Research Article

Ecological Study of Weeds of Sugarcane in District Swabi Khyber Pakhtunkhwa, Pakistan

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Abstract | The present research explains ecological study of weeds of Sugarcane in District Swabi Khyber Pakhtunkhwa, Pakistan. This study was conducted during weeds growing seasons in sugarcane fields from October 2022 to January 2023. The weed flora of sugarcane in study area comprised 50 species spread in 42 genera and 24 families. Out of 24 families, 21 were dicots and 3 were monocots families. Amaranthaceae (9 species.) and Asteraceae (8 species.) were leading families. They were followed by Brassicaceae (4 species.), Euphorbiaceae and Poaceae each (3 species.), Caryophyllaceae, Plantaginaceae, Polygonaceae and Solanaceae each with (2 species.). The rest of 15 families were represented by single species each. Annuals shared 45 (90%) species while perennials contributed 05 (10%) species. Life form and leaf size spectra revealed that therophytes were foremost life form consisted of 45 (90%) species and microphylls were dominant class represented by 30 (60%) species. There were 41 (82%) species with simple leaves, 6 (12%) species with dissected or decompound leaves, while 3 (6%) species were represented by compound leaves. This study reveals that large number of weed plants invade sugarcane crop in the study area. For obtaining better yield, it is imperative to take suitable measures for weed control.

Received | September 03, 2024; **Accepted** | May 09, 2025; **Published** | June 02, 2025
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Citation | Khan, U.U., M. Anwar, M. Saqlain and N. Tufail. 2025. Ecological study of weeds of sugarcane in District Swabi Khyber Pakhtunkhwa, Pakistan. *Pakistan Journal of Weed Science Research,* 31(2): 83-89.
DOI | https://dx.doi.org/10.17582/journal.PJWSR/2025/31.2.83.89
Keywords | Floristic composition, Life form, Leaf size, Sugarcane, Swabi, Weeds

Introduction

District Swabi was declared and upgraded to district on 1st July 1988. Prior to the upgrade, it had been a tehsil of District Mardan since its founding in 1937. Presently, it is a large District in Khyber Pakhtunkhwa province of Pakistan. It lies between 72°-13' and 72°- 49' East longitude and 33°-55' and 34°-23' North latitude. District Buner borders it on the north, district Haripur borders it on the east, district Attock in the Punjab province borders it on the south, and districts Mardan and Nowshera border it on the west (Anwar *et al.*, 2015). Swabi has four tehsils, Lahor, Topi, and Razar. The southern plains and the northern hilly region make up District Swabi. The district has a total area of 1,543 km^2 and a population of 1.625 million according to the 2017 census. The climate of district Swabi is harsh, with scorching summers. From May on, there is a noticeable sharp increase in temperature. In June,

it gets the hottest. The temperature steadily drops starting in October. The coldest month is January. The monsoon season, which spans July and August, received maximum rainfall during which the weather becomes hot and humid (Anwar *et al.*, 2020).

Weeds are unwanted plants growing in cultivated as well as in domesticated and barren areas and adapted to various edaphic and climatic conditions (Anwar et al., 2022). There are almost 30,000 weed plants in the world, out of them, more than 50 causing considerable damage to agricultural crops (Mahmood and Niaz, 1992). Weeds deplete crop quality and quantity by competing with them for resources like water, light, nutrients, and space (Dangwal *et al.*, 2010). Certain weeds secrete allelo-chemicals that have an impact on the germination of seeds and the growth of cultivated and agricultural crops, according to Oudhia and Tripathi (1998). Weeds successfully invade new areas and form mutualistic relationships with insect pollinators, which has an impact on a variety of ecosystems (Jesse *et al.*, 2006; Morale and Aizen, 2006).

The sugarcane (*Saccharum officinarum* L.) is a significant long-duration C4 crop found in tropical and subtropical regions that produces about 35% of ethanol and 80% of the world's sugar (Rathika *et al.*, 2023). Sugarcane, also known as wonder cane, is a crop that grows slowly. The early stages of sugarcane growth are when crop-weed competition occurs. During the first 50 days of the sugarcane life, weeds have been observed to remove more than twice as much N, P, and K. Grasses, broad-leaved weeds, and sedges are the main weeds that affect sugarcane. Sedges grow in bunches or clusters and are grass-like perennial weeds. A variety of weed plants invade sugarcane crop in the area of research leading to significant crop yield losses. Therefore, the aim and objectives of the current study is to provide basic information about the weed ecology and development of weed management programs.

Materials and Methods

During the sugarcane growing seasons from November 2022 to January 2023, a floristic study of weeds in 10 sugarcane fields in the district Swabi was conducted. From these sugarcane fields, specimens of weed plants were carefully collected, dried, and preserved and then mounted on herbarium sheets. The "Flora of Pakistan" (Nasir and Ali, 1970-1989) was then used to identify them. Later, the identification was verified using online resources; The Plant List (www.theplantlist.org.) and Tropicos-Flora of Pakistan (www.tropicos.org/Project/Pakistan). With the help of Raunkiaer (1934) and Hussain (1989) manuals, weed plant species were classified into different life form and leaf size spectra. A comprehensive floristic list of weed plants with ecological features was alphabetically compiled according to Anwar *et al.* (2020).

Results and Discussion

A distinctive group of plant species in an area is known as the floristic composition or species composition. Numerous factors, including habitat, species diversity, composition, and geographic features, influence the species composition. The weed flora of sugarcane in the area of research comprised 50 species spread in 42 genera and 24 families (Table 1, Figure 4). Out of 24 families, 21 were dicots having (37 genera and 45 species) and 3 were monocots having (5 genera and 5 species). Annuals shared 45 (90%) species while perennials contributed 05 (10%) species (Table 2). Amaranthaceae (9 species) and Asteraceae (8 species) were leading families. Brassicaceae (4 species), followed by Euphorbiaceae and Poaceae (3 species each), Caryophyllaceae, Plantaginaceae, Polygonaceae and Solanaceae (2 species each) (Figure 1). The rest of 15 families were represented by single species each. Comparing with Inayat *et al.* (2014) who reported 43 weed species belonging to 39 genera and 17 families from wheat and sugarcane crop of district Charsadda, Pakistan. Similarly, Khan *et al.* (2011) enumerated 73 weed species belonging to 65 genera and 27 families from sugarcane crop of District Bannu, Pakistan. While working on weeds of sugarcane, Khan *et al.* (2017) listed 35 species belonging to 33 genera and 18 families from District Charsadda, Pakistan.

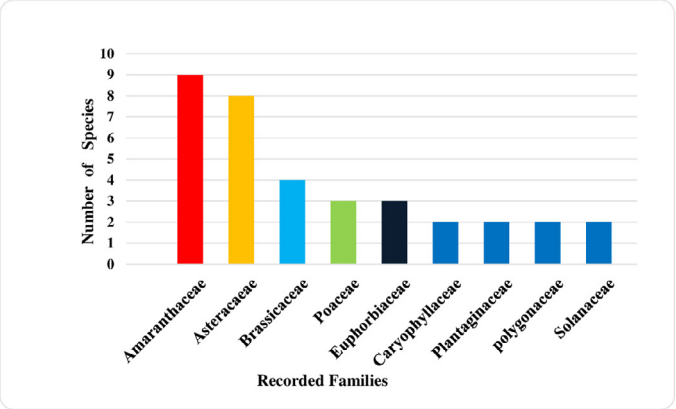

Figure 1: *Number of weed species in recorded families.*

Table 1: *Floristic composition and ecological characteristics of weeds of sugarcane crop in district Swabi.*

S. No.	Divisions/families/species	Life form	Leaf size	Leaf type	Life span
A. Monocotyledonae					
1. Commelinaceae					
1	*Commelina benghalensis* L.	Geophytes	Nanophyll	Simple	Perennial
2. Cyperaceae					
2	*Cyperus compressus* Jacq.	Therophytes	microphyll	Simple	Annual
3. Poaceae					
3	*Eleusine indica* (L.) Gaertn	Hemicryptophyte	Nanophyll	Simple	Perennial
4	*Dactyloctenium aegyptium* (L.) Willd.	Therophytes	Microphyll	Simple	Annual
5	*Brachiaria ramosa* (L.) Stapf	Therophytes	Microphyll	Simple	Annual
B. Dicotyledonae					
1. Amaranthaceae					
6	*Achyranthes aspera* L.	Hemicryptophyte	Microphyll	Simple	Perennial
7	*Aerva sanguinolenta* (L.) Blume	Hemicryptophyte	Microphyll	Simple	Perennial
8	*Alternanthera sessilis* (L.)	Therophytes	Microphyll	Simple	Annual
9	*Amaranthus blitum* L.	Therophytes	Nanophyll	Simple	Annual
10	*A. graecizans* L.	Therophytes	Microphyll	Simple	Annual
11	*A.Viridis* L.	Therophytes	Microphyll	Simple	Annual
12	*Chenopodium album* L.	Therophytes	Microphyll	Simple	Annual
13	*C.ambrosioides* L.	Therophytes	Nanophyll	Simple	Annual
14	*Digera muricata* (L.) Mart.	Therophytes	Microphyll	Simple	Annual
2. Apiaceae					
15	*Scandix pecten-veneris* L.	Therophytes	Nanophyll	Simple	Annual
3. Aristolochiaceae					
16	*Aristolochia rotunda* L.	Therophytes	Microphyll	Dissected	Annual
4. Asteraceae					
17	*Bidens pilosa* L.	Therophytes	Microphyll	Simple	Annual
18	*Calendula arvensis* L.	Therophytes	Microphyll	Simple	Annual
19	*Conyza canadensis* (L.)	Therophytes	Microphyll	Simple	Annual
20	*C. sumatrensis* (S.F.Blake)	Therophytes	Microphyll	Simple	Annual
21	*Eclipta prostrata* (L.) L.	Therophytes	Microphyll	Simple	Annual
22	*Gamochaeta pensylvanica* (Willd.)	Therophytes	Microphyll	Simple	Annual
23	*Parthenium hysterophorus* L.	Therophytes	Mesophyll	Dissected	Annual
24	*Xanthium strumarium* L.	Therophytes	Mesophyll	Simple	Annual
5. Brassicaceae					
25	*Capsella bursa-pastoris* (L.) Medik	Therophytes	Microphyll	Dissected	Annual
26	*Coronopus didymus* (L.) Sm.	Therophytes	Nanophyll	Dissected	Annual
27	*Rorippa dubia* (Pers.) H. Hara	Therophytes	Mesophyll	Simple	Annual
28	*R. islandica* (Oederex Murray) Borbas	Therophytes	Microphyll	Simple	Annual
29	*Nonea edgeworthii* A.DC.	Therophytes	Microphyll	Simple	Annual
6. Caesalpiniaceae					
30	*Cassia occidentalis* hort. ex Steud.	Therophytes	Microphyll	Compound	Annual
7. Cannabaceae					
31	*Cannabis sativa* L.	Therophytes	Nanophyll	Compound	Annual
8. Caryophyllaceae					
32	*Cerastium glomeratum* Thuill	Therophytes	Nanophyll	Simple	Annual
33	*Stellaria media* (L.) Vill	Therophytes	Nanophyll	Simple	Annual

Table continues on next page.....

S. No.	Divisions/families/species	Life form	Leaf size	Leaf type	Life span
9. Euphorbiaceae					
34	*Euphorbia helioscopia* L.	Therophytes	Nanophyll	Simple	Annual
35	*E. heterophylla* L.	Therophytes	Microphyll	Simple	Annual
36	*E.hirta* L.	Therophytes	Nanophyll	Simple	Annual
10. Geraniaceae					
37	*Geranium rotundifolium* L.	Therophytes	Nanophyll	Dissected	Annual
11. Malvaceae					
38	*Malvastrum coromandelianum* (L.) Garcke	Hemicryptophyte	Microphyll	Simple	perennial
12. Oxalidaceae					
39	*Oxalis corniculata* L.	Therophytes	Nanophyll	Simple	Annual
13. Papilionaceae					
40	*Pisum sativum* L.	Therophytes	Nanophyll	Compound	Annual
14. Phrymaceae					
41	*Mazus pumilus* (Burm.f.) Steenis	Therophytes	Microphyll	Simple	Annual
15. Plantaginaceae					
42	*Veronica hederifolia* L.	Therophytes	Nanophyll	Simple	Annual
43	*V.persica* Poir.	Therophytes	Microphyll	Simple	Annual
16. Polygonaceae					
44	*Persicaria barbata* (L.) H. Hara	Therophytes	Microphyll	Simple	Annual
45	*Rumex dentatus* L.	Therophytes	Microphyll	Simple	Annual
17. Ranunculaceae					
46	*Ranunculus muricatus* L.	Therophytes	Microphyll	Simple	Annual
18. Solanaceae					
47	*Physalis divaricate* D. Don	Therophytes	Microphyll	Simple	Annual
48	*Solanum nigrum* L.	Therophytes	Mesophyll	Simple	Annual
19. Tiliaceae					
49	*Corchorus olitorius* L.	Therophytes	Microphyll	Simple	Annual
20. Verbenaceae					
50	*Verbena officinalis* L.	Therophytes	Nanophyll	Dissected	Annual

Similarly, Javed *et al*. (2023) reported 25 weed species of 10 families from sugarcane crop fields of district Sheikhupura (Punjab), Pakistan. According to Anwar *et al*. (2020) plant species belonging to family Poaceae, Papilionaceae, Asteraceae and Brassicaceae constitutes major weed flora in cultivated fields. Our findings are in agreement with them. Life span reveals that most of the weeds were annuals followed by perennials. The domination of annuals over perennials might be a response to harsh climate and biotic pressure. Leaves are the most important organs of most vascular plants. In the current study, simple leaves were dominant over dissected and compound leaves. This is might be a response to light, climate and seasonal variation.

The term life-form refers to the general appearance of the plant body. The terms leaf size spectrum and biological spectrum refer to the percentage distribution of various life forms and leaf size in the local flora. In vegetation analysis, life form and leaf size are two physiognomic characteristics and climate indicators of a region that are commonly utilized (Cain and Castro, 1959). In the present study, therophytes were dominant life form comprised 45 (90%) hemicryptophytes shared 4 (8%) species followed by geophytes 1 (2%) species (Table 2, Figure 2). Similar result was presented by Inayat *et al*. (2014) who described therophytes as a major life form followed by hemicryptophytes and chamaephytes. Similarly, therophytes, hemicryptophytes and chamaephytes were major life forms in the study of Javed *et al*. (2023). While studying weeds of different crops in Pakistan, therophytes were dominant in the study of Hussain *et al*. (2009), Fazlullah *et al*. (2015), Fazal *et al*. (2019) and Abdullah et al. (2021). The domination of therophytes indicated that the area was under biotic pressure and severe anthropogenic activities.

Table 2: *Summary of ecological characteristics of weed flora of sugarcane in district Swabi.*

S. No.	Ecological characteristics	Number	Percentage
Weed flora			
I	Total species	50	---
II	Total genera	42	---
III	Total families	24	---
Life span			
I	Annuals	45	90
II	Perennials	05	10
Life-form spectra			
I	Therophytes	45	90
II	Hemicryptophytes	04	08
III	Geophytes	01	02
Leaf size spectra			
I	Microphylls	30	60
II	Nanophylls	16	32
III	Mesophylls	04	08
Lamina shape/Leaf types			
I	Simple	41	82
II	Dissected/Decompound	06	12
III	Compound	03	06

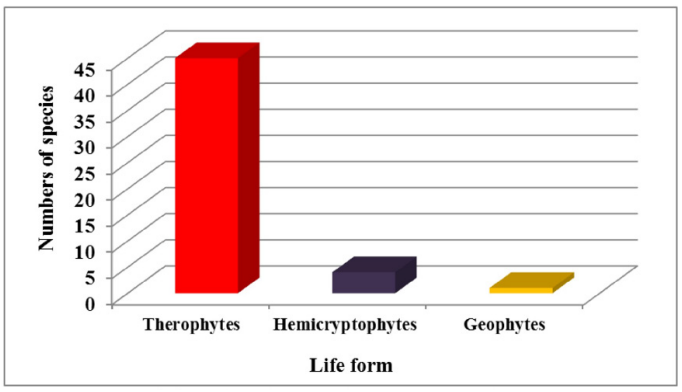

Figure 2: *Life form of weed species of Sugarcane crop in district Swabi.*

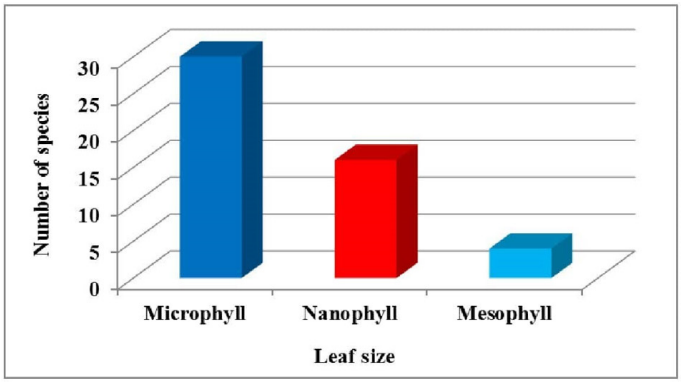

Figure 3: *Leaf size of weed species of Sugarcane crop in district Swabi.*

Figure 4: *Pictures of common weeds of Sugarcane crop in district Swabi.*

Key: (1) Commelina benghalensis; (2) Cyperus compressus; (3) Eleusine indica; (4) Dactyloctenium aegyptium; (5) Brachiaria ramose; (6) Achyranthes aspera; (7) Aerva sanguinolenta; (8) Alternanthera sessilis; (9) Amaranthus blitum; (10) Alternanthera graecizans; (11) Alternanthera viridis; (12) Chenopodium album; (13) Chenopodium ambrosioides; (14) Digera muricata; (15) Scandix pecten-veneris; (16) Aristolochia rotunda; (17) Bidens pilosa; (18) Calendula arvensis; (19) Conyza canadensis; (20) Conyza sumatrensis; (21) Eclipta prostrata; (22) Gamochaeta pensylvanica; (23) Parthenium hysterophorus; (24) Xanthium strumarium; (25) Capsella bursa-pastoris; (26) Coronopus didymus; (27) Rorippa dubia; (28) Rorippa islandica; (29) Nonea edgeworthii; (30) Cassia occidentalis; (31) Cannabis sativa; (32) Stellaria media; (33) Euphorbia helioscopia.

Cain and Castro (1959) suggested that therophytes are characteristics of harsh climate. Our findings are in agreement with them as the climate of the study area is harsh and extreme. Microphylls were dominant group (30 species; 60%) followed by nanophylls (16 species; 32%), and mesophylls (4 species; 8%) in the current exploration (Table 2, Figure 3). Our findings are in according with the results of Fazlullah *et al.* (2015) who reported microphylls as major leaf size

classes. Inayat *et al*. (2014) described microphylls as leading group followed by leptophylls, nanophylls and mesophylls. This might be similar climate and seasonality. Our findings are in contrast with the results presented by Abdullah et al. (2021) who recorded mesophylls as dominant group followed by macrophylls, microphylls, leptophylls and aphyllous. This might be due to climate, seasonality and different habitat conditions.

Conclusions and Recommendations

It is concluded that a high quantity of weed plants are present in sugarcane fields in the study area, leading to significant crop yield losses. To improve yield, it is crucial to implement effective mechanical, chemical and biological methods for weed management.

Acknowledgement

The authors are equally thankful to those who helped us in field survey, plant collection and plant identification.

Novelty Statement

This study provides the first ecological analysis of sugarcane weeds in District Swabi, Pakistan. It contributes valuable baseline data for developing affective weeds managment strategies.

Author's Contribution

Maqsood Anwar: Supervision, technical support and proof reading.
Ubaid Ullah Khan: Data analysis and write up.
Muhammad Saqlain: Field work and data collection.
Numan Tufail: data collection and plant identification.

Conflict of interest
The authors have declared no conflict of interest.

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