaf width (0.778), Fresh weight of Root and Fresh weight of shoot (0.861), Fresh weight of root and No. of leaf (0.754), Fresh weight of Root and length of Root(0.824), Fresh weight of root and leaf width(0.815), fresh weight of root and No. of tillers per plant (0.75), Dry weight of root and leaf width (0.608), dry weight of root and fresh weight of root (0.869), Fresh weight of Inflorescence and No. of root

(0.753), Shoot length and fresh weight of Inflorescence (0.806), Fresh weight of Inflorescence and leaf length (0.82), Dry weight of Inflorescence and No. of Roots (0.85), Dry weight of Inflorescence and fresh weight of Inflorescence (0.90), Leaf area and fresh weight of shoot (0.89), Leaf area and length of root (0.68), Leaf area and leaf width (0.97), Leaf area and No. of Tillers per plant(0.77), Leaf area and Fresh weight of Root(0.73), Inflorescence area and No. of leaf(0.45), Inflorescence area and Inflorescence length (0.98), Inflorescence area and Inflorescence width(0.84), Shoot Moisture and Shoot length(0.54), Shoot Moisture and No. of Leaf (0.69), Shoot Moisture and Length of Root(0.65), Shoot Moisture and Leaf width(0.85), Shoot Moisture and No. of Tillers per Plant(0.81), Shoot Moisture and Fresh weight of root (0.81), Shoot moisture and Dry weight of root (0.56), Shoot moisture and Leaf Area (0.85), Root Moisture and fresh weight of Shoot(0.85), Root Moisture and No. of Leaf (0.86), Root Moisture and Length of root(0.85), Root moisture and leaf width(0.80), Root moisture and No. of tillers per plant (0.82), Root moisture and Fresh weight of Root(0.94), Root Moisture and Dry weight of root (0.71), Root Moisture and Inflorescence Area (0.71), Inflorescence moisture and Fresh weight of shoot (0.79), Inflorescence moisture and No. of leaf(0.82), Inflorescence moisture and Length of root (0.83), Inflorescence moisture and leaf width(0.77) , Inflorescence moisture and No. of Tillers per plant (0.82), Inflorescence moisture and fresh weight of root (0.86), Inflorescence moisture and dry weight of root (0.66), Inflorescence moisture and Leaf area(0.68), Inflorescence moisture and Root moisture (0.68), Root moisture and shoot moisture(-0.. Positive correlation revealed the traits are highly associated with each other and caused survival ability improvement in crop plants (Ali et al., 2012; Harem et al.,2015; Mobeen et al., 2015). The significant and negative correlation was found between Dry weight of shoot and Shoot length(-0.70), Dry weight of shoot and fresh weight of shoot (-0.82), No. of roots and No. of leaf (-0.67), Leaf width and dry weight of shoot (-0.76), Inflorescence length and No. of root (-0.89), Inflorescence length and leaf length(0.66), Inflorescence width and shoot length (-0.68), Inflorescence width and leaf length (-0.78), Fresh weight of root and dry weight of shoot (-0.72), Fresh weight of Inflorescence and No. of leaf (-0.43), Fresh weight of Inflorescence and Inflorescence length (-0.73), Fresh weight of Inflorescence and Inflorescence width (-0.8), Dry weight of Inflorescence and Inflorescence length(-0.75), Dry weight of Inflorescence and Inflorescence width (-0.66), Dry weight of Inflorescence and Fresh weight of root (-0.66), Dry weight of Inflorescence and dry weight of root(-0.69), Dry weight of Inflorescence and fresh weight of Inflorescence(-0.90), Leaf area and dry weight of shoot (-0.78), Inflorescence area and Shoot length (-0.54), Inflorescence area and No.

of root(-0.85), Inflorescence area and leaf length(-0.73), Inflorescence area and fresh weight of inflorescence (-0.79), Inflorescence area and Dry weight of Inflorescence (-0.76), Shoot Moisture and dry weight of shoot(-0.89), Root moisture and No. of root (-0.73), Root moisture and dry weight of inflorescence(-0.76), Inflorescence moisture and No. of root(-0.71), Inflorescence moisture and dry weight of inflorescence (-0.80).

High heritability and high genetic advance:

Root Length: Exhibits extremely high heritability (nearly 100%) and the greatest genetic advancement among measured traits.

Root moisture: Displays near-perfect heritability (100%) with the highest genetic advance value.

Shoot Length: Possesses very high heritability (96.2%) and substantial genetic progress (104.8).

Fresh Shoot Weight: Shows very high heritability (93.5%) and very high genetic advance (115.3%).

Fresh/Dry weight of root & inflorescence: All show very high heritability (>89% to 95%) and high genetic progress, making them ideal for selection.

Moderate Heritable and Moderate Genetic Advance:

No. of Leaves: Moderately high heritability (73.3%) and moderate genetic advance (60.3%).

No. of Roots: Moderately high heritability (78.1%) and high genetic advance (94.0%).

Leaf Length & Width: Moderate heritability (74% and 69%) with low to moderate genetic progress.

Leaf area: Moderate heritability (68.2%) and high genetic advance (71.5%).

Low Heritability and Genetic Advance Dry Shoot

Weight: Has moderately high heritability (79.2%) but limited genetic progress (22.2%), implying control by multiple genes with minor effects.

Inflorescence width: Has high heritability (79.6%) but the lowest genetic advance (8.1%) of all traits, suggesting non-additive genetic influence

Conclusion

This Study reveals that *Phalaris minor* shows strong morphological variability and high genetic adaptability across different field locations, enabling it to thrive aggressively in wheat-based systems. Significant correlations among growth, biomass, and moisture-related traits highlight the weed's ability to maintain vigorous growth even under stress. The high heritability of major traits, such as shoot length. Root length and fresh biomass further indicate that the species can rapidly respond to selection pressures, including herbicide use. Overall, the results confirm that *P. minor* is a highly competitive and persistent weed, emphasizing the need for integrated and sustainable management approaches beyond chemical control.

References

Rajak, B. K., Rani, P., Singh, N., & Singh, D. V. (2023). Sequence and structural similarities of ACCase protein of *Phalaris minor* and wheat:

- An insight to explain herbicide selectivity. *Frontiers in Plant Science*, 13.
- Xu, G., Shen, S., Zhang, Y., Clements, D. R., Yang, S., Li, J., Dong, L., Zhang, F., Jin, G., & Gao, Y. (2019). Designing cropping systems to improve the management of the invasive weed *Phalaris minor* Retz. *Agronomy*, 9(12). <https://doi.org/10.3390/agronomy9120809>
- Hadayat, A., Zahir, Z. A., Cai, P., & Gao, C. H. (2024). Integrated application of synthetic community reduces consumption of herbicide in field *Phalaris minor* control. *Soil Ecology Letters*, 6(2). <https://doi.org/10.1007/s42832-023-0207-1>
- Rezvani, M., Nadimi, S., Zaefarian, F., & Chauhan, B. S. (2021). Environmental factors affecting seed germination and seedling emergence of three *Phalaris* species. *Crop Protection*, 148. <https://doi.org/10.1016/j.cropro.2021.105743>
- Hadayat, A., Zahir, Z. A., Cai, P., & Gao, C. H. (2024). Integrated application of synthetic community reduces consumption of herbicide in field *Phalaris minor* control. *Soil Ecology Letters*, 6(2). <https://doi.org/10.1007/s42832-023-0207-1>
- Yadav, P., Singh, R. S., Kumar, P., Kumar Maurya, N., Pal, R. K., Verma, H., & Kumar Pal, R. (2022). Effect of weed management practices on weed flora of wheat crop (*Triticum aestivum* L.). ~ 320 ~ *The Pharma Innovation Journal*, 11(4)
- Bhan, V. M., & Kumar, S. (1997). Integrated management of *Phalaris minor* in rice–wheat ecosystems in India. In *Proceedings of the International Conference on Ecological Agriculture: Towards Sustainable Development* (Vol. 2, pp. 400–415). Chandigarh, India.
- Bir, S. S., & Sidhu, M. (1979). Observations on the weed flora of cultivable lands in Punjab – wheat fields in Patiala district. *New Botanist*, 6, 79
- Singh, S.; Kirkwood, R.C.; Marshall, G. (1995). Resistant *Phalaris minor* mimics wheat in detoxifying isoproturon. *Resistant Pest Management Newsletter*
- Harrem, K., Qurban, A., Sadia, A., Mobeen, A., Ali, A., Arfan, A., Muhammad, S., Muhammad, S., Idrees, A., and Tayyab, H. (2015). Biodiversity and correlation studies among various traits of *Digeria arvensis*, *Cyperus rotundus*, *Digitaria adescenscence* and *Sorghum halepense*. *NY Sci J* 8, 37-4
- Mobeen, A., Qurban, A., Sadia, A., Harrem, K., Ali, A., Arfan, A., Muhammad, S., Muhammad, S., Idrees, A., and Tayyab, H. (2015). Estimation of correlation among various morphological traits of *Coronopus didymus*, *Euphorbia helioscopia*, *Cyperus difformis* and *Aristida adscensionis*. *NY Sci J* 8, 47-51

Declarations

Author contribution statement

All author contributed equally in writing and conducting research.

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All data generated or analyzed during the study are included in the manuscript.

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Not applicable

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Conflict of Interest

Regarding conflicts of interest, the authors state that their research was carried out independently without any affiliations or financial ties that could raise concerns about biases.



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