The Pharma Innovation Journal 2023; 12(9): 2985-2990

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(9): 2985-2990

www.thepharmajournal.com
Received: 28-07-2023
Accepted: 30-08-2023

Monu Kumar
Research Scholar, Department of Agronomy, Banda University of Agriculture & Technology, Banda, Uttar Pradesh, India

Dinesh Sah
Professor, Department of Agronomy, Banda University of Agriculture & Technology, Banda, Uttar Pradesh, India

Shipra Yadav
Assistant Professor, Department of Agriculture Integral Institute of Agricultural Sciences & Technology Integral University, Lucknow, Uttar Pradesh, India

Vikash Singh
Research Scholar, Department of Agronomy, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

Rinku Kumar
Research Scholar, Department of Agronomy, Banda University of Agriculture & Technology, Banda, Uttar Pradesh, India

Kamaran Azam
Research Scholar, Department of Agronomy, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

Corresponding Author:
Monu Kumar
Research Scholar, Department of Agronomy, Banda University of Agriculture & Technology, Banda, Uttar Pradesh, India

Structure, composition and importance value index of weeds in major rabi crops of Banda district of U.P. Bundelkhand

Monu Kumar, Dinesh Sah, Shipra Yadav, Vikash Singh, Rinku Kumar and Kamaran Azam

Abstract
Crop weed competition is most common under limited resources conditions. Weeds compete with cultivated crops for resources also encourage other biotic problems like pest and disease problems, serve as alternate host for deleterious insects and pathogens, increase the cost of production and reduce the market value of crops. Phyto-sociological study gives an assessment of weeds of importance in a particular area with fact and figures; provide overall information on the species-wise distribution in and around crops of a given area and; compare and classify weeds in a crop-weed ecosystem. Phytosociological studies of weeds are necessary for understanding the relationship between crops and their weed flora and may be useful, as a tool for developing a sustainable long-term weed management strategy. The structure and composition of vegetation in the agricultural fields have been compared in terms of frequency, density, abundance and their relative values and Importance Value Index (IVI).

Keywords: Weed, weed management**,** phytosociology, abundance, diversity

Introduction
Rabi crops are major source of income for farming community of Bundelkhand region of Uttar Pradesh. During the season farmers are cultivating cereals, pulses, oilseeds and several vegetable and medicinal crops. Among them major are wheat, chickpea, lentil, field pea, mustard, linseed, vegetable pea, brinjal, onion, tulsi etc. Field also remains occupied by pigeonpea crop, an important kharif pulse crop of the region. Most of the crops in the region are grown under limited resource conditions. These crops are suffering a lot by heavy weed infestations. Crop weed competition is most common under limited resources conditions. Weeds compete with cultivated crops for resources such as water, nutrients and light. Weeds infestation also encourage other biotic problems like pest and disease problems, serve as alternate host for deleterious insects and pathogens, increase the cost of production, reduce the market value of crops. Out of total losses due to various biotic factors weeds are known to account for one third. The extent of crop yield losses, vary depending on the crop and associated agro-ecological factors. The weeds in cereals, pulses and oilseed crops alone cost the nation an economic loss over Rs 50.000 crores per annum (Yaduraju *et al*, 2015) [12].
Phyto-sociological study gives an assessment of plants or weeds of importance in a particular area with fact and figures; provide overall information on the species-wise distribution in and around crops of a given area and; compare and classify weeds in a crop-weed ecosystem (Sah et al. 2020) [2]. Understanding the sociological structure of weeds in crop fields is a pre-requisite for its effective management. Phytosociological studies of weeds are necessary for understanding the relationship between crops and their weed flora and may be useful, as a tool for developing a sustainable long-term weed management strategy. Moreover, such studies are helpful in determining how a weed population changes over time in response to selective pressures due to field management practices. This study was under taken to determine the phytosociological characters of weeds in chickpea, lentil, pea, pigeonpea, mustard, wheat, linseed and some other crops and suggest an effective weed management strategy.
In agriculture, weeds compete with crop plants for various resources like water, nutrient, sunlight etc. Because of their highly competitive ability and allelopathic interference, weeds cause an irreversible damage to plants. Crop-weed competition has been established as major deterrent for low crop productivity. Therefore, the management of weeds was consideration as a must.

Other aspects, such as, phytosociology and reciprocal relations of weeds and crop needs to be studied as thoroughly as possible. It is, therefore, necessary to make a detailed survey of weeds in crop fields, their distribution, and relative occurrence in specific crops. The importance of studying the weed dynamics in a cropping system has been reported to facilitate formulation of an appropriate management strategy (Derksen *et al.*, 2002) [3]. A clear knowledge about the existence of different weed flora under different cropping systems is therefore needed to gain a better understanding in suggesting appropriate weed management strategy for farmers. The present study was carried out to study the weed flora of various crop and cropping system to create a base line data for framing management strategies.

Materials and Methods

The study was conducted at the Research and Students Instructional Farm of College of Agriculture, Banda University of Agriculture and Technology, Banda, Uttar Pradesh, India. University is located in Bundelkhand Region of Uttar Pradesh (25.50^0 N latitude and 80.34^0 E longitude). The climate of region is typical subtropical with long dry season from late September to late June and wet season from July to September with hot desiccating winds in summer (May-June) with intensive evaporation transpiration losses.

This work is based on fields surveys was carried out in January 2023 within the 2022/2023 cropping season. At this stage, approximately two months would have gone after weeding. This time chosen for observation because, most of the weeds were well established, most of them were in flowering or seed setting stages. Frequent visits were made to the crop fields and the specimens collected were identified with the help of available literature.

Weed species compositions in the fields were assessed by throwing 1 m^2 quadrate randomly in 10 different locations in each crop field. The structure and composition of vegetation in the agricultural fields have been compared in terms of frequency, density, abundance and their relative values were derived from the primary data (Curtis 1959) [2].

The method for calculating various phytosociological attributes studied are described as:

Frequency (F) = Number of quadrates in which the species occurs /Number of quadrates studied Relative Frequency (RF) = (Frequency value for a species/Total of Frequency value for all the species) × 100

Density (D) = Total number of individuals of a species in all the quadrates/Number of quadrates studied

Relative Density (RD) = (Density value for a species/Total of Density value for all the species) × 100.

Abundance (A) = Total number of individuals of a species/Number of quadrate in which the species occurs

Relative abundance (RA) = (Abundance value for a species/Total of abundance value for all the species) x 100.

Importance Value Index (IVI) (Phillips 1959) [4].

Importance Value Index is valuable statistical measures for the analysis of phytosociology and plant community and it provides an overall idea of a species and its importance in the plant community. It is derived by summing up Relative Frequency, Relative Density and Relative Abundance.

Importance Value Index (IVI) = RA + RD+ RF

Species Diversity Index [Shannon-Weiner Index (1963)] [10]

Shannon-Weiner Index (1963) [10] is one of the widely used indices for measuring species diversity, which is the expression of community structure and indicates the complexity of a habitat, of an ecosystem

Shannon-wiener index (H) = - S [Pi (ln Pi)]

Here Pi = (Number of individual of one weed species/Total number of all individual of weed species) × 100

Evenness index (Pielou 1975) [5]

Evenness index (E) =H /Hmax. or = H/ Log S

Here H = Shannon wiener diversity index
S = Total number of species

Species Richness [Menhinick's Index (1964)] Species richness is another mode of expression of the diversity and based on the total number of species and total number of individuals in a sample or habitat.

Menhinick's Index (1964) $D = S/\sqrt{N}$ Where, 'D' is the index value 'S' total number of species 'N' total number of individuals of all species.

Similarity Index [Sorensen's Index (1968)]

Similarity index (S) = 2C/ (A+B)

Here A = Number of species in one crop
B = Number of species in another crop
C = Number of species common in both crop

Dissimilarity index

Dissimilarity index = 1- S
Here S =Similarity index

Results and Discussion

Composition of weed species

All together twenty-six weed species belonging to 12 different families were found in all crop fields surveyed during study (Table 1). The type and number of weeds diverge in the different cropping systems studied. Crop wise number of weeds recorded were ranging between 4 to 7. Maximum number of weed species seven (07) were present in the mustard and wheat crop field, followed by six (06) in chickpea crop, while five (05) number of weed species in pigeon pea, linseed, and field pea crop field, and least number (04) of weed species were present in the lentil crop. The floristic composition of recorded weed species was grouped into monocotyledons and dicotyledons. Total number of monocot species observed in the study was 07 (26.9 %), while the number of dicot species was 19 (76 %). Out of 26 weed species 18 were annual and remaining 08, *viz. Cirsium arvense, Cynodon dactylon, Rumex dentatus, Saccharum spontaneum, Milium effusum Cyperus rotundus, Trifolium repens and Centella asiatica* were perennial.

Frequency, Density and Abundance

The frequency, density and abundance of various weed species under the prevailing environmental set up presented in Table 2. In wheat field, highest frequency (0.8) of weed population was recorded for *Trifolium repens*, *Anethum graveolens*, and *Chenopodium album* followed by 0.7 for *Phalaris minor* and minimum frequency of 0.4 for *Lathyrus hirsutus*. In lentil highest frequency of 1 observed for *Chenopodium album*, while *Rumex dentatus Anethum graveolens* showed frequency of 0.6. *Milium effusum* exhibits lower frequency of 0.5 (Table 2). In Pea crop, *Saccharum spontaneum* and *Cyperus rotundus* showed highest frequency of 1 while minimum frequency of 0.3 was for *Centella asiatica* (Table 2).

As mentioned in Table 2, in chickpea crop, highest frequency of 0.9 was observed for *Anagallis arvensis* while minimum frequency of 0.5 was associated with *Rumex dentatus*. In pigeon pea crop, highest frequency of 0.6 was observed for *Cirsium arvense*, and *Eruca vesicaria*, while minimum frequency of 0.5 was associated with *Dactyloctenium aegyptium, Tridax procumbens, and Poa annua* (Table 2). In mustard crop, highest frequency of 0.7 was observed for *Chenopodium album*, Cyperus *rotundus*, *Polygonum aviculare*, while minimum frequency of 0.1 was associated with *Cirsium arvense* (Table 2). Similarly, in Linseed crop, highest frequency of 1 was observed for *Cyperus rotundus*, while minimum of 0.6 was associated with *Cirsium arvense, and Saccharum spontaneum* (Table 2).

Density

In wheat (Table 2), weed density value was in the range between 0.5 to 26.1. Weed species *Trifolium repens* showed highest density (26.1) followed by *Chenopodium album* (8.3) while *Lathyrus hirsutus showed lowest density* (0.5). Weed density values in lentil ranges between 1.1 to 6. Minimum density value of (1.1) was observed by *Rumex dentatus*, while highest density value (6) was recorded by *Anethum graveolens.* Most of the weed species reflecting lower density values indicating single plant dominated community structure of the weed flora of the lentil field.

In Pea, weed density value ranges between (0.6 to 5.6). Minimum density value of (0.6) was observed by *Parthenium hysterophorus* while highest density value (5.6) was recorded by *Cyperus rotundus* (Table 2). While in chickpea weed density value ranges between (1.2 to 8.7). Minimum density value of (1.2) was observed by *Spergula arvensis*, whereas, highest density value (8.7) was recorded by *Anagallis arvensis* (Table 2). In Pigeon pea weed density value ranges between (1.2 to 1.9). Highest density value (1.9) was recorded by *Eruca vesicaria* while, minimum density value of (1.2) was observed by *Poa annua* (Table 2).

In mustard crop (Table 2), weed species *Cyperus rotundus* was dominated community over others. Weed density value ranges between (0.4 to 2.1). Highest value (2.1) with *Cyperus rotundus* and lowest (0.4) with *Cirsium arvense.* Weed density value ranges between (1.3 to 16.3) in linseed crop. Highest density value (16.3) was recorded by *Cyperus rotundus* and minimum density value of (1.3) was observed by *Cynodon dactylon* (Table 2).

Abundance

The weeds with maximum abundance in wheat crop was *Trifolium repens* and *Chenopodium album*. Weed abundance value ranges between 1.25 to 32.62. Weed species *Trifolium repens* showed highest abundance (32.62) followed by *Chenopodium album* (10.4) while *Lathyrus hirsutus* showed lowest abundance value of 0.5 (Table 2).

In Lentil, (Table 2) weed abundance value ranges between 1.83 to 10. Minimum abundance value of (1.83) was observed by *Rumex dentatus*, while highest abundance value (10) was recorded by *Anethum graveolens.* In Pea, abundance value ranges between 1.2 to 5.6. Minimum abundance value of (1.2) was observed by *Parthenium hysterophorus* and highest abundance value (5.6) was recorded by *Cyperus rotundus.* In Chickpea (Table 2) abundance value ranges between 2 to 9.66. Highest abundance value (9.66) was recorded by *Anagallis arvensis* while minimum abundance value of (2) was observed by *Spergula arvensis.* In pigeonpea, highest abundance value (3.4) was recorded by *Tridax procumbens* while *Poa annua* showed lowest abundance value of 2.4. The values were in the range between 2.4 to 3.4.

Among oilseed crops, in mustard field weed abundance value ranges between 1.4 to 3. Highest (3) was associated with *Trifolium repens* and *Cyperus rotundus followed by Helichrysum luteoalbum* (2.5), *Chenopodium album* (2.4), while lowest (1.4) with *Anethum graveolens (Table 2).* In Linseed, abundance value ranges between 1.85 to 16.3. Minimum abundance value of 1.8 was observed by *Cynodon dactylon* while highest abundance value (16.3) was recorded by *Cyperus rotundus* (Table 2).

Relative Frequency, Density, Abundance and Importance Value Index

Values represented in Table 3 reflects considerable variation among the different relative values of weed species. The lower relative frequency values represent less occurrence and higher frequency values represent more occurrence of weed species. In the Wheat field, highest relative frequency (17.39) of weed population was recorded for *Trifolium repens*, *Anethum graveolens* and *Chenopodium album* followed by (15.22) for *Phalaris minor* and minimum relative frequency of (8.69) for *Lathyrus hirsutus.* Maximum relative density (55.06), relative abundance (52.47) and IVI value (124.92) found with *Trifolium repens* was most dominant among the observed weed community.

In the Lentil field, highest relative frequency (37.03) of weed population was recorded for *Chenopodium album*, followed by (22.22) for *Rumex dentatus, Anethum graveolens* and minimum relative frequency of 18.51 for *Milium effusum* (Table 3). Maximum relative density (39.47), relative abundance (44.38) and IVI value (106.07) found with *Anethum graveolens* was most dominant among the observed weed community.

In Pea crop, highest frequency of 28.57 was observed for *Saccharum spontaneum* and Cyperus *rotundus* while minimum frequency of 8.57 was *Centella asiatica.* Maximum relative density (57.73), relative abundance (47.33) and IVI value (133.63) found with *Cyperus rotundus* was most dominant among the observed weed community (Table 3).

In field of chickpea crop, highest relative frequency of 21.95 was observed for *Anagallis arvensis* while minimum relative frequency of 12.19 was associated *Rumex dentatus*. Maximum relative density (42.64), relative abundance (34.47) and IVI value (99.06) found with *Anagallis arvensis* was most dominant among the observed weed community (Table 4).

In Pigeon pea crop, highest relative frequency of 22.22 was

observed for *Cirsium arvense*, and *Eruca vesicaria*, while minimum relative frequency of 18.51 was associated with *Dactyloctenium aegyptium*, *Tridax procumbens*, *and Poa annua*. Maximum relative density (25.33) and IVI value (70.25) found with *Eruca vesicaria* and relative abundance (24.42) was most dominant among the observed weed community (Table 3).

In case of mustard field, highest relative frequency (15.55) of weed population was recorded for *Chenopodium album*, *Cyperus rotundus*, *Polygonum aviculare*, followed by (13.33) for *Trifolium repens Helichrysum luteoalbum*, and minimum relative frequency of 6.66 for *Cirsium arvense* (Table 3). Maximum relative density (20.38), relative abundance (17.14) and IVI value (53.07) found with *Cyperus rotundus* was most dominant among the observed weed community.

In linseed crop field, highest frequency of 26.31 was observed for *Cyperus rotundus*, and minimum frequency of 15.78 was associated with *Cirsium arvense* and *Saccharum spontaneum* (Table 3). Maximum relative density (69.95), relative abundance (61.97) and IVI value (158.23) found with *Cyperus rotundus* was most dominant among the observed weed community.

Species Diversity Index

Shannon's H Index of weed flora diversity was high in mustard crop (1.90) followed by pigeonpea (1.59) and chickpea (1.52). The lowest value (1.27) of Shannon Diversity Index (H) was observed in wheat. All values presented (Table 5) showed the highest diversity in the crop with Shannon index (H > 1.0).

Evenness index

The Evenness index values more than 2 were observed in order of pigeonpea 2.27 > Linseed 2.23 >Lentil 2.22 > pea 2.08 (Table 5). Higher evenness index means weed species were uniformly distributed in it whereas the lowest was in wheat (1.50). The evenness index is very low for the wheat crop which therefore indicates the species are clustered within their habitat and therefore not evenly spaced.

Richness index

Richness index indicates the number of species present in observation site. The highest richness index was found in mustard (1.46) followed by wheat (1.27) and chickpea (1.09), whereas the lowest richness index value of 0.73 was in lentil crop.

Similarity index

The similarity index shows the pattern of similarity between crops/ sites/ treatments. In observed crops the value was in the range between 0.13 to 0.25. Wheat, lentil, chickpea and mustard crop showed a high similarity index (0.25) while lower value 0.13 was associated with pigeon pea, pea and linseed (Table 4).

Dissimilarity index

Wheat, lentil, chickpea and mustard crop showed a lower dissimilarity index (0.75) while higher value of 0.87 was associated with pigeon pea, pea and linseed (Table 4). Difference in canopy structure as well as cultural practices could be the reason of this diversity, similarity and dissimilarity.

In studied crops some common weed species has observed in some crops illustrated in table 5. In Wheat, Lentil, Chickpea, Linseed, Mustard one weed was common. One weed also was common in crops like wheat, chickpea, mustard; wheat, lentil, mustard; pigeon pea, linseed; Common in lentil, chickpea; pigeonpea, linseed, mustard; and pea, linseed, mustard crops. In spite of these two weeds were common in chickpea, mustard; and pea, linseed crops.

Table 1: Floristic composition of the weed flora in the crop fields

Spot no..	Common name of weed species	Botanical name of weed species	Family	Group	Life cycle
1.	Bathua	*Chenopodium album*	Amaranthaceae	Dicot	Annual
2.	Bhabra or kharthua	*Chenopodium murale*	Amaranthaceae	Dicot	Annual, BLW
3.	Canadian thistle	*Cirsium arvense*	Asteraceae	Dicot	Perennial
4.	Canary grass	*Phalaris minor*	Poaceae	Monocot	Annual grass
5.	Tridax daisy	*Tridax procumbens*	Asteraceae	Dicot	Annual or Perennial
6.	Congress grass	*Parthenium hysterophorus*	Asteraceae	Dicot	Annual, BLW
7.	Corn spurry	*Spergula arvensis*	Caryophyllaceae	Dicot	Annual, BLW
8.	Crowfoot grass	*Dactyloctenium aegyptium*	Poaceae	Monocot	Annual
9.	Dill/ Soya	*Anethum graveolens*	Apiaceae	Dicot	Annual or Biennial
10.	Doobgrass	*Cynodon dactylon*	Poaceae	Monocot	Perennial hardy
11.	Jangli palak	*Rumex dentatus*	Polygonaceae	Dicot	Perennial
12.	Jersey cudweed	*Helichrysum luteoalbum*	Asteraceae	Dicot	Annual or Biennial
13.	Kans grass	*Saccharum spontaneum*	Poaceae	Monocot	Perennial
14.	Knot weed	*Polygonum aviculare*	Polygonaceae	Dicot	Annual
15.	Krishnaneel	*Anagallis arvensis*	Primulaceae	Dicot	Annual, BLW
16.	Lesua	*Digera arvensis*	Amaranthaceae	Dicot	Annual
17.	Meadow grass or poa	*Poa annua*	Poaceae	Monocot	Annual
18.	Milk purslane	*Euphorbia maculate*	Euphorbiaceae	Dicot	Annual, BLW
19.	Millet grass	*Milium effusum*	Poaceae	Monocot	Perennial
20.	Motha	*Cyperus rotundus*	Cyperaceae	Monocot	Perennial
21.	Ragweed	*Ambrosia artemisiifolia*	Asteraceae	Dicot	Annual, BLW
22.	Rocket	*Eruca vesicaria*	Brassicaceae	Dicot	Annual
23.	Sowthistle	*Sonchus oleraceus*	Asteraceae	Dicot	Annual
24.	White clover	*Trifolium repens*	Fabaceae	Dicot	Perennial
25.	Wild Pea	*Lathyrus hirsutus*	Fabaceae	Dicot	Annual
26.	Brahami	*Centella asiatica*	Apiaceae	Dicot	Perennial herb

Table 2: The frequency, density and abundance of different weed species at the observation site.

	Wheat			Lentil			Field pea			Chickpea			Pigeon pea			Mustard			Linseed		
Weed species	F	D	A	F	D	A	F	D	A	F	D	A	F	D	A	F	D	A	F	D	A
Phalaris minor	0.7	2.8	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trifolium repens	0.8	26.1	32.6	-	-	-	-	-	-	0.6	2.3	3.8	-	-	-	-	1.8	3.0	-	-	-
Anethum graveolens	0.8	6.5	8.1	0.6	-	-	-	-	-	-	-	-	-	-	-	-	0.7	1.4	-	-	-
Chenopodium album	0.8	8.3	10.4	1.0	-	-	-	-	-	0.8	2.1	2.6	-	-	-	-	1.7	2.4	*0.9*	*2.4*	*2.7*
Sonchus oleraceus	0.6	1.8	3.0	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
Digera arvensis	0.5	1.4	2.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lathyrus hirsutus	0.4	0.5	1.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Milium effusum	-	-	-	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rumex dentatus	-	-	-	0.6	-	-	-	-	-	0.5	2.1	4.2	-	-	-	-	-	-	-	-	-
Cirsium arvense	-	-	-	-	0.6	0.6	-	-	-	-	-	-	0.6	1.3	2.2	-	-	-	-	-	-
Anagallis arvensis	-	-	-	-	-	-	-	-	-	0.9	8.7	9.7	-	-	-	-	-	-	-	-	-
Chenopodium murale	-	-	-	-	-	-	-	-	-	0.7	4.0	5.7	-	-	-	-	-	-	-	-	-
Spergula arvensis	-	-	-	-	-	-	-	-	-	0.6	1.2	2	-	-	-	-	-	-	-	-	-
Eruca vesicaria	-	-	-	-	0.6	0.6	-	-	-	-	-	-	0.6	1.9	3.2	0.6	-	-	-	-	-
Dactyloctenium aegyptium	-	-	-	-	0.5	0.5	-	-	-	-	-	-	0.5	1.4	2.8	0.5	-	-	-	-	-
Tridax procumbens	-	-	-	-	0.5	0.5	-	-	-	-	-	-	0.5	1.7	3.4	0.5	-	-	-	-	-
Poa annua	-	-	-	-	0.5	0.5	-	-	-	-	-	-	0.5	1.2	2.4	0.5	-	-	-	-	-
Cynodon dactylon	-	-	-	-	-	-	0.6	0.9	1.5	-	-	-	-	-	-		-	-	0.7	1.3	1.8
Saccharum spontaneum	-	-	-	-	-	-	1.0	1.9	2.4	-	-	-	-	-	-		-	-	0.6	1.6	2.7
Parthenium hysterophorus	-	-	-	-	-	-	0.4	0.6	1.2	-	-	-	-	-	-		-	-	-	-	-
Centella asiatica	-	-	-	-	-	-	0.3	0.7	1.2	-	-	-	-	-	-		-	-	-	-	-
Cyperus rotundus	-	-	-	-	-	-	1.0	5.6	5.6	-	-	-	-	-	-		2.1	3.0	1	**16.3**	**16.3**
Polygonum aviculare	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.3	1.8		-	-
Helichrysum luteoalbum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5	2.5		-	-
Cirsium arvense	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*0.6*	0.4	1.3	0.6	1.7	2.8

F= Frequency, **D**= Density, **A**= Abundance

Table 3: The relative frequency, relative density, relative abundance and IVI of different weed species at the observation site.

	Wheat				Lentil				Field Pea				Chickpea				Pigeonpea				Mustard				Linseed			
Weed species	**RF**	**RD**	**RA**	**IVI**	**RF**	**RD**	**RA**	**IVI**	**RF**	**RD**	**RA**	**IVI**	**RF**	**RD**	**RA**	**IVI**	**RF**	**RD**	**RA**	**IVI**	**RF**	**RD**	**RA**	**IVI**	**RF**	**RD**	**RA**	**IVI**
Phalaris minor	15.2	5.9	6.4	27.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trifolium repens	17.4	55.1	52.5	124.9	-	-	-	-	-	-	-	-	14.6	11.3	13.7	39.6	-	-	-	-	13.3	17.5	17.1	47.9	-	-	-	-
Anethum graveolens	17.4	13.7	13.1	44.2	22.2	39.5	44.4	106.1	-	-	-	-	-	-	-	-	-	-	-	-	11.1	6.8	8	25.9	-	-	-	-
Chenopodium album	17.4	17.5	16.7	51.6	37.0	36.2	24.4	97.6	-	-	-	-	19.5	10.29	9.4	39.2	-	-	-	-	15.5	16.5	13.8	45.9	23.7	10.3	10.1	44.1
Sonchus oleraceus	13.0	3.8	4.8	21.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Digera arvensis	10.9	3.0	4.5	18.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lathyrus hirsutus	8.7	1.1	2.0	11.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Milium effusum	-	-	-	-	18.5	17.1	23.1	58.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rumex dentatus	-	-	-	-	22.2	7.2	8.1	37.6	-	-	-	-	12.2	10.3	15.0	37.5	-	-	-	-	-	-	-	-	-	-	-	-
Polygonum aviculare	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15.5	12.6	10.6	38.7	-	-	-	-
Helichrysum luteoalbum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13.3	14.6	14.3	42.2	-	-	-	-
Cirsium arvense	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22.2	17.3	15.5	55.1	6.7	3.9	7.6	18.1	-	-	-	-
Ambrosia artemisiifolia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.9	7.8	11.4	28.1	-	-	-	-
Anagallis arvensis	-	-	-	-	-	-	-	-	-	-	-	-	21.9	42.6	34.5	99.1	-	-	-	-	-	-	-	-	-	-	-	-
Chenopodium murale	-	-	-	-	-	-	-	-	-	-	-	-	17.1	19.6	20.4	57.0	-	-	-	-	-	-	-	-	-	-	-	-
Spergula arvensis	-	-	-	-	-	-	-	-	-	-	-	-	14.6	5.9	7.1	27.6	-	-	-	-	-	-	-	-	-	-	-	-
Cyperus rotundus	-	-	-	-	-	-	-	-	28.6	57.7	47.3	133.6	-	-	-	-	-	-	-	-	15.5	20.4	17.1	53.1	26.3	69.9	61.9	158.2
Cynodon dactylon	-	-	-	-	-	-	-	-	17.1	9.3	12.7	39.1	-	-	-	-	-	-	-	-	-	-	-	-	18.4	5.6	7.0	31.0
Saccharum spontaneum	-	-	-	-	-	-	-	-	28.6	57.7	47.3	133.6	-	-	-	-	-	-	-	-	-	-	-	-	15.8	6.9	10.1	32.8
Parthenium hysterophorus	-	-	-	-	-	-	-	-	11.4	6.2	10.1	27.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Centella asiatica	-	-	-	-	-	-	-	-	8.6	7.2	9.8	25.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Poa annua	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18.5	16	17.2	51.8	-	-	-	-	-	-	-	-
Tridax procumbens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18.5	22.7	24.4	65.7	-	-	-	-	-	-	-	-
Eruca vesicaria	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22.2	25.3	22.7	70.2	-	-	-	-	-	-	-	-
Dactyloctenium aegyptium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18.5	18.7	20.1	57.3	-	-	-	-	-	-	-	-

Table 4: H Index, Evenness Index, Richness Index, Similarity and Dissimilarity Index

Crops\ Indices	Shannon Diversity Index (H)	Shannon Evenness Index (E)	Richness Index	Similarity Index	Dissimilarity Index
Wheat	1.2693	1.50	1.27	0.25	0.75
Lentil	1.3385	2.22	0.73	0.25	0.75
Pea	1.4557	2.08	0.91	0.13	0.87
Chickpea	1.5281	1.96	1.09	0.25	0.75
Pigeon pea	1.5878	2.27	0.91	0.13	0.87
Mustard	1.9016	1.71	1.46	0.25	0.75
Linseed	1.559	2.23	0.91	0.13	0.87

Table 5: Weed species occurrence in different crop fields.

Weed species	Wheat	Lentil	Pea	Chickpea	Pigeonpea	Linseed	Mustard
Anagallis arvensis	-	-	-	√	-	-	-
Anethum graveolens	√	√	-	-	-	-	√
Centella asiatica	-		√	-	-	-	-
Chenopodium album	√	√	-	√	-	√	√
Chenopodium murale	-	-	-	√	-	-	-
Cirsium arvense	-	-	-	-	√	√	√
Cynodon dactylon	-	-	√	-	-	√	-
Cyperus rotundus	-	-	√	-	-	√	√
Dactyloctenium aegyptium	-	-	-	-	√	-	-
Digera arvensis	√	-	-	-	-	-	-
Eruca vesicaria	-	-	-	-	√	-	-
Helichrysum luteoalbum	-	-	-	-	-	-	√
Lathyrus hirsutus	√	-	-	-	-	-	-
Milium effusum	-	√	-	-	-	-	-
Parthenium hystorophorus	-	-	√	-	-	-	-
Phalaris minor	√	-		-	-	-	-
Poa annua	-	-		-	√	-	-
Polygonum aviculare	-	-	-	-	-	-	√
Rumex dentatus	-	√	-	√	-	-	-
Saccharum spontaneum	-	-	√	-	-	√	-
Sonchus oleraceus	√	-	-	-	-	-	-
Spergula arvensis	-	-	-	√	-	-	-
Tridax procumbens	-	-	-	-	√	-	-
Trifolium repens	√	-	-	√	-	-	√
No of species observed	07	04	05	06	05	05	07

√ = Present, - = Absent

Conclusion

It was concluded that the land used such as cultivation practices, inputs application, crops and cropping systems, weed management practices and other cultural practices affects the weed flora composition. The presence of some weeds in two or three crops indicates that their wider adoptability while restriction of some weeds to particular crop shows them requirement for special condition in order to grow. This survey will provide a base for future weed surveys. However, extensive field studies would be necessary to quantify the abundance and diversity of weeds under various cropping systems of Bundelkhand.

Acknowledgement

Authors express their gratitude to the authorities of Banda University of Agriculture & Technology, Banda for providing necessary support and facility during the course of study.

References

1. Batista K, Giacomini AA, Gerdes L, Mattos WT de, Andrade JB de. Phytosociological Survey of Weeds in Areas of Crop-Livestock Integration. American Journal of Plant Sciences. 2014;5:1090-1097.
2. Curtis JT. The vegetation of Wisconsin; an ordination of plant community. University of Winconsin press, Madison; c1959.
3. Derksen DA, Lafond GP, Thomas AG, Loeppky HA, Swanton CJ. The impact of agronomic practices on weed communities: tillage systems. Weed Sci. 1993;41:409–417. http://dx.doi.org/10.4236/ajps.2014.58121.
4. Philips EA. Methods of vegetation study. Henry Holt and company, New York; c1959.
5. Pielou EC. Ecological Diversity. Wiley New York, 1975, 165.
6. Das TK. Weed Science- Basics and Application. New Delhi. Jain brothers, 2008, 901.
7. Rathod PS, Patil DH, Dodamani BM. Integrated weed management of chickpea under rainfed conditions of Karnataka, India. Legume Research. 2017;40(3):580-585.
8. Sankar JP, Satapathy KB. Weed diversity of Rabi crops and their ethno medical uses in Kendrapara District of Odisha, India. Int Res J Biol Sci. 2015;4(3):33-8.
9. Sah Dinesh, Panwar GS, Kumar Arun, Kalhapure AH, Singh Narendra. Phytosociological study of weeds in major rabi season crops of Bundelkhand region. Journal of Pharmacognosy and Phytochemistry. 2020;9(5):3209-3213.
10. Shannon CE, Wiener W. The mathematical theory of communication. University of Juionis Press, Urbana, 1963 117.
11. Yadav RB, Vivek Singh RV, Yadav KG. Weed management in lentil. Indian Journal of Weed Science. 2013;45(2):113-115.
12. Yaduraju NT, Sharma AR, Rao AN. Weeds in Indian Agriculture- problems and prospects to become self-sufficient. Indian farming. 2015;65(7):2-6.