

**COMPARATIVE EVALUATION OF DIVERSITY AND HOMOGENEITY OF WEED COMMUNITIES OF WHEAT CROP IN TEHSIL RAZAR DISTRICT SWABI, PAKISTAN**

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**ABSTRACT**

The present study explains comparative evaluation of diversity and degree of homogeneity of weed communities of wheat crop. This study was conducted in tehsil Razar district Swabi Khyber Pakhtunkhwa, Pakistan during February-April 2016. A total of 200 quadrats (square shaped) having size (1m × 1m) were placed in 20 randomly selected wheat fields in the study area. Analytical quantitative characters like density, frequency and cover were calculated for each weed species. Twenty weed communities were established in 20 selected sites/stands. Comparative evaluation of diversity revealed that Menhinick's index ranged from 0.61 to 1.72, Margalef's species richness index ranged from 2.82 to 6.31, Simpson's diversity index ranged from 0.78 to 0.94, Shannon-Wiener diversity index varied from 2.13 to 3.24, Pielou's evenness index varied from 0.67 to 0.97 while maturity index ranged from 39.6 to 67.7. Based on Raunkiaer's law of frequency, out of 20 weed communities, 13 communities were found heterogeneous, while, other 7 were homogeneous. Maximum numbers of weed species were distributed in frequency class A, B and E. The heterogeneity of weed communities shows that the area is under heavy biotic pressure. It was concluded that a variety of weed plants infest wheat crop in the study area that may cause a loss to crop yield. For acquiring better yield, it is necessary to take the appropriate chemical, mechanical and biological measurements for weed control.

**Keywords:** Diversity indices, Frequency, Swabi, Weeds, Wheat.

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## INTRODUCTION

Razar is a tehsil of district Swabi Khyber Pakhtunkhwa, Pakistan. It lies from 34° 6' 0" to 34° 23' 0" North latitudes and 72° 12' 0" to 72° 27' 0" East longitudes. The total area of Razar is approximately 385 km<sup>2</sup> and its population is 583,936 as per census of 2017. The soil of the area is fertile and used for general cropping. It shows great variation in color and texture. Area has harsh climate. Summer is very hot and months of July and August record quite high temperature. A rapid fall in temperature is observed from October onwards. Winter is very cold. January is coldest month. Maximum rainfall is received during the months of July and August (monsoon). Maximum humidity has been recorded in monsoon and in winter in the month of December (Anwar *et al.*, 2015; Anwar *et al.*, 2020).

Weed, general term for any plant growing where it is not wanted. Weeds are unwanted plants growing in cultivated as well as in domesticated areas and adapted to various edaphic and climatic conditions. These are distributed everywhere and no crop is free of weeds. Weeds competes with crops mainly for water, space, light, nutrients and decreases quality as well as quantity of crop (Dangwal *et al.*, 2010). Weeds develop mutualistic relationship with insect pollinators (Jesse *et al.*, 2006) and effectively invade new areas that affect various ecosystems (Morale and Aizen, 2006). Oudhia and Tripathi (1998) reported that some weed plants secrete allelochemicals which affect the growth and germination of agricultural crops. The weed species with high importance value and frequency might compete better to reduce growth and yield of associated crop (Sher *et al.*, 2011). The invasive weeds change the community structure and composition of native plants and as a result create pressure on ecological energetics (Pysek and Richardson, 2007). Species richness (SR) is the number of different species in an ecological community. Species diversity (SD) is the

degree of variation in life form within an ecosystem. It refers to variety and variability among the ecosystem and living organisms. Species evenness (SE) is the uniformity of abundance between species in an ecological community. Species maturity (SM) is the proportion of total percentage frequency of all species in a stand. Degree of homogeneity refers to uniform distribution of species in Raunkiaer's frequency classes.

The review reveals that there is no detailed study regarding comparative evaluation of diversity and degree of homogeneity of weed communities of wheat crop in tehsil Razar district Swabi, Pakistan. Therefore, the aim and objectives of the present study were to explore diversity and degree of homogeneity of weed communities of wheat crop in tehsil Razar district Swabi Khyber Pakhtunkhwa, Pakistan. This research will provide baseline knowledge about weed ecology and it will be helpful in future studies.

## MATERIALS AND METHODS

### Analytical data

A total of 20 wheat fields were selected on the basis of floristic composition and physiognomy contrast in study area during 2016. At each field, 10 quadrats (square shaped) having (1m ×1m) size were placed systematically (Hussain, 1989). The number of weed species were counted in each quadrat and analytical quantitative characters i.e. cover, frequency and density were determined for each weed species. The relative value of each quantitative character was added to get the importance value (IV). Twenty weed communities were established on the basis of highest importance value (HIV) of three leading weed species (Hussain, 1989; Ahmad and Shaukat, 2012).

### Diversity indices

Species richness was determined using method of Margalef (1958) and Menhinick (1964). Species diversity was determined after Simpson (1949) and

Shannon-Wiener (1949). Species evenness was calculated according to Pielou (1975) method. Index of maturity was calculated according to formula of Pichi-Sermolli (1948). Raunkiaer's law of frequency (Raunkiaer, 1934) was used to determined degree of homogeneity.

## RESULTS AND DISCUSSION

### Weeds communities

Twenty weed communities were established in 20 selected sites. These were, *Parthenium* (VMP) community, *Anagallis-Cerastium-Veronica* (ACV) community, *Coronopus-Anagallis-Medicago* (CAM) community, *Phalaris-Emex-Anagallis* (PEA) community, *Chenopodium-Emex-Phalaris* (CEP) community, *Trifolium-Cynodon-Melilotus* (TCM) community, *Anagallis-Medicago-Poa* (AMP) community, *Cynodon-Medicago-Cerastium* (CMC) community, *Polygonum-Anagallis-Cynodon* (PAC) community, *Polygonum-Cynodon-Medicago* (PCM) community, *Galium-Anagallis-Phalaris* (GAP) community, *Poa-Anagallis-Avena* (PAA) community, *Phalaris-Papaver-Veronica* (PPV) community, *Anagallis-Coronopus-Polygonum* (ACP) community, *Stellaria-Poa-Anagallis* (SPA) community and *Cynodon-Veronica-Medicago* (CVM) community. These communities were floristically diverse due to diverse edaphic variables and favorable growth seasons. Spring is a favorable growth season for the growth of most weed plants. There is always a bloom of annual plants in the spring and early summer. Badshah *et al.* (2013) stated that generally spring and summer have higher number of species than other seasons. While studying weeds of wheat, other workers (Qureshi and Bhatti, 2001; Jakhar *et al.*, 2005; Qureshi *et al.*, 2009; Waheed *et al.*, 2009; Sher *et al.*, 2011; Malik *et al.*, 2013) recognized weed communities in wheat crop fields in different parts of Pakistan. These studies support the present findings.

### Diversity indices

Species richness, species diversity and species evenness were determined for each weed community. Comparative

evaluation of diversity revealed that Menhinick's index ranged from 0.61 to 1.72, Margalef's richness ranged from 2.82 to 6.31, Simpson's diversity index ranged from 0.78 to 0.94, Shannon-Wiener diversity index varied from 2.13 to 3.24 while Pielou's evenness index varied from 0.67 to 0.97 (Table-1, Figure 1). Sher *et al.* (2011) determined diversity indices for four weed communities of wheat in village Lahor, district Swabi, Pakistan. In comparison to them, the current research found maximum species richness and diversity. These are attributable to extensive exploration from diverse habitats and are due to diverse edaphic variables. Similar work was also conducted in Himalayan forests vegetation of Pakistan (Shaheen *et al.*, 2011; Amjad *et al.*, 2014).

### Species maturity and degree of homogeneity

Highest maturity index (67.7) was observed for *Fumaria-Medicago-Anagallis* community and lowest (39.6) for *Polygonum-Cynodon-Medicago* community (Table-1, Figure 2). A mature community is indicated by value more than 60%. Based on Raunkiaer's law of frequency, out of 20 weed communities, 13 communities were found heterogeneous while 7 were homogeneous. Maximum number of weed species were distributed in frequency class A, B and E (Table-2). Majority of weed communities showed heterogeneity due to the presence of large number of annual weeds. The heterogeneity of weed communities shows that the area is under heavy biotic pressure. Sher *et al.* (2011) found maturity index for four weed communities of wheat in village Lahor, district Swabi, Pakistan. In comparison to them, the current research found highest maturity index. This is due to diverse habitats and diverse edaphic variables. Raunkiaer's law of frequency is called normal frequency ratio which helps in testing the uniformity of vegetation (Khan *et al.*, 2012). Various climatic, biotic and edaphic factors, species composition, distribution, particular growth-form and life form affect

homogeneity of plant communities in different seasons in particular area.

### **CONCLUSIONS**

The present findings suggest that a large number of weed plants infest wheat crop in the study area that cause loss to crop yields on large scale. For acquiring

better yield, it is important to take appropriate biological, chemical and mechanical measure for weed control. This information about weed biology can be helpful for the selection of weed control methods and will provide baseline knowledge about weed ecology and will be helpful in future studies.

**Table-1. Comparative evaluation of diversity indices of weed communities of wheat crop in tehsil Razar district Swabi, Pakistan.**

S. No.	Weed Communities	Total species	Species Richness		Species Diversity		Evenness	Maturity Index
			Menhinick	Margalef	Simpson	Shannon-Wiener	Pielou	Pichi-Sermoli
1	<i>Polypogon-Ranunculus-Veronica</i> community	25	1.17	3.92	0.81	2.17	0.67	42.0
2	<i>Melilotus-Medicago-Ranunculus</i> community	21	1.40	3.69	0.89	2.45	0.81	44.7
3	<i>Fumaria-Medicago-Anagallis</i> community	27	1.22	4.20	0.94	3.05	0.92	67.7
4	<i>Fumaria-Medicago-Phalaris</i> community	21	1.01	3.29	0.87	2.35	0.77	50.9
5	<i>Veronica-Medicago-Parthenium</i> community	15	1.33	2.89	0.90	2.44	0.91	43.3
6	<i>Anagallis-Cerastium-Veronica</i> community	15	1.33	2.89	0.89	2.32	0.86	44.0
7	<i>Coronopus Anagallis-Medicago</i> community	26	1.14	4.00	0.89	2.59	0.79	45.0
8	<i>Phalaris-Emex-Anagallis</i> community	21	1.10	3.39	0.78	2.13	0.71	43.8
9	<i>Chenopodium-Emex-Phalaris</i> community	22	1.43	3.85	0.91	2.67	0.86	46.8
10	<i>Trifolium-Cynodon-Melilotus</i> community	20	1.44	3.61	0.86	2.25	0.75	41.0
11	<i>Anagallis-Medicago-Poa</i> community	21	0.61	2.82	0.83	2.15	0.71	57.1
12	<i>Cynodon-Medicago-Cerastium</i> community	25	0.87	3.57	0.90	2.62	0.81	60.8
13	<i>Polygonum-Anagallis-Cynodon</i> community	41	1.72	6.31	0.94	3.24	0.87	52.4
14	<i>Polygonum-Cynodon-Medicago</i> community	32	1.63	5.21	0.91	2.71	0.78	39.6
15	<i>Galium-Anagallis-Phalaris</i> community	23	0.94	3.44	0.92	2.76	0.88	65.6
16	<i>Poa-Anagallis-Avena</i> community	26	1.13	3.98	0.91	2.71	0.83	51.5
17	<i>Phalaris-Papaver-Veronica</i> community	22	0.91	3.31	0.90	2.53	0.82	55.4
18	<i>Anagallis-Coronopus-Polygonum</i> community	34	1.33	5.09	0.93	3.04	0.86	58.5
19	<i>Stellaria-Poa-Anagallis</i> community	32	1.48	5.04	0.92	2.85	0.97	41.8
20	<i>Cynodon-Veronica-Medicago</i> community	21	0.91	3.19	0.84	2.31	0.76	48.7

**Table-2. Degree of homogeneity of weed communities of wheat crop in tehsil Razar district Swabi, Pakistan.**

S. No.	Weed Communities	Total species	Distribution of species in frequency classes					Raunkiaer's Homogeneity Equation	Remarks
			A	B	C	D	E		
1	<i>Polypogon-Ranunculus-Veronica</i> community	25	13	4	2	0	6	$A > B > C > D < E$	Homogeneous
2	<i>Melilotus-Medicago-Ranunculus</i> community	21	11	2	1	3	4	$A > B > C < D < E$	Heterogeneous
3	<i>Fumaria-Medicago-Anagallis</i> community	27	2	2	5	12	6	$A = B < C < D > E$	Heterogeneous
4	<i>Fumaria-Medicago-Phalaris</i> community	21	6	5	3	2	5	$A > B > C > D < E$	Homogeneous
5	<i>Veronica-Medicago-Parthenium</i> community	15	5	3	3	3	1	$A > B = C = D > E$	Heterogeneous
6	<i>Anagallis-Cerastium-Veronica</i> community	15	6	3	2	1	3	$A > B > C > D < E$	Homogeneous
7	<i>Coronopus Anagallis-Medicago</i> community	26	6	9	5	2	4	$A < B > C > D < E$	Heterogeneous
8	<i>Phalaris-Emex-Anagallis</i> community	21	7	7	1	3	3	$A = B > C < D = E$	Heterogeneous
9	<i>Chenopodium-Emex-Phalaris</i> community	22	5	8	4	2	3	$A < B > C > D < E$	Heterogeneous
10	<i>Trifolium-Cynodon-Melilotus</i> community	20	11	3	1	0	5	$A > B > C > D < E$	Homogeneous
11	<i>Anagallis-Medicago-Poa</i> community	21	6	0	7	4	4	$A > B < C > D = E$	Heterogeneous
12	<i>Cynodon-Medicago-Cerastium</i> community	25	4	4	7	3	7	$A = B < C > D < E$	Heterogeneous
13	<i>Polygonum-Anagallis-Cynodon</i> community	41	7	9	12	8	5	$A < B < C > D > E$	Heterogeneous
14	<i>Polygonum-Cynodon-Medicago</i> community	32	15	5	4	3	5	$A > B > C > D < E$	Homogeneous
15	<i>Galium-Anagallis-Phalaris</i> community	23	2	5	4	3	9	$A < B > C > D < E$	Heterogeneous
16	<i>Poa-Anagallis-Avena</i> community	26	8	5	4	3	6	$A > B > C > D < E$	Homogeneous
17	<i>Phalaris-Papaver-Veronica</i> community	22	7	3	1	4	7	$A > B > C < D < E$	Heterogeneous
18	<i>Anagallis-Coronopus-Polygonum</i> community	34	4	10	5	7	8	$A < B > C < D < E$	Heterogeneous
19	<i>Stellaria-Poa-Anagallis</i> community	32	12	7	6	3	4	$A > B > C > D < E$	Homogeneous
20	<i>Cynodon-Veronica-Medicago</i> community	21	7	3	6	1	4	$A > B < C > D < E$	Heterogeneous

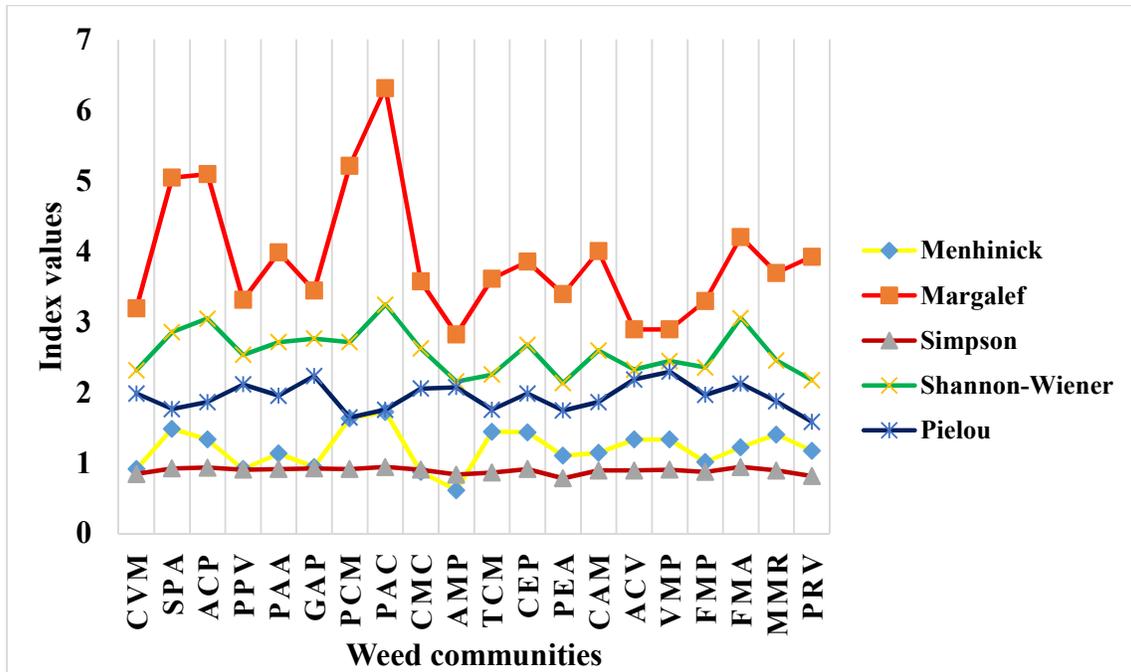


Figure 1. Comparative evaluation of diversity of weed communities of wheat crop in tehsil Razar district Swabi.

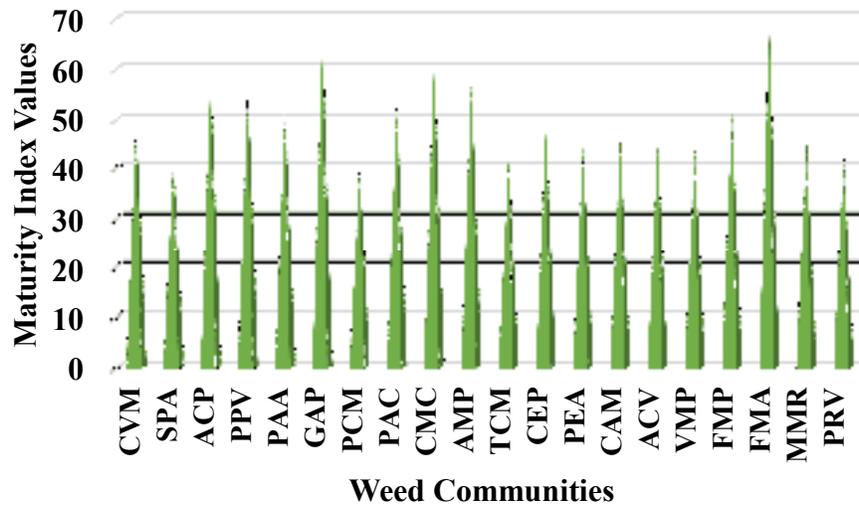


Figure 2. Maturity index of weed communities of wheat crop in tehsil Razar district Swabi.

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