WEED COMMUNITY ANALYSIS IN MAIZE CROP IN NATURAL CLIMATE OF KHAIRPUR DISTRICT, PAKISTAN

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Abstract

Weeds are the noxious plants that stunt growth and yield of many crops. This study recorded the community composition of weeds in maize crops grown at District Khairpur, Sindh, Pakistan. The weeds were collected from the maize crop at three different localities using the quadrat method (60 quadrats/site). The species were identified and herbarium samples were preserved in Herbarium, Shah Abdul Latif University, Khairpur, Sindh Pakistan, for future reference. The species community composition, habit, and life span were determined. The study confirmed 35 weed species belonging to 14 plant families. The weed community was dominated by the plant families Poaceae (8 spp.), Amaranthaceae (7 spp.), and Aizoaceae (3 spp.). The most frequent species with relatively higher densities include *Digera muricata* (Amaranthaceae), *Trianthema portulacastrum* (Aizoaceae), and *Corchorus olitorius* (Malvaceae). The weed community was dominated by annual herbs. The community composition among the study sites was highly comparable. The study found a lack of weed management practices across the sites.

Keywords: Density, Frequency, Khairpur, Maize, Weeds

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Introduction

The weeds are unwanted plants growing in different cultivated cereal crops that affect crop production (Hussain *et al.*, 2008; Waheed-Ullah *et al.*, 2008; Waheed *et al.*, 2009; Iderawumi and Friday, 2018; Ikram *et al.*, 2018). These species may not only tend to compete with crops for space and available resources but also serve as an alternative host of pests and pathogens that increases the likelihood of plant diseases spread (Oerke and Dehne, 2004; Gharde *et al.*, 2018). The problem costs a huge economic loss to the agriculture sector in the reduction of crop production (Iderawumi and Friday, 2018). Maize (*Zea mays* L.), the highest yielding cereal crop in the world, is of great significance to developing countries. It is cultivated on more than ten thousand hectares in Pakistan (Government of Pakistan, 2018). The crop is very sensitive to infestation of weeds. The invasion of weeds in maize crop may reduce up to 45% of the production and the extent of loss depends on the weed density and duration of weed infestation (Kumar and Sundari, 2002; Mahmoodi and Rahimi, 2009).

Maize (*Zea mays* L.) is cultivated in a large area in district Khairpur, Sindh, located on the left bank of Indus River between 26°12′ to 27°24′ N and 68°13′ to 70°10′ E. The region is characterized by arid climate where the annual temperature records around between 41.5°C to 44.3 ℃ in summer and 29.8 ℃ to 6.4 ℃ in winter. The region receives very low annual rainfall; the precipitation generally occurs in the monsoon season from July to September. Aridity is the main characteristic feature of the region, with dry and wet years occurring in a cluster (Qureshi and Bhatti, 2005). Agricultural regions of the district generally grow wheat, oat, barley, and sugarcane besides maize. Many studies have reported the weed species of various crops in Khairpur (Memon *et al.*, 2003, 2007, 2013; Jakhar *et al.*, 2005). None of the studies (to our knowledge) has studied the weed distribution in maize crops in the region. It is therefore desirable to understand weed community composition in maize crops in order to gather baseline information for future extensive work on weed biology. The study aimed to evaluate the weed community of maize crops in District Khairpur, Pakistan.

Material and Methods

The weed species were collected during the maize season 2017- 2018 from selected locations of District Khairpur *viz.* Saleemabad, Wari Goth, and Rhaina Goth. A total of 60 quadrates of (2x2m) were laid down in the selected fields at each location. The collected specimens were processed for making herbarium sheets as per standard protocol (Bridson and Forman, 2013) and deposited in the Herbarium, Centre for Biodiversity and Conservation (CBC), Shah Abdul Latif University, Khairpur, for future reference.

The weeds were further identified with the help of available taxonomic literature; Flora of Pakistan (Ali and Nasir, 1992; Ali and Qaiser, 2008; Missouri Botanical Garden, 2020), Flora of Karachi (Jafri, 1966), and floral studies at Nara Desert (Qureshi, 2012). The weed community was analyzed. Bray-Curtis index and Morisita-Horn similarity index were calculated to analyze the overall similarity of the weed community at three study locations, using *EstimateS* 9.1. Version (Colwell, 2013). Density, relative density, frequency, and relative frequencies of each weed species were calculated according to the formula:

$$\text{Density (D)} = \frac{\textit{Number of individuals of a species}}{\text{Total No. of quadrats}}$$

$$\text{Relative Density(RD)} = \frac{\text{Density of a given species}}{\text{Total densities of all species}} \text{ x } 100$$

$$\text{Frequency (F)} = \frac{\text{Number of quadrats in which species occurs}}{\text{Total No. of quadrats}}$$

$$\text{Relative frequency} = \frac{\text{Frequency of a given species}}{\text{Total frequency values of all species}} \times 100$$

Results and Discussion

A total of 35 species belonging to 26 genera and 14 families were recorded in the maize crops at three agricultural regions (Table 1); of which about three-fourth were dicotyledons. The plant family Poaceae (8 spp.) was the dominant family followed by Amaranthaceae (7 spp.), Aizoaceae (3 spp.). The rest of the families contained less than three species each (Table 1). About 63% of species were recorded with 70% or more frequency; *Digera muricata* (Amaranthaceae) and *Trianthema portulacastrum* (Aizoaceae) were the most frequent species found with the highest density in the crop recorded in all sampling units. Although, *Corchorus olitorius* (Malvaceae) was found with high frequency (100%), the density of species was comparable to *Cynodon dactylon* (Cyperaceae), *Tribulus longipetalus* (Zygophyllaceae), and *Tribulus terrestris* (Zygophyllaceae). On the contrary, *Euphorbia hirta* (Euphorbiaceae) and *Zaleya pentandra* (Aizoaceae) sporadically appeared with the least frequency and density. Maize is an annual crop that grows up to 120 days. The majority of observed weeds (74% spp.) in the crop were the annuals (Table 1). However, a small portion (26%) of perennial herb species were also recorded. The dominant habit form of the species were herbs, followed by grasses and a species of sedge. Moreover, the analysis revealed a remarkable similarity in the weed community among the study sites (Figure 1). The study sites had more than 85% similar weed community composition (Morisita-Horn index mean 0.91 ± 0.03 SD and Bray-Curtis index: mean 0.83 ± 0.02 SD).

None of the studies to our knowledge has reported the weed composition in maize crops of District Khairpur. A similar study conducted in Manikial found a comparable number of 31 weed species in maize crops (Ullah and Rashid, 2013). Nevertheless, the species composition was markedly different. Only four weed species, *Amaranthus viridis*, *Chenopodium murale* (Amaranthaceae), *Convolvulus arvensis* (Convolvulaceae), and *Portulaca oleracea* (Portulaceae), recorded in Manikial were present in Khairpur district (Ullah and Rashid, 2013). Another study recorded 47 weed species in maize crops at Banu, Khyber Pakhtunkhwa and had 14 similar species to this study (Khan *et al.*, 2014).

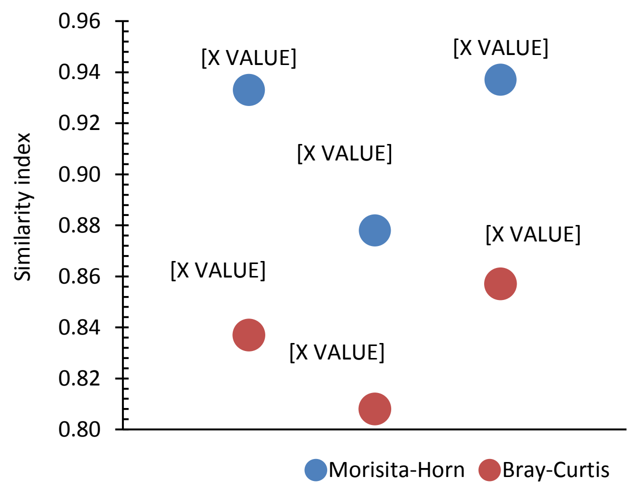

Figure 1 Weed community similarity among the study sites. Morisita-Horn and Bray-Curtis similarity indices calculated form species abundance based data using *EstimatesS* 9.1 (Colwell, 2013).

Table 1: Community structure of weed species distributed in Maize crop of district Khairpur, Sindh. The legitimate name and plant families are updated with the new online version of flora of Pakistan (Missouri Botanical Garden, 2020).

Weed taxa	**Habit**	**Life span**	**Density**	**Relative density**	**Frequency %**	**Relative frequency**
Aizoaceae (Dicot species)						
Sesuvium sesuvioides Verdc.	Herb	Annual	0.9	1.5	70	2.9
Trianthema portulacastrum L.	Herb	Annual	4.7	7.7	100	4.2
Zaleya pentandra (L.) Jeffrey.	Herb	Perennial	0.5	0.8	40	1.7
Amaranthaceae (Dicot species)						
Achyranthes aspera L.	Herb	Perennial	1.1	1.8	70	2.9
Amaranthus graecizans L.	Herb	Annual	1.1	1.8	70	2.9
Amaranthus viridis L.	Herb	Annual	2.2	3.6	80	3.3
Chenopodium album L.	Herb	Annual	1.2	2.0	70	2.9
Chenopodium ficifolium Sm.	Herb	Annual	1.6	2.6	70	2.9
Chenopodium murale L.	Herb	Annual	1.6	2.6	70	2.9
Digera muricata (L.) Mart.	Herb	Annual	5.5	9.0	100	4.2
Asphodelaceae (Dicot species)						
Asphodelus tenuifolius Cav.	Herb	Annual	0.8	1.3	50	2.1
Celomaceae (Dicot species)						
Cleome scaposa DC.	Herb	Annual	1.2	2.0	70	2.9
Convolvulaceae (Dicot species)						
Convolvulus arvensis L.	Herb	Annual	1.2	2.0	60	2.5
Cressa cretica L.	Herb	Perennial	0.9	1.5	50	2.1
Cucurbitaceae (Dicot species)						
Cucumis melo L.	Herb	Annual	1.2	2.0	70	2.9
Mukia maderaspatana (L.) M. Roem.	Herb	Perennial	0.9	1.5	70	2.9
Cyperaceae (Monocot species)						
Cyperus rotundus L.	Sedge	Perennial	4.0	6.6	90	3.7
Euphorbiaceae (Dicot species)						
Euphorbia hirta L.	Herb	Annual	0.5	0.8	40	1.7
Euphorbia prostrata Aiton	Herb	Annual	1.4	2.3	80	3.3
Malvaceae (Dicot species)						
Corchorus depressus Stocks.	Herb	Perennial	1.6	2.6	70	2.9
Corchorus olitorius L.	Herb	Annual	3.7	6.1	100	4.2
Poaceae (Monocot species)						
Brachiaria ramosa (L.) Stapf	Herb	Annual	2.2	3.6	80	3.3
Brachiaria reptans (L.) Gardner &	Herb	Annual	0.8	1.3	50	2.1
Cynodon dactylon (L.) Pers.	Grass	Perennial	2.8	4.6	90	3.7
Dactyloctenium aegyptium (L.) Wild	Grass	Annual	0.8	1.3	50	2.1
Desmostachya bipinnata (L.) Stapf.	Grass	Perennial	2.4	3.9	90	3.7
Echinochloa colonum (L.) Link.	Grass	Annual	0.6	1.0	50	2.1
Echinochloa crusgalli (L.) p. Beauv.	Grass	Annual	1.0	1.6	60	2.5
Stipagrostis plumosa (L.) Munro ex T.	Grass	Perennial	0.9	1.5	50	2.1
Portulaceae (Dicot species)						
Portulaca oleracea L.	Herb	Annual	0.9	1.5	70	2.9
Primulaceae (Dicot species)						
Anagallis arvensis L.	Herb	Annual	0.7	1.2	50	2.1
Solanaceae (Dicot species)						
Solanum nigrum L.	Herb	Annual	1.0	1.6	60	2.5
Solanum surattense Burm.f.	Herb	Annual	0.9	1.5	50	2.1
Zygophyllaceae (Dicot species)						
Tribulus terrestris L.	Herb	Annual	4.0	6.6	80	3.3
Tribulus longipetalus Viv.	Herb	Annual	4.0	6.6	80	3.3

The observation of distinct species in this study to those recorded in Manikial and Banu (Ullah and Rashid, 2013; Khan *et al.*, 2014) is due to the geographical distance and different climatic conditions of study areas.

The weeds recorded in this study were not specific to maize crops. A few weed species i.e. *C. album, C. murale* (Amaranthaceae), *C. arvensis* (Convolvulaceae), and *Cynodon dactylon* (Poaceae) have been recorded infesting other crops in the region of Khairpur and Sukkur (Jakhar *et al.*, 2005; Memon *et al.*, 2013). Those weeds are hardy in nature with wide ecological amplitude. The seeds of such weeds remain dormant in soil and germinate as the conditions favor their growth. *Echinochloa crusgalli* (Poaceae), having a cosmopolitan distribution is recorded as one of the most noxious weeds around the world (Rao *et al.*, 2007; Chauhan and Johnson, 2010). It is recorded infesting various crops i.e. peanuts, cotton, sorghum, maize, sugarcane, soybean, and rice (Holm *et al.*, 1991). Although recorded at a low frequency in this study, a tough weed *C. dactylon* (Cyperaceae) has infested many crops around the world (Ndam *et al.*, 2014). The species is drought and heat-resistant that can survive in extreme weather conditions. This fast-growing grass is highly aggressive and invades various habitats by crowding out other plants.

A high number of weed species present in the maize crops indicate the lack of weed management practices in the region. One of the potential reasons for the lack of weed management might be the alternate use of such weed plants by farmers. The grown-up weed plants of family Poaceae, i.e. *Brachiaria ramose, B. reptans, Echinochloa colonum, E. crusgalli*, are handpicked from the crops to be used as fodder for livestock. Whereas leafy herbs such as *Amaranthus graecizans, A. viridis*, *C. murale* (Amaranthaceae), and *P. oleracea* (Portulaceae) are used as vegetables by the local inhabitants. These weed communities result in a significant loss of crop yield (Iderawumi and Friday, 2018). This study recognized the existing weed species and their community composition in maize crop at District Khairpur. It sets background knowledge for the preparation of a weed management program for the region. Moreover, these records would also help in spotting the invasive species and their distribution pattern in the future.

CONCLUSION

The study found a significant amount of weed species in the maize crops grown in the Khairpur District. This indicates that farmers perhaps ignore the weed treatments which may reduce the production of the crop. The species composition was quite similar among the sites. Many weed species grow in different other crops as well. Having recognition of weeds in maize crops, it would help to prepare a long term management for weed control in the maize crop in the region.

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