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INDICATOR SPECIES ANALYSES OF WEED COMMUNITIES OF MAIZE CROP IN DISTRICT MARDAN, PAKISTAN

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ABSTRACT

Weeds are unwanted plant species growing in natural environment. Composition and abundance of weeds are influenced by number of environmental variables as well as farming practices in an ecosystem. Present study was formulated to measure the effect of environmental variables on weed species composition, abundance, distribution pattern and formation of various weeds communities in Union Council Shahbaz Ghari (total area 3956 ha, Agriculture land 1701 ha), District Mardan. Quantitative ecological techniques by adapting quadrat method were used to assess environmental variability and weed species distribution in the targeted region. Nine quadrats of 1×1 m^2 size were placed randomly in 65 different fields of the UC. Phytosociological attributes such as density, frequency, relative density, relative frequency and Importance Values were measured for each field. Preliminary results showed that UC Shahbaz Ghari has 29 different weed species belong to 15 different families. Presence absence (1,0) data of 29 species and 65 fields were analyzed using Cluster and Two Way Cluster Analysesvia PC-ORD version 5 resulting four major weed communities. Dominant weed species of the area are Cyperus rotundus, Urochloa panicoides, Brachiaria ramosa, Dactyloctenium aegyptium, Commelina benghalensis and Canvolvulus arvensis while Cannabis sativa, Ipomea purpurea, Amaranthus blitoides, Xanthium strumarium, Lactuca dissecta and Cucurbita maxima are rare weed species. Indicator Species Analyses (ISA) of data identified indicators of each sort of micro environmental condition. Based on our findings, it is recommended that awareness can be created among farmers especially about their farming practices to minimize noxious weeds of maize crop

Key words: Cluster analyses, indicator species analyses, maize, PC-ORD, weeds and Weed communities.

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INTRODUCTION

Maize (*Zea mays*) is usually grown in tropical and temperate regions with highly drained and fertile soil (Mills, 1994). According to global crop diversity trust (2006), maize is cultivated from equator to high latitude in north and south up to more than 3000 meter from sea level. Maize is grown on an area of 132 million hectare, with 570 metric tons of yield on the global scale (Ashique *et al*., 1997). In Pakistan during 2012-13 maize cultivated area was 0.981 m ha with 36.581 m tons yield and during same year in KPK its cultivation was 0.512 m ha with yield of 1.468 m t (Muoni *et al.*, 2011). It has higher contents of protein and fat as compared to other cereals (Breadley, 1992). It is used as human food, raw material for several industries and isvaluable livestock feed (Kumar and Jhariya, 2013).Maize growth and yield can be affected by several factors one of which is weeds and maize crop competition for available resources (Rashid *et al*., 2008).

Weed competition is most severe and can reduce maize production (Khan *et al*., 2013) at initial stage of growth (Mitchell *et al*., 2005). Weed species though important component of biodiversity but create problems to crop by competing with them for existing resources (Baker, 1965; Aldrich, 1984). There are 8000 weed plant species out of which 250 have been identified as beneficial while the others are competitors of the agricultural crops (Holm *et al*., 1979). Weeds can cause damage and reduce crop productivity in different ways. According to Valverde *et al*. (1995) 16-40% product of maize crop is lost due to weeds. Glauninger and Holzner (1982) reported that weeds fight for CO_2, compete with crop plants for nutrients, water and light. Weed cause increase in expenditures of farming practices and reduce production, quality of fertile land andeven water flow in the irrigation canals. Weeds exhibit vigorous growth and development due to their short period of seed dormancy, rapid rate of seed germination, short span of life cycle, long term survival, adaptation and tolerance to abiotic and biotic stresses (Baker, 1965; Iqbal *et al.,* 2015). As a result in the world weed species become dominant and cause threat to native biodiversity (Lowe *et al*., 2000).

In Pakistan, annual losses of about Rs. 10 billion have been estimated due to weed species (Khan *et al*., 1998). According to Hassan and Marwat (2001), in Pakistan the loss caused by weeds is more than 130 billion annually. In Australia, Adkin and Navie (2006), reported $3.3 billion loss by weeds annually and in USA Pimentel *et al*.

(2005), reported more than US$ 138 billion hammering annually. Therefore, control of weed species is important to enhance yield, production and quality of maize or any other crops. Because the weed infestation can affect the overall crop prpduction and economy of Pakistan (Afridi and Khan, 2014: 2015). Statistical analyses in relation to weed studies are important to find out the relationships among the weed communities distribution and measured variables (Ter Braak, 1986). Such analyses are of great help to visualize the relationship between species and environmental factors graphically for better understanding and eventually weeds management.

The present study is conducted to find out theindicator species of various weed communities of Union Council Shahbaz Ghari, district Mardan, Khyber Pakhtunkhwa, Pakistan as well as to find out weed indicator species.

MATERIALS AND METHODS

Weeds data

Mardan a District of Khyber Pakhtunkhwa have a total area of 1632 square Kilometers. It lies at 34°05' to 34°32' North latitudes and 71°48' to 72°25' East longitudes. There are 20 Union Councils in District Mardan including Shahbaz Garhi with an area of 3956 hectares located on Mardan-Swabi road at a distance of 12 Kilometer from Mardan. The Union Council ShahbazGarhi is the main junction of three districts i.e., Mardan, Swabi and Buner. People of this area mostly depend on agriculture. Important crops of UC are wheat, maize, rice, sugarcane, tobacco and mustard. Study of Indicator species of weed species and communities in maize crop was carried out to evaluate the indicator species of each microclimatic condition/habitat in the region.

Field survey was conducted during the months of August and September of 2014. Quantitative ecological techniques by adapting quadrat method were used to assess environmental variability and weed species distribution in the targeted region. Nine quadrats of 1×1 m^2 size were placed randomly each in 65 different fields of the UC following Clements, 1905. Phytosociological attributes such as density, frequency, relative density, relative frequency and Importance Values were measured for each field (Braun Blanquet, 1932; Oosting, 1956; Ambasht and Ambasht, 1969;).

Weed specimens were collected from each quadrat labeled with tags, placed between newspapers and pressed in plant presser. After this process the plant specimens were poisons and mounted on standard upon herbarium sheets. Specimens were identified using available literatures (Ali and Qaiser, 1995-2007; Khan *et al.,* 2013a). The specimens were deposited in the Herbarium of Hazara UniversityMansehra Pakistan.

Data analyses

For data analysis,presence absence (1,0) data of sixty five fields (585 quadrats) was prepared in MS EXCEL for Cluster Analysis. The data matrices were analyzed in PCORD version 5 to find out clusters of weed species and indicator species using utilities of Cluster and IndicatorSpecies Analyses (Khan *et al.,* 2012; Khan *et al.,* 2013b; Khan *et al.,* 2014).

RESULTS AND DISCUSSION

A total of 29 weed species were collected from 585 Quadrats distribute over 65 fields. These 29 species belong to 15 families. Poaceae and Amaranthaceae were leading families of the each area with 4 weed species (13.8%), followed by Cucurbitaceae and Asteraceae, having 3 species each (10.4%) respectively. Family Euphorbiaceae, Malvaceae, Convolvulaceae and Solanaceae have 2 species (6.9%) and remaining families Cyperaceae, Commelinaceae, Nyctaginaceae, Portulaceae, Fabacaeae, Leguminosae and Canabinaceae have one species (3.4%) each.

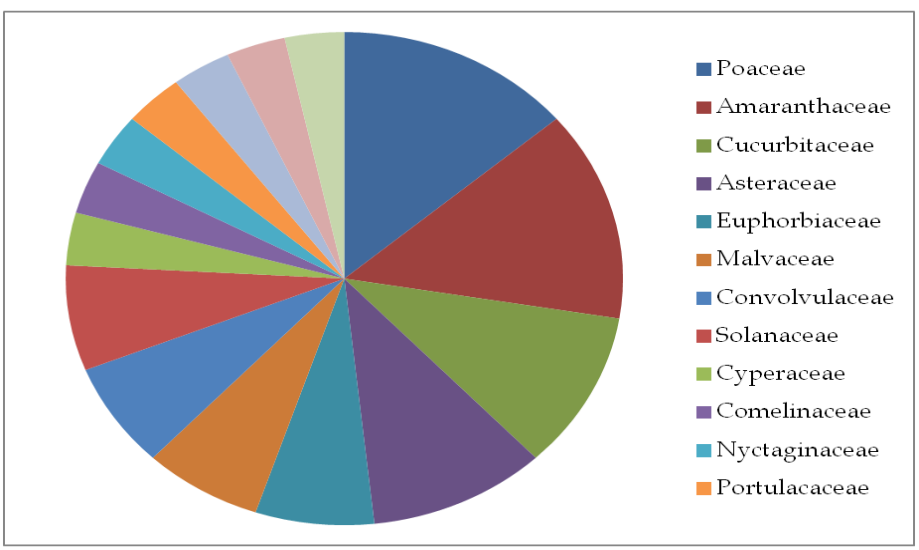

Figure 1. Distribution of weed species (%age) among to 15 different families in the study area

Abundant weed species of the region

The plants species present in fields with high Important Value (IV) were documented by adding relative density and relative frequency of a species and obtained values.

The most frequent weed species with high Importance Values of study area are as follows. The *Cyperus rotundus*, *Urochloa panicoides, Brachiaria ramosa, Dactyloctenium aegyptium*, *Commelina benghalensis, Convolvulus arvensis, Celosia argentea, Boerhavia diffusa, Euphorbia prostrate* and *Portulaca oleracea* (IVs mentioned in Fig. 2).

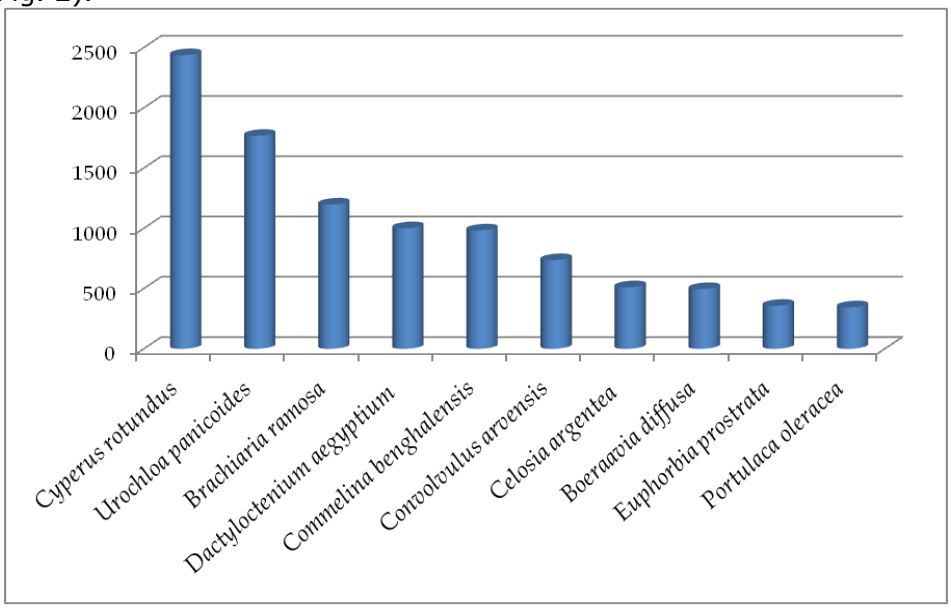

Figure 2. The top 10 abundant with high IV weed species of study area.

Less abundant weed species of study area

Ten less frequent weeds with minimum Important Value i.e. (less than 38) in the region are *Physalis angulata, Solanum nigrum, Archyranthes aspersa, Cannabis sativa, Malvastrum tricuspidatum, Ipomea purpurea, Amaranthus blitoides, Xanthium strumarium, Lactuca dissecta* and *Cucurbita maxima* (IVs mentioned in Fig. 3).

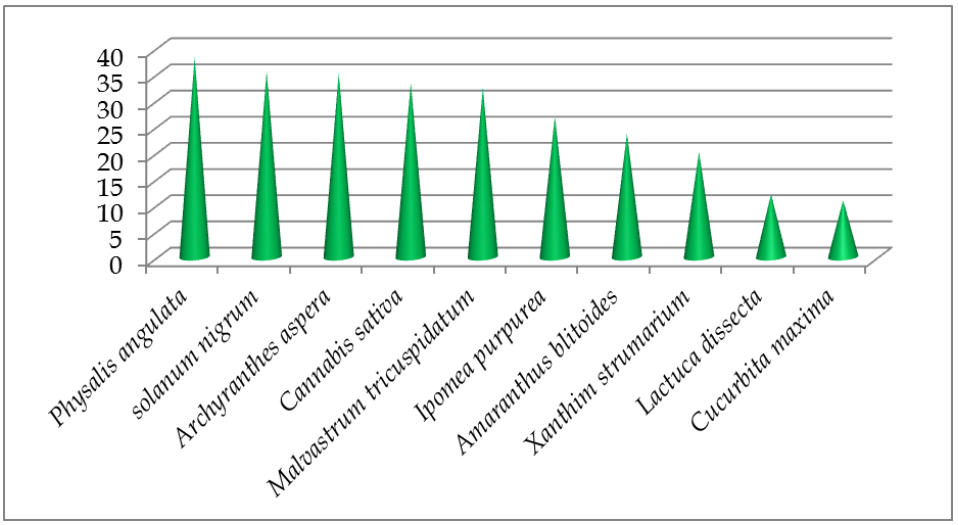

Figure 3. Top 10 less abundant weed species (with minimum IV) in the region.

Cluster Analysis

Cluster Analyses using PCORD version 5 resulted four weed communities from 65 fields (Fig. 4). Presence absence (1, 0) data was used for this purpose. Distances between adjoining groups were measured using Sorenson equation,

$$QS = \frac{2c}{a+b} \times 100$$

Where, a = Number of species in an area A, b = Number of species in an area B and c = Number of species common to area A and B (Fig. 4)

Four weeds communities identified as a result of grouping of fields are designated as weeds communities A, B, C, and D in the cluster.

1. *Celosia -Convolvulus - Euphorbia* weeds community

The community name was given based on Indicator Species Analyses (ISA). The topmost 3 indicator species of this community are *Celosia argentea, Convolvulus arvensis* and *Euphorbia prostrata*. The most abundant weed species of first community are *Cyperus rotundus, Urochloa panicoides* and *Brachiaria ramose* with Importance Value of more than 220. The less abundant weed species of first community in the region are *Cucurbita maxima, Archyranthes aspera* and *Amaranthus blitoides* (Appendix 1).

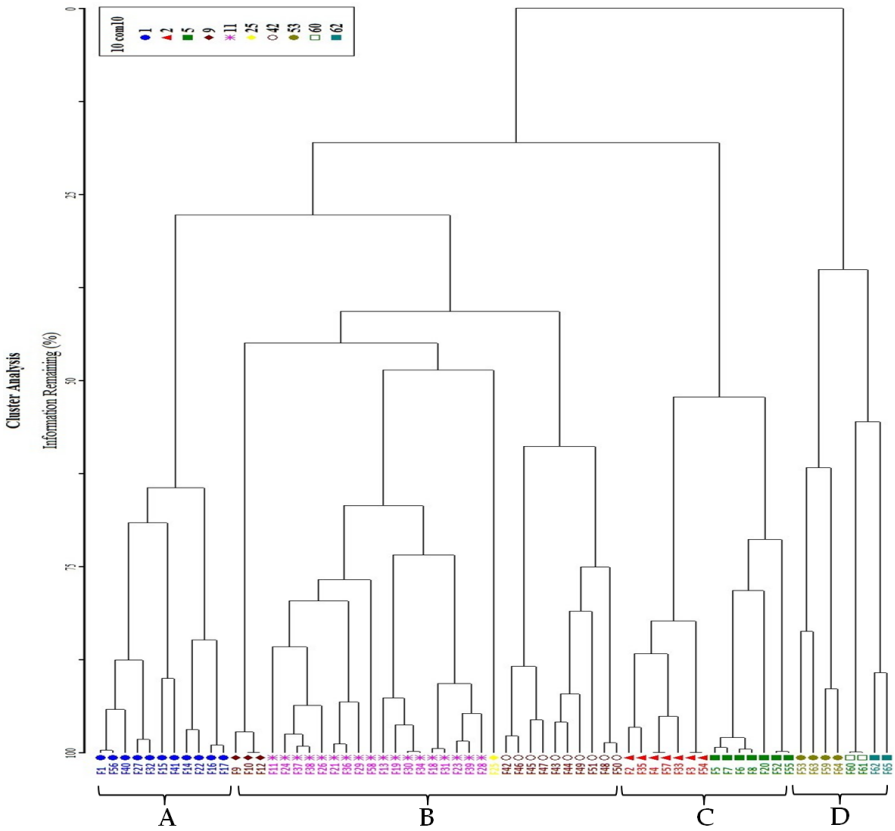

Figure 4. Cluster dendrogram of 65 fields based on 1, 0 data via Sorensen measures showing four weed communities.

2. *Archyranthes –Ipomea –Physalis* weeds community

This weed community includes more number of fields (A total of 32 fields) in the study area. Top 3 indicators of community are *Archyranthes aspera*, *Ipomea purpurea* and *Physalis angulata.* The most abundant weed species of this community are *Cyperus rotundus, Urochloa panicoides and Brachiaria ramosa* having Importance Value above than 570. The less frequent species of community 2 were *Solanum nigrum, Lactuca dissecta* and *Cucurbita maxima* with minimum importance Values in the community (Appendix-1).

3. *Corchorus-Lactuca–Commelina* Weeds community

Corchorus olitorius, *Lactuca dissecta* and *Commelina benghalensis* were the top indicator species of this community on the basis of which community name was given (Table-1)

Based on Importance Values most abundant weed species were *Cyperus rotundus, Urochloa panicoides* and *Brachiaria ramose* with IV

of above than 350. Among less abundant species of community 3 with minimum Importance Values were *Cannabis sativa, Cucurbita maxima* and *Amaranthus blitoides* are noteworthy (Appendix-1).

4. *Amaranthus– Euphorbia –Parthenium*Weeds community.

This weeds community has less number of fields in the projected area. The primary 3 indicator species of community were *Amaranthus viridis, Euphorbia hirta* and *Parthenium hysterophorus,* respectively. The top most abundant weed species of community are *Urochloa panicoides, Commelina benghalensis and Cyperus rotundas* having more than 190 IV. As the same time the rare species of community are *Cynodon dactylon, Cassia occidentalis* and *Physalis angulata* which show minimum important Value in the region (Appendix-1).

Our study revealed 29 weed species distributed among 15 families. Poaceae and Amaranthaceae are the dominant weed families each followed by Asteraceae and Cucurbitaceae. These findings can be compared with the study of Hadi *et al.* (2014), where they reported 31 weed species distributed in 27 genera and 15 families from the Torkow, Upper Chitral, Pakistan. Our study also revealed *Cyperus rotundus* a highly abundant weed of the region with importance value (IV) more than 2000 where as Sead *et al.* (2014), also reported the same species as most frequent weed species. Khan *et al.* (2013) studied *Parthenium* weed is well established in Swabi, Mardan and Charsadda districts. Similarly present project also revealed *Parthenium hysterophorus* one of the abundant species (IV ≥ 115) in the study area. Wazir *et al. (*2014) reported *Amaranthus viridis, Portulaca oleracea* from North Waziristan Agency, likewise our research work also showed *Amaranthus viridis* with higher concentration of $CaCO_3$ and phosphorous. While *Portulaca oleracea* weed species with higher electric conductivity and clay nature of soil. Khatam *et al.* (2013) reported *Cynodon dactylon, Cyperus rotundus, Dactyloctenium aegyptium* and *Achyranthus aspera* weeds in the maize crop. Similarly, our finding showed the same weed species in relation with canal irrigation farming practice, high pH, artificial fertilizers and higher electrical conductivity. Ibrar *et al*. (2003), reported 36 weeds from District Abbottabad which can be compared with our findings in terms of species diversity and pattern of distribution.

It isconcluded that the study area is diverse in weed flora, the most abundant weed species is *Cyperus rotundus* while *Cucurbita maxima* was the least frequent species. All weedhave a specific distribution patterns under influence of edaphic factor and various farming practices in the region. Significant edaphic factors influencing the indicator species were E.C, pH, clay nature of soil, phosphorous, potassium and $CaCO_3$ concentration of soil. Among farming practices

that cause specific indicators for four different weed communities (habitat type) were used of artificial and natural fertilizers , number of canal irrigation and tube well , plough, spray, hoeing, variety of maize and preceding crop.

CONCLUSION

The Indicator species Analyses confirmed the top indicators of the weed communities in the region i.e., *Celosia argentia, Convolvulus arvensis, Euphorbia prostrata, Achyranthes aspera, Ipomea purpurea, Physalis angulata, Corchorus olitorius*, *Lactuca dissecta, Commelina benghalensis, Amaranthus viridis, Euphorbia hirta* and *Parthenium hysterophorus.* These species were correlated to various edaphic factors i.e. higher concentration of organic matter, potassium and sandy nature of soil. Weeds of specific habitats can be controlled or manage by bringing changes in farming practices and culture.

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