



## Research Article

# Identification and Morphological Characteristics of Weed Flora Associated with Wheat, Rice and Maize crops in Batkhela, District Malakand, Khyber Pakhtunkhwa, Pakistan

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**Abstract** | The ecological exploration of weed of wheat (*Triticum aestivum* L.), maize (*Zea mays* L.) and rice (*Oryza sativa* L.) was conducted in Batkhela region, District Malakand. The data were collected about the weed diversity and morphological characteristics through field visits in Dheri, Julagram, Khar, Matkanai, Trai and Totakan. The study revealed 131 species. Among these 97 plants species were weed of wheat crop, 41 plants species were weed in maize crop and 39 plant species occurred in rice crop. Plants belonged to 43 families and 106 genera. There were 3 (2.2%) pteridophytes and 128 angiosperms. Out of angiosperm, 112 (85.4%) species were dicots and 16 were monocot (13.7%). Poaceae was dominant monocot family with 15 (11.5%) species. In dicot leading family was Asteraceae contained 19 plant species (14.5%) followed by Amaranthaceae, Lamiaceae, Papilionaceae (Sub family of Fabaceae) and Polygonaceae with 8 (6.1%) species. Chenopodiaceae and Euphorbiaceae each had 5 (3.8%) species. Apiaceae, Brassicaceae and Solanaceae possessed 4 (3.05%) plant species each. Ecological evaluation indicated 102 (77.8%) species were Therophytes, 18 (13.7%) species were Geophytes, 9 (6.8%) species were Hemicryptophytes, and 2 (1.52%) species were Chamaephytes. In leaf size class the leading category was mesophyll with 51 (38.93%). Of these 86 (65.6%) species were indigenous to study area and 45 (34.3%) were exotic. During the study 95 (72.5%) plants were found in reproductive stage S2, 27 (20.61%) at pre-reproductive stage S1 and 9 (6.8%) occurred at post reproductive stage S3. In leaf shapes 79 (60.3%) species had simple leaves, 52 (39.6%) contained dentate and 1 (0.07%) species was aphyllous. 17 (12.98%) species were spiny SP and 114 (87.02%) species were non-spiny NS. The study concludes that Therophytes dominate the weed flora of Batkhela, indicating disturbance in cereal crops. It is recommended to adopt integrated weed management practices to control dominant species and conserve indigenous flora.

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**Keywords** | Batkhela, Cereal crops, Dicotyledon, Leaf size spectrum, Life forms, Monocot, Weed flora



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## Introduction

Plant ecology deals with the effect of environmental factors on the distribution and abundance

of plant species (Ain *et al.*, 2026). Plants have critical relationship with its environment. Their adoptability, growth and interaction are submissive to area they dwell. Plants depends on all conditions

for existence in environment (Ali *et al.*, 2026). The physiological and morphological adaptation is important for plants species. The interrelations between plant physiology and synecology are very close (Hassan *et al.*, 2024). Ecological features of plants change with altitude, edaphic, climatic and anthropogenic factors (Ullah *et al.*, 2022).

A soil all over the world is basic contributor for continuous existence of life. Soil is the combination of organic and inorganic materials. Soil provides medium for the germination, growth and development of plants species (Anwar *et al.*, 2021). The physicochemical features of soil include soil texture, color, structure, pH, electrical conductivity, TSS and NPK (Nathalie *et al.*, 2020). Plants survival has direct relation to soil it anchors, the constituents it possesses, aeration it favors, water it retains and microorganism it hosts. So, study of plant is meaning less without systematic study of soil (Haq *et al.*, 2024).

Ecological characteristics of weed will help to understand the prevailing environmental condition of the area and better future planning for sustainable and improved weed control practices (Ahmad *et al.*, 2020). The weed flora of the area is unexplored previously and this is the first ever study on weed diversity in this area. Study was conducted in Batkhela, District Malakand, Khyber Pakhtunkhwa, Pakistan. The areas have a subtropical climate and supports irrigated cereal cultivation, including wheat, rice and maize. Its diverse ecological conditions make it suitable for investigate weed flora and their morphological characteristics' (GOP, 1998). Therefore, the present study was conducted with the objective to document the weed flora and their association with wheat, rice and maize crops in the study area (Ning *et al.*, 2020).

## Materials and Methods

### Field visit

Crops cultivated localities with altitudinal variation and topography were selected for the collection of plants. Various localities include Dheri, Julagram, Khar, Matkanai, Trai and Totakan were visited. Field surveys were conducted during 2017-2018 covering both Rabi and Kharif seasons. A total of 10-15 field visits were made to each locality at vegetative, flowering and harvesting stages of the crops. In each crop field weeds were collected using random quadrat sampling method. Five quadrates of 1m x1m were randomly

placed in each wheat, rice and maize field. Weeds growing within the crop field and within 5m radius of crops plants were recorded as associated with wheat, rice and maize crops. The specimens after drying were mounted on herbarium sheets and identified following *Flora of Pakistan* and available literature on weed plants (Nasir and Ali, 1970-1989; Ali and Nasir, 1989-1991; Ali and Qaiser 1993-2017). The identified plants were submitted in the herbarium Centre of Plant Biodiversity University of Peshawar for future research.

### Ecological evaluation

The biological spectra including life forms and leaf size were known after Raunkiaer (1934), Hussain (1989), Shah *et al.* (2021), Khan *et al.* (2022) and Ain *et al.* (2026). Phenologically, weeds were classified into S1= Vegetative/ Pre-reproductive, S2= Reproductive and S3= post-reproductive stages. Leaf shapes, spinniness NS = Non spiny, SP = Spiny and biogeographic status of weed were also recorded.

## Results and Discussion

### Floristic diversity

The Study revealed 131 plant species were typical weed in the research area. 97 plants were weed of wheat crop, 41 species were weed in maize crop and 39 species were found in rice crop.

The plant species belonged to 43 families and 106 genera (Table 1, Figure 7).

A total of 3 Pteridophytic species were recorded. Family Equisetaceae was represented by 1 species and family Pteridaceae was represented by 2 species. Angiosperms were represented by 128 species in which dicots had 112 species (85.4%) and monocots were represented by 16 species (13.7%). The leading monocot family was Poaceae with 15 (11.5%) species, followed by Asparagaceae, Cyperaceae and Iridaceae with 1 (0.76%) species each. Among dicots, Asteraceae was the dominant dicot family with nineteen (14.5%) species, followed by Amaranthaceae, Lamiaceae. Papilionaceae (Sub family of Fabaceae) and Polygonaceae each with 8 (6.1%) species, Chenopodiaceae and Euphorbiaceae had 5 (3.8%) species. Apiaceae, Brassicaceae and Solanaceae possessed 4 (3%) species each, Boraginaceae and Convolvulaceae were represented by 3 (2.2%) species. Acanthaceae, Caryophyllaceae, Malvaceae,

**Table 1:** Ecological characteristics and biogeographic status of weeds of cereal crops in batkhela, pakistan.

| S. No | Plant species                                       | Life form | Leaf size | Leaf shape | Phenology | Spinescence | Biogeographic status |
|-------|-----------------------------------------------------|-----------|-----------|------------|-----------|-------------|----------------------|
| A.    | Pteridophyte                                        |           |           |            |           |             |                      |
| 1.    | Equisetaceae                                        |           |           |            |           |             |                      |
| 1.    | <i>Equisetum arvense</i> L.                         | G         | L         | S          | S1        | NS          | Exo                  |
| 2.    | Pteridaceae                                         |           |           |            |           |             |                      |
| 2.    | <i>Adiantum capillus-veneris</i> L.                 | G         | N         | D          | S1        | NS          | Exo                  |
| 3.    | <i>Pteris vittata</i> L.                            | G         | Mic       | D          | S1        | NS          | Exo                  |
| B.    | Angiosperms                                         |           |           |            |           |             |                      |
| a.    | Monocots                                            |           |           |            |           |             |                      |
| 3.    | Asparagaceae                                        |           |           |            |           |             |                      |
| 4.    | <i>Asparagus officinalis</i> L.                     | Ch        | N         | S          | S2        | SP          | Exo                  |
| 4.    | Cyperaceae                                          |           |           |            |           |             |                      |
| 5.    | <i>Cyperus rotundus</i> L.                          | G         | Mic       | S          | S2        | NS          | Ind                  |
| 5.    | Iridaceae                                           |           |           |            |           |             |                      |
| 6.    | <i>Iris reticulata</i> M.Bieb.                      | G         | Mic       | S          | S2        | NS          | Exo                  |
| 6.    | Poaceae                                             |           |           |            |           |             |                      |
| 7.    | <i>Brachiaria ramosa</i> L.                         | Th        | Mic       | S          | S2        | NS          | Ind                  |
| 8.    | <i>Brachiaria latifolia</i> L.                      | Th        | Mic       | S          | S2        | NS          | Ind                  |
| 9.    | <i>Cynodon dactylon</i> (L.) Pers.                  | H         | Mic       | S          | S2        | NS          | Ind                  |
| 10.   | <i>Desmostachya bipinnata</i> (L.) Stapf            | H         | Mes       | S          | S2        | NS          | Ind                  |
| 11.   | <i>Dichanthium annulatum</i> (Forssk.) Stapf        | H         | Mic       | S          | S2        | NS          | Ind                  |
| 12.   | <i>Digitaria ciliaris</i> (Retz.) Koel. Descr. Gram | H         | Mes       | S          | S2        | NS          | Ind                  |
| 13.   | <i>Eragrostis minor</i> Host.                       | Th        | N         | S          | S2        | NS          | Ind                  |
| 14.   | <i>Paspalum paspalodes</i> Michx.) Scribn.          | Th        | N         | S          | S2        | NS          | Exo                  |
| 15.   | <i>Poa annua</i> L.                                 | Th        | N         | S          | S2        | NS          | Ind                  |
| 16.   | <i>Poa bulbosa</i> L.                               | Th        | Mes       | S          | S2        | NS          | Ind                  |
| 17.   | <i>Rostraria cristata</i> (L.) Tzvelev              | Th        | Mes       | S          | S2        | NS          | Ind                  |
| 18.   | <i>Saccharum officinarum</i> L.                     | H         | Mes       | S          | S2        | NS          |                      |
| 19.   | <i>Setaria pumila</i> (Poir.) Roem. & Schult.       | H         | Mes       | D          | S2        | NS          |                      |
| 20.   | <i>Echinochloa crus-galli</i> (L.) P.Beauv.         | Th        | Mes       | S          | S2        | NS          |                      |
| 21.   | <i>Urochloa panicoides</i> P.Beauv.                 | G         | Mes       | S          | S2        | SP          | Ind                  |
| b.    | Dicots                                              |           |           |            |           |             |                      |
| 7.    | Asteraceae                                          |           |           |            |           |             |                      |
| 22.   | <i>Anaphalis margaritacea</i> (L.) Benth.           | Th        | Mes       | S          | S2        | NS          | Exo                  |
| 23.   | <i>Artemisia maritima</i> L.                        | H         | N         | S          | S2        | NS          | Ind                  |
| 24.   | <i>Artemisia vulgaris</i> L.                        | H         | Mes       | D          | S2        | NS          | Exo                  |
| 25.   | <i>Bidens pilosa</i> L.                             | Th        | Mes       | S          | S2        | NS          | Exo                  |
| 26.   | <i>Calendula arvensis</i> (Vaill.) L.               | Th        | Mic       | S          | S2        | NS          | Ind                  |
| 27.   | <i>Carthamus oxyacantha</i> M.Bieb.                 | Th        | Mes       | D          | S2        | SP          | Ind                  |
| 28.   | <i>Gentaurea benedicta</i> (L.)                     | Th        | Mac       | D          | S2        | SP          | Ind                  |
| 29.   | <i>Cirsium arvense</i> L.                           | Th        | Mac       | D          | S2        | SP          | Exo                  |
| 30.   | <i>Conyza bonariensis</i> L.                        | Th        | Mic       | S          | S2        | NS          | Exo                  |
| 31.   | <i>Conyza canadensis</i> L.                         | Th        | Mic       | S          | S2        | NS          | Exo                  |
| 32.   | <i>Eclipta alba</i> L.                              | Th        | Mic       | S          | S1        | NS          | Exo                  |
| 33.   | <i>Lactuca biennis</i> Willd.                       | Th        | Mac       | D          | S1        | NS          | Exo                  |
| 34.   | <i>Lactuca viminea</i> L.                           | Th        | Mes       | D          | S1        | SP          | Ind                  |
| 35.   | <i>Launaea secunda</i> (Frossk.) Muschl.            | Th        | Mes       | D          | S1        | NS          | Exo                  |

|     |                                                           |    |     |   |    |    |     |
|-----|-----------------------------------------------------------|----|-----|---|----|----|-----|
| 36. | <i>Parthenium hysterophorus</i> L.                        | Th | Mes | D | S1 | NS | Exo |
| 37. | <i>Sonchus arvensis</i> L.                                | Th | Mes | D | S2 | NS | Ind |
| 38. | <i>Sonchus asper</i> (L.) Hill                            | Th | Mes | D | S2 | NS | Ind |
| 39. | <i>Sonchus oleraceus</i> L.                               | Th | Mac | D | S2 | NS | Exo |
| 40. | <i>Xanthium strumarium</i> L.                             | Th | Mac | D | S2 | SP | Ind |
| 8.  | Acanthaceae                                               |    |     |   |    |    |     |
| 41. | <i>Barleria cristata</i> L.                               | Th | Mes | S | S1 | NS | Exo |
| 9.  | Amaranthaceae                                             |    |     |   |    |    |     |
| 42. | <i>Amaranthus viridis</i> L.                              | Th | Mic | S | S2 | NS | Ind |
| 43. | <i>Achyranthes bidentata</i> L.                           | Th | Mes | S | S2 | SP | Exo |
| 44. | <i>Amaranthus hypochondriacus</i> L.                      | Th | Mac | S | S2 | NS | Exo |
| 45. | <i>Amaranthus spinosus</i> L.                             | Th | Mes | D | S2 | SP | Exo |
| 46. | <i>Aerva javanica</i> (Burm. f.) Juss. Ex J.A. Schult.    | Th | Mes | S | S1 | NS | Exo |
| 47. | <i>Aerva lanata</i> L.                                    | Th | Mic | S | S2 | NS | Exo |
| 48. | <i>Alternanthera pungens</i> Kunth                        | Th | N   | S | S1 | SP | Exo |
| 10. | Apiaceae                                                  |    |     |   |    |    |     |
| 49. | <i>Eryngium maritimum</i> L.                              | Th | Mic | D | S2 | SP | Exo |
| 50. | <i>Pimpinella diversifolia</i> DC.                        | G  | Mic | D | S2 | NS | Ind |
| 51. | <i>Scandix pecten-veneris</i> L.                          | Th | Mic | D | S2 | NS | Exo |
| 52. | <i>Torilis arvensis</i> (Huds.) Link.                     | Th | Mes | D | S2 | NS | Exo |
| 11. | Boraginaceae                                              |    |     |   |    |    |     |
| 53. | <i>Arnebia euchroma</i> (Royle ex Benth.) I.M. Johnst.    | Th | Mic | S | S2 | SP | Ind |
| 54. | <i>Cynoglossum lanceolatum</i> Frossk.                    | Th | Mic | S | S2 | NS | Ind |
| 55. | <i>Onosma bispida</i> Wall.                               | Th | Mic | S | S2 | NS | Ind |
| 12. | Brassicaceae                                              |    |     |   |    |    |     |
| 56. | <i>Capsella bursa-pastoris</i> (L.) Medik.                | Th | Mic | D | S2 | NS | Ind |
| 57. | <i>Coronopus didymus</i> (L.) Sm.                         | Th | N   | D | S3 | NS | Exo |
| 58. | <i>Malcolmia africana</i> var. <i>africana</i> (L.) R.Br. | Th | Mes | D | S3 | NS | Ind |
| 59. | <i>Sisymbrium irio</i> L.                                 | Th | Mes | D | S3 | NS | Ind |
| 13. | Cannabaceae                                               |    |     |   |    |    |     |
| 60. | <i>Cannabis sativa</i> L.                                 | Th | Mes | D | S2 | NS | Ind |
| 14. | Capparidaceae                                             |    |     |   |    |    |     |
| 61. | <i>Cleome viscosa</i> L.                                  | Th | N   | D | S1 | NS | Ind |
| 15. | Caryophyllaceae                                           |    |     |   |    |    |     |
| 62. | <i>Arenaria serpyllifolia</i> L.                          | Th | L   | S | S3 | NS | Exo |
| 63. | <i>Silene conoidea</i> L.                                 | Th | N   | S | S3 | NS | Exo |
| 16. | Chenopodiaceae                                            |    |     |   |    |    |     |
| 64. | <i>Chenopodium album</i> L.                               | Th | Mic | S | S2 | NS | Ind |
| 65. | <i>Chenopodium ambrosioides</i> L.                        | Th | Mes | D | S2 | NS | Exo |
| 66. | <i>Chenopodium murale</i> L.                              | Th | Mes | D | S1 | NS | Exo |
| 67. | <i>Chenopodium botrys</i> L.                              | Th | N   | D | S2 | NS | Exo |
| 68. | <i>Kochia indica</i> L.                                   | Th | Mic | S | S1 | NS | Exo |
| 17. | Convolvulaceae                                            |    |     |   |    |    |     |
| 69. | <i>Convolvulus arvensis</i> L.                            | Th | Mic | D | S2 | NS | Ind |
| 70. | <i>Ipomoea purpurea</i> L.                                | Th | Mes | D | S3 | NS | Ind |
| 71. | <i>Ipomoea eriocarpa</i> R.Br.                            | G  | Mes | D | S2 | NS | Exo |
| 18. | Commelinaceae                                             |    |     |   |    |    |     |

|      |                                                    |    |     |   |    |    |      |
|------|----------------------------------------------------|----|-----|---|----|----|------|
| 72.  | <i>Commelina benghalensi</i> L.                    | Th | N   | S | S2 | NS | Exo  |
| 19.  | Cuscutaceae                                        |    |     |   |    |    |      |
| 73.  | <i>Cuscuta reflexa</i> L.                          | Th | AP  | S | S2 | NS | Exo  |
| 20.  | Cucurbitaceae                                      |    |     |   |    |    |      |
| 74.  | <i>Citrullus colocynthis</i> L.                    | Th | Mic | D | S1 | NS | Exo  |
| 21.  | Euphorbiaceae                                      |    |     |   |    |    |      |
| 75.  | <i>Euphorbia granulate</i> Frossk.                 | Th | L   | S | S2 | NS | Exo  |
| 76.  | <i>Euphorbia helioscopia</i> L.                    | Th | N   | S | S2 | NS | Ind  |
| 77.  | <i>Euphorbia indica</i> Lam.                       | Th | Mic | S | S2 | NS | Ind  |
| 78.  | <i>Euphorbia peplus</i> L.                         | Th | N   | S | S2 | NS | Exo  |
| 79.  | <i>Phyllanthus niruri</i> Ssensu L.                | Th | N   | S | S1 | NS | Ind  |
| 22.  | Fumariaceae                                        |    |     |   |    |    |      |
| 80.  | <i>Fumaria indica</i> (Hauskn.) Pugsley            | Th | Mes | D | S2 | NS | Indo |
| 23.  | Geraniaceae                                        |    |     |   |    |    |      |
| 81.  | <i>Geranium wallichianum</i> D.Don                 | Th | Mic | D | S2 | NS | Ind  |
| 24.  | Lamiaceae                                          |    |     |   |    |    |      |
| 82.  | <i>Ajuga bracteosa</i> Wall.                       | Th | N   | D | S2 | NS | Ind  |
| 83.  | <i>Origanum vulgare</i> L.                         | Th | Mic | S | S2 | NS | Exo  |
| 84.  | <i>Micromia biflora</i> (Buch-Ham. Ex D.Don) Benth | Th | Mes | D | S2 | NS | Exo  |
| 85.  | <i>Mentha longifolia</i> (L.) Pers                 | G  | Mic | D | S2 | NS | Ind  |
| 86.  | <i>Oenanthe javanica</i> (Blume) DC.               | Th | Mic | D | S2 | NS | Ind  |
| 87.  | <i>Salvia moorcroftiana</i> Wall.                  | G  | Mac | S | S2 | NS | Ind  |
| 88.  | <i>Salvia plebeia</i> R. Br.                       | Th | Mes | D | S2 | NS | Ind  |
| 89.  | <i>Thymus linearis</i> Benth.                      | Th | Mes | S | S3 | NS | Ind  |
| 25.  | Lythraceae                                         |    |     |   |    |    |      |
| 90.  | <i>Ammannia auriculata</i> Willd.                  | Th | Mic | D | S3 | NS | Ind  |
| 26.  | Menispermaceae                                     |    |     |   |    |    |      |
| 91.  | <i>Cissampelos pareira</i> L.                      | Th | Mes | S | S2 | NS | Ind  |
| 27.  | Malvaceae                                          |    |     |   |    |    |      |
| 92.  | <i>Malva parviflora</i> L.                         | Th | Mac | D | S2 | NS | Ind  |
| 93.  | <i>Malvastrum coromandelianum</i> (L.) Garcke.     | Th | Mes | S | S2 | NS | Ind  |
| 28.  | Oenotheraceae                                      |    |     |   |    |    |      |
| 94.  | <i>Oenothera rosea</i> L. Her. Ex Aiton            | Th | Mes | S | S2 | NS | Ind  |
| 29.  | Oxalidaceae                                        |    |     |   |    |    |      |
| 95.  | <i>Oxalis corniculata</i> L.                       | Th | L   | D | S1 | NS | Ind  |
| 30.  | Papilionaceae                                      |    |     |   |    |    |      |
| 96.  | <i>Astragalus amherstianus</i> Benth.              | Th | N   | S | S2 | NS | Ind  |
| 97.  | <i>Lathyrus aphaca</i> L.                          | Th | Mes | D | S2 | NS | Ind  |
| 98.  | <i>Lotus corniculatus</i> L.                       | Th | L   | S | S2 | NS | Ind  |
| 99.  | <i>Medicago polymorpha</i> L.                      | G  | N   | S | S2 | NS | Ind  |
| 100. | <i>Melilotus officinalis</i> (L.) Pall.            | Th | N   | S | S2 | NS | Ind  |
| 101. | <i>Sesbania sesban</i> (L.) Merr.                  | Th | N   | S | S2 | NS | Ind  |
| 102. | <i>Trifolium repens</i> L.                         | G  | N   | S | S2 | NS | Ind  |
| 103. | <i>Trifolium resupinatum</i> L.                    | G  | N   | S | S2 | NS | Ind  |
| 31.  | Papaveraceae                                       |    |     |   |    |    |      |
| 104. | <i>Papaver somniferum</i> L.                       | Th | Mes | S | S2 | NS | Ind  |
| 32.  | Polygonaceae                                       |    |     |   |    |    |      |

|      |                                              |    |     |   |    |    |     |
|------|----------------------------------------------|----|-----|---|----|----|-----|
| 105. | <i>Emex spinosus</i> (L.) Campd.             | Th | Mes | S | S2 | SP | Ind |
| 106. | <i>Persicaria glabra</i> (Wild.) M.O.Delgado | Th | Mic | S | S2 | NS | Ind |
| 107. | <i>Persicaria maculosa</i> (Raf.) Gay.       | Th | Mic | S | S2 | NS | Ind |
| 108. | <i>Polygonum aviculare</i> L.                | G  | Mic | S | S2 | NS | Ind |
| 109. | <i>Polygonum plebeium</i> R.Br.              | Th | L   | S | S2 | NS | Ind |
| 110. | <i>Polygonum recumbens</i> R.Br.             | Th | N   | S | S2 | NS | Ind |
| 111. | <i>Rumex hastatus</i> D.Don.                 | Th | Mes | D | S2 | NS | Ind |
| 112. | <i>Rumex dentatus</i> L.                     | Th | Mes | S | S2 | NS | Ind |
| 33.  | Pontederiaceae                               |    |     |   |    |    |     |
| 113. | <i>Eichhornia crassipes</i> (Mart.) Solms    | G  | Mes | S | S2 | NS | Ind |
| 34.  | Plantaginaceae                               |    |     |   |    |    |     |
| 114. | <i>Plantago lanceolata</i> L.                | Th | Mes | S | S2 | NS | Ind |
| 115. | <i>Veronica anagallis-aquatica</i> L.        | Th | N   | S | S1 | NS | Ind |
| 35.  | Portulacaceae                                |    |     |   |    |    |     |
| 116. | <i>Portulaca oleracea</i> L.                 | Th | Mes | D | S1 | NS | Ind |
| 36.  | Ranunculaceae                                |    |     |   |    |    |     |
| 117. | <i>Ranunculus muricatus</i> L.               | G  | Mes | S | S1 | NS | Ind |
| 37.  | Rubiaceae                                    |    |     |   |    |    |     |
| 118. | <i>Galium aparine</i> L.                     | Th | N   | S | S3 | SP | Exo |
| 38.  | Scrophulariaceae                             |    |     |   |    |    |     |
| 119. | <i>Verbascum thapsus</i> L.                  | G  | Mes | S | S1 | NS | Ind |
| 39.  | Solanaceae                                   |    |     |   |    |    |     |
| 120. | <i>Datura stramonium</i> L.                  | Th | Mes | D | S1 | SP | Ind |
| 121. | <i>Solanum surattense</i> Burm.f.            | Th | Mac | D | S1 | SP | Ind |
| 122. | <i>Solanum nigrum</i> L.                     | Th | Mic | D | S1 | NS | Ind |
| 123. | <i>Withania somnifera</i> L.                 | Ch | Mes | S | S2 | NS | Ind |
| 40.  | Urticaceae                                   |    |     |   |    |    |     |
| 124. | <i>Pilea peperomioides</i> Diels.            | Th | Mic | S | S2 | NS | Ind |
| 125. | <i>Urtica dioica</i> L.                      | Th | Mes | D | S1 | SP | Ind |
| 41.  | Violaceae                                    |    |     |   |    |    |     |
| 126. | <i>Viola serpens</i> W. Becker.              | G  | Mic | D | S1 | NS | Ind |
| 127. | <i>Viola stocksii</i> Boiss.                 | Th | Mes | S | S1 | NS | Ind |
| 42.  | Verbenaceae                                  |    |     |   |    |    |     |
| 128. | <i>Phyla nudiflora</i> L.                    | Th | Mes | S | S2 | NS | Ind |
| 129. | <i>Verbena officinalis</i> L.                | Th | Mic | D | S2 | NS | Ind |
| 43.  | Zygophyllaceae                               |    |     |   |    |    |     |
| 130. | <i>Peganum harmala</i> L.                    | H  | N   | S | S2 | NS | Ind |
| 131. | <i>Tribulus terrestris</i> L.                | Th | N   | S | S2 | SP | Exo |

Keys: Therophyte= Th, Geophyte= G, Hemicryptophyte= H, Chamaephyte= Ch, Mesophyte= Mes, Microphyll= Mic, Nanophyll= N, Macrophyll= Mac, Leptophyll= L, Smooth= S, Denta

Plantaginaceae, Urticaceae, Violaceae, Verbenaceae, Zygophyllaceae had 2 species each, Commelinaceae, Cannabaceae, Capparidaceae, Cuscutaceae, Lythraceae, Menispermaceae, Cucurbitaceae. Oenotheraceae, Fumariaceae, Oxalidaceae, Geraniaceae. Papaveraceae, Pontederiaceae, Portulacaceae, Ranunculaceae, Rubiaceae and Scrophulariaceae had 1 species each (0.76%).

Weed in wheat (*Triticum aestivum* L.)

Total 97 plant species were found as weed in wheat crop (Table 1). The leading family was Asteraceae with 19 species (14.5%), Poaceae was represented by 9 species (6.8%), Lamiaceae and Polygonaceae each with 7 (5.34%) species. Boraginaceae and Amaranthaceae was had 6 species each Chenopodiaceae and Euphorbiaceae each possessed 5 species each,

Papilionaceae (Sub family of Fabaceae) contained 4 species. Apiaceae, Boraginaceae, Convolvulaceae, Acanthaceae, Caryophyllaceae, Malvaceae, Plantaginaceae, Urticaceae, Violaceae, Verbenaceae, Zygophyllaceae, Cannabaceae, Capparidaceae, Commelinaceae, Cuscutaceae, Cucurbitaceae, Fumariaceae, Geraniaceae, Lytheraceae, Menispermaceae, Oenotheraceae, Oxalidaceae, Papaveraceae, Pontederiaceae, Portulacaceae, Ranunculaceae, Rubiaceae and Scrophulariaceae had less than 3 species.

**Table 2:** Summary of ecological characteristics of weeds of cereal crops in Batkhela, Pakistan.

| S.No                          | Ecological Parameters        | No of species | Percentage |
|-------------------------------|------------------------------|---------------|------------|
| <b>A. Life Forms</b>          |                              |               |            |
| 1.                            | Therophyte                   | 102           | 77.86%     |
| 2.                            | Geophyte                     | 18            | 13.7%      |
| 3.                            | Hemicryptophyte              | 09            | 6.8%       |
| 4.                            | Chamaephyte                  | 02            | 1.5%       |
| Total                         |                              | 131           | 100%       |
| <b>B. Leaf size classes</b>   |                              |               |            |
| 1.                            | Mesophyll                    | 51            | 38.93%     |
| 2.                            | Microphyll                   | 37            | 28.2%      |
| 3.                            | Nanophyll                    | 27            | 20.6%      |
| 4.                            | Macrophyll                   | 09            | 6.8%       |
| 5.                            | Leptophyll                   | 06            | 4.5%       |
| 6.                            | Aphyllous                    | 01            | 0.76%      |
| Total                         |                              | 131           | 100%       |
| <b>C. Leaf shape</b>          |                              |               |            |
| 1.                            | Smooth                       | 79            | 60.3%      |
| 2.                            | Dentate                      | 52            | 39.6%      |
| Total                         |                              | 131           | 100%       |
| <b>D. Phenological stages</b> |                              |               |            |
| 1.                            | Reproductive stage (S2)      | 95            | 72.52%     |
| 2.                            | Pre-reproductive (S1)        | 27            | 20.6%      |
| 3.                            | Post reproductive stage (S3) | 09            | 6.8%       |
| Total                         |                              | 131           | 100%       |
| <b>E. Spinniness</b>          |                              |               |            |
| 1.                            | Spiny (SP)                   | 17            | 12.98%     |
| 2.                            | Non-spiny (NS)               | 114           | 87.02%     |
| Total                         |                              | 131           | 100        |
| <b>F. Invasiveness</b>        |                              |               |            |
| 1.                            | Indigenous                   | 86            | 65.65%     |
| 2.                            | Exotic                       | 45            | 34.3%      |
| Total                         |                              | 131           | 100%       |

#### Weed in maize (*Zea mays* L.)

41 species belonging to 22 families and 37 genera were present in maize field (Table 2). In maize leading

families were Poaceae 7 (5.34%) species, Asteraceae 6 (4.58%) species, Chenopodiaceae and Convolvulaceae with 3 (2.29%) species.

#### Weed in rice (*Oryza sativa* L.)

39 species were found in rice field belonging to 21 families and 35 genera (Table 1). In rice crop the leading family was Asteraceae with 6 (4.5%) species followed by Papilionaceae (Sub family of Fabaceae) 4 (3.05%) species and poaceae was 3 (2.29) number of species. Other families had a smaller number of species.

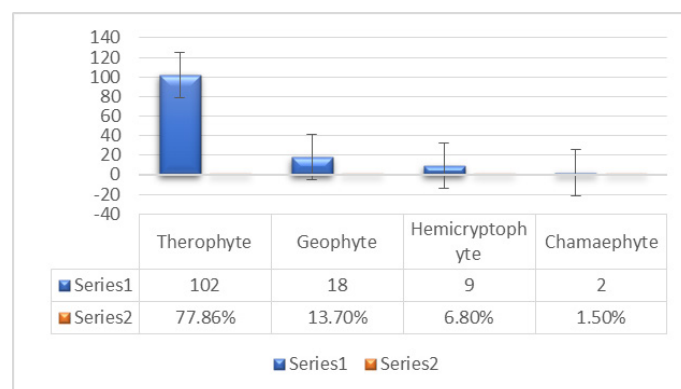


**Figure 1:** Distribution of life form classes of weed species in Batkhela, Pakistan.

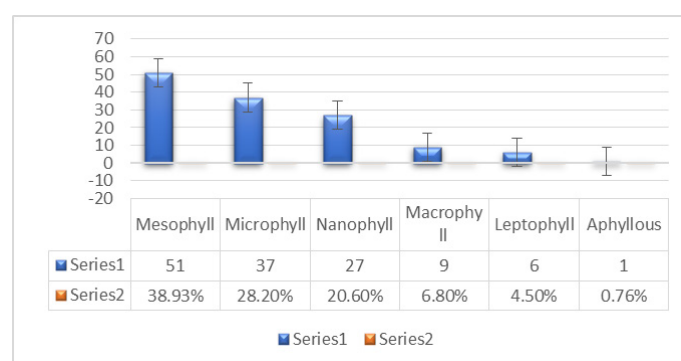


**Figure 2:** Distribution of leaf size classes of weed species in Batkhela, Pakistan.

#### Ecological characteristics

Biological spectra indicated that the major life form class among the weed flora was therophytes with 102 species (77.8%) followed by geophytes with 18 (13.74%) species, Hemicryptophytes were 9 (7.63%) species and 2 (1.52%) species were Chamaephytes (Table 2; Figure 1). Most common category regarding leaf size class was mesophyll with 51 (38.93%) species followed by microphyll with 37 (28.24%) species, Nanophyll were next to it with 27 (19.84%) species, Macrophyll had 9 (6.87%) species and Leptophyll consisted of 6 (5.34%) species and Aphyllous had 1 species (0.76%) (Table 2; Figure 2). Regarding

biogeographic status 86 (65.6%) species were indigenous to study area and 45 (34.3%) were exotic (Table 2; Figure 3). During the study 95 (72.5%) plants were found at reproductive stage S2, 27 (20.61%) at pre-reproductive stage S1 and 9 (6.8%) were at post reproductive stage S3 (Table 2; Figure 4). In leaf shapes, 79 (60.3%) species had simple leaves, 52 (39.6%) possessed were dentate leaves (Table 2; Figure 5). In spinniness 114 (87.02%) were non spiny NS and 17 (12.98%) species were spiny (Table 2; Figure 6).

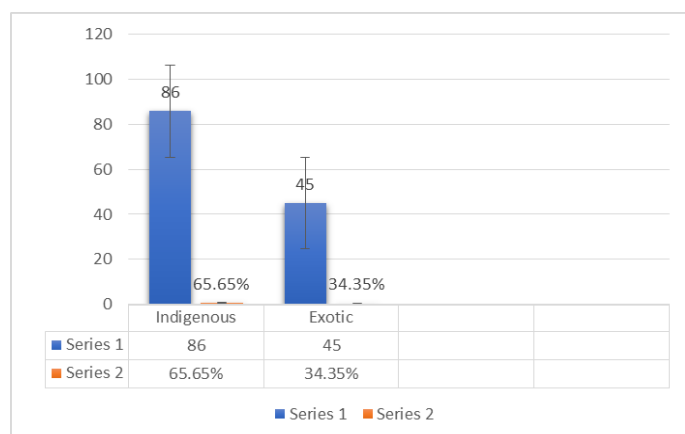


**Figure 3:** Distribution of indigenous and exotic species of weed species in Batkhela, Pakistan

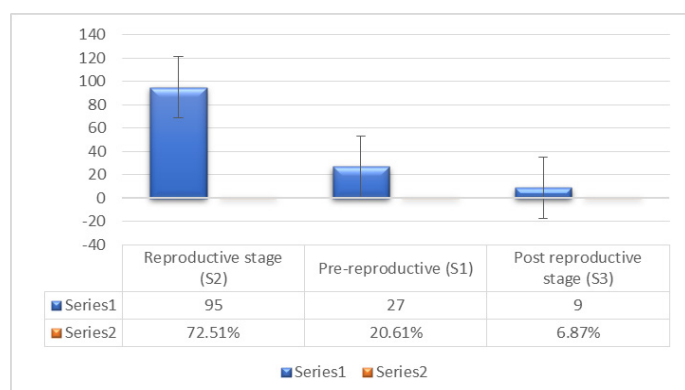


**Figure 4:** Distribution of Phenological stages of weed species in Batkhela, Pakistan.

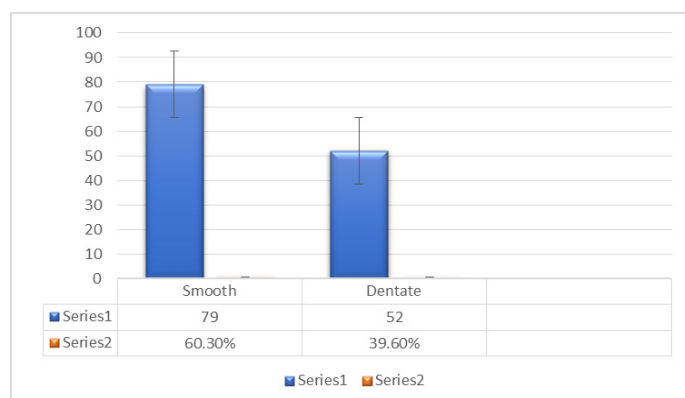


**Figure 5:** Distribution of leaf shapes classes of weed species in Batkhela, Pakistan.

Weed plants are reported to compete with crops for resources for space, water and nutrients Ehtesham-Ul-Haq *et al.* (2025). They grow in wild in crop fields Tahir *et al.* (2022). The weed possesses great competing quality with crops in term of adoptability and growth rate. Further studies are needed to assess allelopathic effects and nativity impact Luqman *et al.* (2022). During this study on ecological evaluation and management of weed diversity in cereal crops of the study area it was revealed 131 plant species were typical weed in the research area. 97 plants were weed of wheat crop, 41 species were weed in maize crop and 39 species were found in rice crop.

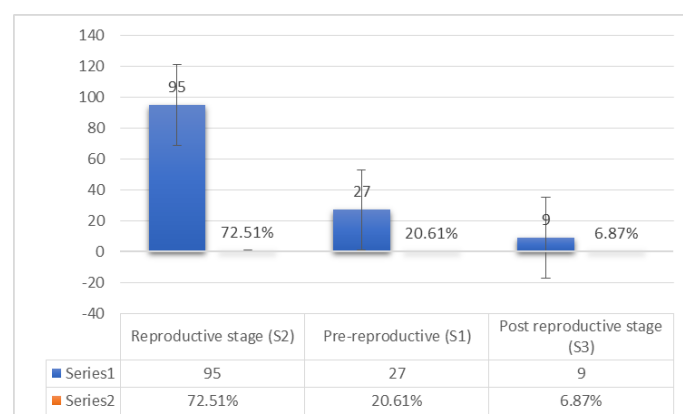


**Figure 6:** Distribution of spiny and non-spiny species of weed species in Batkhela, Pakistan.

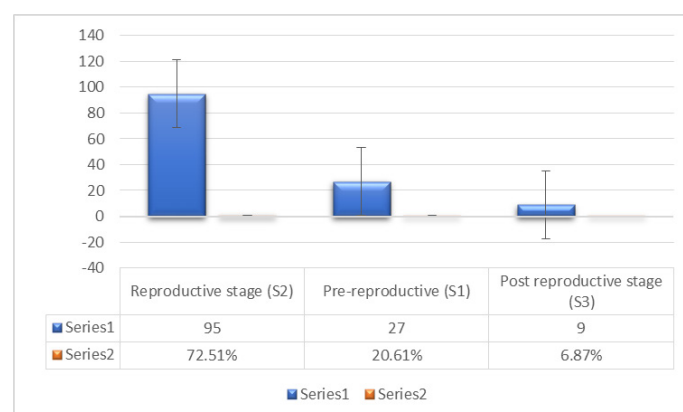


**Figure 7:** Distribution of weed of cereal crops of weed species in Batkhela, Pakistan.

In our study 97 plant species were found as weed in wheat crop and 39 species were found in rice field belonging to 21 families and 35 genera. Similarly, 41 species belonging 22 families and 37 genera were present in maize field Ali *et al.* (2026). These weeds were found to be in competition with cultivated crops for space, water and nutrients Ain *et al.* (2026). Ahmad *et al.* (2020) reported role of edaphic variables. Our study is quite similar to previous studies conducted

**Table 3:** Distribution of weeds plants growing in cereal crops in Batkhela, Pakistan

| S. No | Botanical Names                               | Cereal Crops                         |                             |                                |
|-------|-----------------------------------------------|--------------------------------------|-----------------------------|--------------------------------|
|       |                                               | Wheat ( <i>Triticum aestivum</i> L.) | Maize ( <i>Zea mays</i> L.) | Rice ( <i>Oryza sativa</i> L.) |
| A.    | Pteridophyte                                  |                                      |                             |                                |
| 1.    | Equisetaceae                                  |                                      |                             |                                |
| 1.    | <i>Equisetum arvense</i> L.                   | -                                    | -                           | +                              |
| 2.    | Pteridaceae                                   |                                      |                             |                                |
| 2.    | <i>Adiantum capillus-veneris</i> L.           | +                                    | -                           | -                              |
| 3.    | <i>Pteris vittata</i> L.                      | -                                    | -                           | +                              |
| B.    | Angiosperms                                   |                                      |                             |                                |
| a.    | Monocots                                      |                                      |                             |                                |
| 3.    | Asparagaceae                                  |                                      |                             |                                |
| 4.    | <i>Asparagus officinalis</i> L.               | +                                    | -                           | -                              |
| 4.    | Cyperaceae                                    |                                      |                             |                                |
| 5.    | <i>Cyperus rotundus</i> L.                    | -                                    | -                           | +                              |
| 5.    | Iridaceae                                     |                                      |                             |                                |
| 6.    | <i>Iris reticulata</i> M.Bieb                 | +                                    | -                           | -                              |
| 6.    | Poaceae                                       |                                      |                             |                                |
| 7.    | <i>Brachiaria ramosa</i> L.                   | +                                    | -                           | -                              |
| 8.    | <i>Brachiaria latifolia</i> L.                | +                                    | -                           | -                              |
| 9.    | <i>Cynodon dactylon</i> (L.) Pers.            | -                                    | -                           | +                              |
| 10.   | <i>Desmostachya bipinnata</i> (L.) Stapf      | +                                    | -                           | -                              |
| 11.   | <i>Dichanthium annulatum</i> (Forssk) Stapf   | +                                    | -                           | -                              |
| 12.   | <i>Digitaria ciliaris</i> (Retz.) Koeler.     | +                                    | -                           | -                              |
| 13.   | <i>Eragrostis minor</i> Host                  | -                                    | -                           | +                              |
| 14.   | <i>Paspalum paspalodes</i> (Michx.) Scribn.   | -                                    | +                           | -                              |
| 15.   | <i>Poa annua</i> L.                           | +                                    | -                           | -                              |
| 16.   | <i>Poa bulbosa</i> L.                         | +                                    | +                           | -                              |
| 17.   | <i>Rostraria cristata</i> (L.) Tzvelev        | -                                    | +                           | +                              |
| 18.   | <i>Saccharum officinarum</i> L.               | +                                    | -                           | -                              |
| 19.   | <i>Setaria pumila</i> (Poir.) Roem. & Schult. | +                                    | +                           | -                              |
| 20.   | <i>Echinochloa cruz-galli</i> (L.) P.Beauv    | -                                    | +                           | -                              |
| 21.   | <i>Urochloa panicoides</i> P. Beauv.          | -                                    | +                           | -                              |
| b.    | Dicots                                        |                                      |                             |                                |
| 7.    | Asteraceae                                    |                                      |                             |                                |
| 22.   | <i>Anaphalis margaritacea</i> (L.) Benth.     | +                                    | -                           | -                              |
| 23.   | <i>Artemisia maritima</i> L.                  | -                                    | -                           | +                              |
| 24.   | <i>Artemisia vulgaris</i> L.                  | +                                    | -                           | -                              |
| 25.   | <i>Bidens pilosa</i> L.                       | +                                    | -                           | -                              |
| 26.   | <i>Calendula arvensis</i> Vaill.              | +                                    | -                           | -                              |
| 27.   | <i>Carthamus oxyacantha</i> M.Bieb.           | +                                    | -                           | -                              |
| 28.   | <i>Centaurea benedicta</i> L.                 | +                                    | -                           | -                              |
| 29.   | <i>Cirsium arvense</i> L.                     | +                                    | -                           | -                              |
| 30.   | <i>Conyza bonariensis</i> L.                  | -                                    | +                           | +                              |
| 31.   | <i>Conyza canadensis</i> L.                   | -                                    | +                           | +                              |
| 32.   | <i>Eclipta alba</i> L.                        | -                                    | +                           | -                              |
| 33.   | <i>Lactuca biennis</i> Willd.                 | +                                    | +                           | -                              |

|     |                                                           |   |   |   |
|-----|-----------------------------------------------------------|---|---|---|
| 34. | <i>Lactuca viminea</i> L.                                 | - | - | + |
| 35. | <i>Launaea secunda</i> (Frosk.) Muschl.                   | - | - | + |
| 36. | <i>Parthenium hysterophorus</i> L.                        | + | + | - |
| 37. | <i>Sonchus arvensis</i> L.                                | + | - | - |
| 38. | <i>Sonchus asper</i> (L.) Hill                            | + | + | - |
| 39. | <i>Sonchus oleraceus</i> L.                               | - | - | + |
| 40. | <i>Xanthium strumarium</i> L.                             | + | - | - |
| 8.  | Acanthaceae                                               |   |   |   |
| 41. | <i>Barleria cristata</i> L.                               | + | - | - |
| 9.  | Amaranthaceae                                             |   |   |   |
| 42. | <i>Amaranthus viridis</i> L.                              | + | - | - |
| 43. | <i>Achyranthes bidentata</i> L.                           | + | - | - |
| 44. | <i>Amaranthus hypochondriacus</i> L.                      | + | - | - |
| 45. | <i>Amaranthus spinosus</i> L.                             | + | + | - |
| 46. | <i>Aerva javanica</i> (Burm. f.) Juss. ex. J.A.Schult.    | + | + | - |
| 47. | <i>Aerva lanata</i> L.                                    | - | + | + |
| 48. | <i>Alternanthera pungens</i> Kunth                        | + | + | - |
| 10. | Apiaceae                                                  |   |   |   |
| 49. | <i>Eryngium maritimum</i> L.                              | - | - | + |
| 50. | <i>Pimpinella diversifolia</i> DC.                        | + | + | + |
| 51. | <i>Scandix pecten veneris</i> L.                          | + | + | - |
| 52. | <i>Torilis arvensis</i> (Huds.) Link                      | + | + | - |
| 11. | Boraginaceae                                              |   |   |   |
| 53. | <i>Arnebia euchroma</i> (Royle ex Benth.) I.M.Johnst.     | + | + | - |
| 54. | <i>Cynoglossum lanceolatum</i> Frosk.                     | - | + | - |
| 55. | <i>Onosma hispida</i> Wall.                               | + | + | - |
| 12. | Brassicaceae                                              |   |   |   |
| 56. | <i>Capsella burs-pastoris</i> (L.) Medik.                 | + | + | - |
| 57. | <i>Coronopus didymus</i> (L.) Sm.                         | + | + | - |
| 58. | <i>Malcolmia africana</i> var. <i>Africana</i> (L.) R.Br. | + | - | - |
| 59. | <i>Sisymbrium irio</i> L.                                 | + | + | - |
| 13. | Cannabaceae                                               |   |   |   |
| 60. | <i>Cannabis sativa</i> L.                                 | + | - | + |
| 14. | Capparidaceae                                             |   |   |   |
| 61. | <i>Cleome viscosa</i> L.                                  | + | - | - |
| 15. | Caryophyllaceae                                           |   |   |   |
| 62. | <i>Arenaria serpyllifolia</i> L.                          | + | - | - |
| 63. | <i>Silene conoidea</i> L.                                 | + | - | - |
| 16. | Chenopodiaceae                                            |   |   |   |
| 64. | <i>Chenopodium album</i> L.                               | + | + | - |
| 65. | <i>Chenopodium ambrosioides</i> L.                        | + | + | - |
| 66. | <i>Chenopodium murale</i> L.                              | + | - | - |
| 67. | <i>Chenopodium botrys</i> L.                              | + | + | - |
| 68. | <i>Kochia indica</i> L.                                   | + | - | - |
| 17. | Convolvulaceae                                            |   |   |   |

|      |                                                      |   |   |   |
|------|------------------------------------------------------|---|---|---|
| 69.  | <i>Convolvulus arvensis</i> L.                       | + | + | + |
| 70.  | <i>Ipomoea purpurea</i> L.                           | + | + | - |
| 71.  | <i>Ipomoea eriocarpa</i> R.Br.                       | + | + | + |
| 18.  | Commelinaceae                                        |   |   |   |
| 72.  | <i>Commelina benghalensis</i> L.                     | + | - | + |
| 19.  | Cuscutaceae                                          |   |   |   |
| 73.  | <i>Cuscuta reflexa</i> L.                            | + | - | - |
| 20.  | Cucurbitaceae                                        |   |   |   |
| 74.  | <i>Citrullus colocynthis</i> L.                      | + | + | + |
| 21.  | Euphorbiaceae                                        |   |   |   |
| 75.  | <i>Euphorbia granulate</i> Frosk.                    | + | - | + |
| 76.  | <i>Euphorbia helioscopia</i> L.                      | + | - | - |
| 77.  | <i>Euphorbia indica</i> Lam.                         | + | + | - |
| 78.  | <i>Euphorbia peplus</i> L.                           | + | - | - |
| 79.  | <i>Phyllanthus niruri</i> L.                         | + | - | - |
| 22.  | Fumariaceae                                          |   |   |   |
| 80.  | <i>Fumaria indica</i> (Hausskn.) Pugsley             | + | - | - |
| 23.  | Geraniaceae                                          |   |   |   |
| 81.  | <i>Geranium rotundifolium</i> L.                     | + | - | - |
| 24.  | Lamiaceae                                            |   |   |   |
| 82.  | <i>Ajuga bracteosa</i> Wall.                         | + | - | - |
| 83.  | <i>Origanum vulgare</i> L.                           | + | + | - |
| 84.  | <i>Micromia biflora</i> (Buch.-Ham. ex D. Don) Benth | + | + | - |
| 85.  | <i>Mentha longifolia</i> (L.) Pers                   | + | - | - |
| 86.  | <i>Oenanthe javanica</i> (Blume) DC., Prod           | - | + | + |
| 87.  | <i>Salvia moorcroftiana</i> Wall. ex.Benth.          | + | - | - |
| 88.  | <i>Salvia plebeia</i> R.Br.                          | + | - | - |
| 89.  | <i>Thymus sinensis</i> L.                            | + | - | - |
| 25.  | Lythariaceae                                         |   |   |   |
| 90.  | <i>Ammannia auriculata</i> Willd., Enum              | + | - | - |
| 26.  | Menispermaceae                                       |   |   |   |
| 91.  | <i>Cissampelos pareira</i> L.                        | - | + | - |
| 27.  | Malvaceae                                            |   |   |   |
| 92.  | <i>Malva parviflora</i> L.                           | + | - | - |
| 93.  | <i>Malvastrum coromandelianum</i> (L). Garcke.       | + | - | + |
| 28.  | Oenotheraceae                                        |   |   |   |
| 94.  | <i>Oenothera rosea</i> L.Her.                        | + | + | - |
| 29.  | Oxalidaceae                                          |   |   |   |
| 95.  | <i>Oxalis corniculata</i> L.                         | + | + | - |
| 30.  | Papilionaceae                                        |   |   |   |
| 96.  | <i>Astragalus amherstianus</i> L.                    | + | - | - |
| 97.  | <i>Lathyrus aphaca</i> L.                            | + | - | - |
| 98.  | <i>Lotus corniculatus</i> L.                         | + | - | - |
| 99.  | <i>Medicago polymorpha</i> L.                        | - | - | + |
| 100. | <i>Melilotus officinalis</i> (L.) Pall.              | - | - | + |
| 101. | <i>Sesbania sesban</i> (L.) Merrill.                 | - | - | + |

|              |                                             |        |       |       |
|--------------|---------------------------------------------|--------|-------|-------|
| 102.         | <i>Trifolium repens</i> L.                  | -      | -     | +     |
| 103.         | <i>Trifolium resupinatum</i> L.             | +      | +     | +     |
| 31.          | Papaveraceae                                |        |       |       |
| 104.         | <i>Papaver somniferum</i> L.                | +      | -     | -     |
| 32.          | Polygonaceae                                |        |       |       |
| 105.         | <i>Emex spinosus</i> (L.) Campd.            | +      | -     | -     |
| 106.         | <i>Persicaria glabra</i> (Wild) M.O.Delgado | +      | -     | -     |
| 107.         | <i>Persicaria maculosa</i> S.F.Gay.         | +      | -     | -     |
| 108.         | <i>Polygonium aviculare</i> L.              | +      | -     | +     |
| 109.         | <i>Polygonum plebeium</i> R.Br.             | +      | +     | +     |
| 110.         | <i>Polygonum recumbens</i> R.Br.            | -      | +     | +     |
| 111.         | <i>Rumex hastatus</i> D.Don.                | +      | -     | +     |
| 112.         | <i>Rumex halepensis</i> Mill.               | +      | -     | -     |
| 33.          | Pontederiaceae                              |        |       |       |
| 113.         | <i>Eichornia crassipes</i> (Mart.) Solms    | -      | -     | +     |
| 34.          | Plantaginaceae                              |        |       |       |
| 114.         | <i>Plantago lanceolata</i> L.               | +      | -     | -     |
| 115.         | <i>Veronica anagallis-aquatica</i> L.       | -      | -     | +     |
| 35.          | Portulacaceae                               |        |       |       |
| 116.         | <i>Portulaca oleracea</i> L.                | +      | -     | -     |
| 36.          | Ranunculaceae                               |        |       |       |
| 117.         | <i>Ranunculus muricatus</i> L.              | +      | +     | -     |
| 37.          | Rubiaceae                                   |        |       |       |
| 118.         | <i>Galium aparine</i> L.                    | +      | -     | -     |
| 38.          | Scrophulariaceae                            |        |       |       |
| 119.         | <i>Verbascum thapsus</i> L.                 | +      | -     | +     |
| 39.          | Solanaceae                                  |        |       |       |
| 120.         | <i>Datura stramonium</i> L.                 | -      | -     | +     |
| 121.         | <i>Solanum surattense</i> Burm.f.           | +      | +     | -     |
| 122.         | <i>Solanum nigrum</i> L.                    | -      | -     | +     |
| 123.         | <i>Withania somnifera</i> L.                | +      | -     | -     |
| 40.          | Urticaceae                                  |        |       |       |
| 124.         | <i>Pilea peperomioides</i> Diels.           | +      | -     | -     |
| 125.         | <i>Urtica dioica</i> L.                     | +      | -     | -     |
| 41.          | Violaceae                                   |        |       |       |
| 126.         | <i>Viola serpens</i> Wall. ex Roxb.         | +      | -     | -     |
| 127.         | <i>Viola stocksii</i> Boiss.                | +      | -     | -     |
| 42.          | Verbenaceae                                 |        |       |       |
| 128.         | <i>Phyla nudiflora</i> L. Greene            | -      | +     | -     |
| 129.         | <i>Verbena officinalis</i> L.               | +      | -     | +     |
| 43.          | Zygophyllaceae                              |        |       |       |
| 130.         | <i>Peganum harmala</i> L.                   | -      | +     | -     |
| 131.         | <i>Tribulus terrestris</i> L.               | -      | +     | +     |
| Total        | 131                                         | 97     | 41    | 39    |
| Percentage % |                                             | 74.04% | 31.2% | 29.7% |

in other areas [Mandal et al. \(2019\)](#). Some notable research work including ([Ali and Qaiser, 2009](#); [Khan et al., 2022](#) and [Haq et al., 2024](#)) agree with our findings.

The present study agrees with Shah *et al.* (2021) who described the ecological parameters of weed in wheat crop fields of Chitral. They reported life-forms including Therophytes, Geophytes and Hemicryptophytes. Similarly, in leaf-sizes Mesophyllous, Microphyllous, Macrophyllous, Nanophyllous, Megaphyllous, Leptophyllous and Aphyllous species were reported. Same results were also presented by Naila *et al.* (2017). Shah *et al.* (2021) who reported most common families were Asteraceae, Polygonaceae, Brassicaceae, Caryophyllaceae, Chenopodiaceae, Papilionaceae (Sub family of Fabaceae) and Poaceae in their study discussed by Khan *et al.* (2018) and showed that Asteraceae, Fabaceae, Poaceae and Ranunculaceae as dominant families of weeds. Khan *et al.* (2017) showed *Emex spinosus*, *Cannabis sativa*, *Oxalis corniculata*. *Chenopodium* and *Euphorbia helioscopia* were most common weeds. These species also reported in the present research. Ahamd *et al.* (2022) elaborated that the edaphic variables had higher concentration of Potassium, organic matter and sandy nature of soil which is in favour of the present research. Invasiveness of weed was studied by El-Metwally *et al.* (2022) and Abidin *et al.*, (2021) with similar results. Weed species composition and distribution pattern in the maize crop under the influence of edaphic factors and farming practices was studied by Naeem *et al.* (2021) and reported similar results. Study of Shahzad *et al.* (2021) showed elemental composition in leaf, stem and roots of weed with similar outcome.

## Conclusions and Recommendations

The present research reported 131 weeds species distributed in cereal crops of the study area. Therophytes followed by geophytes and hemicryptophytes were dominant while Mesophyllous, Microphyllous and Nanophyllous leaf sizes were more prevalent. Wheat showed the highest weed diversity (97 spp.) followed by maize (41 spp.) and rice (39 spp.) crops. The dominance of Asteraceae and Poaceae families is consisted with regional flora. The present research provides baseline data on weed diversity in cereal crops of the study area. Dominance of therophytes and mesophylls indicates adaptation to the local climates. Future studies focusing on management trials and ethnobotanical uses of these species are recommended.

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## Novelty Statement

This study provides a comprehensive field-based assessment of weed flora associated with wheat, rice and maize crops in Batkhela, District Malakand, documenting 131 weed species and their taxonomic, life-form, morphological and ecological characteristics. It also identifies crop-associated weed patterns and dominant life forms, providing baseline information for integrated weed management and conservation of indigenous flora.

## Author's Contribution

Bibi Mayam: Field survey, data collection, identification of weed species, morphological characterization, ecological evaluation, data analysis, and manuscript preparation/writing.

Syed Mukarram Shah: Supervision, research guidance, review and critical revision of the manuscript.

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## Generative AI and AI-assisted technology statement

The authors declare that no generative AI and AI assisted technology was used in the creation of this manuscript.

## Conflict of interest

The author declares no conflict of interest.

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