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EFFECT OF SOIL TEXTURE ON THE WEED FLORA COMPOSITION OF RAINFED WHEAT FIELDS IN ISLAMABAD/RAWALPINDI

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Abstract

For the study, two soil types, sandy clay loam and clay loam, were selected in Islamabad/Rawalpindi. The floral composition of both the soil types was more or less the same in terms of species number (diversity) and density. However, they differed in species type as well as the net productivity (dry weight) and the moisture retention which was much higher at sandy clay loam. Similarly, the composition of species also differed at these sites. At sandy clay loam, the most established species appear to be Fumaria indica, Buglossoides arvensis, Avena fatua, Medicago polymorpha and Silene conoidea. On the other hand, Ranunculus muricatus, Medicago polymorpha, Anagallis arvensis, Lathyrus aphaca and Vicia sativa were the first five dominant weeds of site with clay loam. Some weeds showed significant correlation with soil texture and other physical characteristics.

Introduction

Moisture availability has been declared as one of the important factor contributing to establishment of a particular species at a particular site (Numata, 1991; Alexandra, 1991; Dakshini and Sabina, 1981; Hunter, 1986; Aldrich, 1984; Werger, 1979). Under rainfed conditions, rainfall alone is a poor index for estimating the amount of moisture available to plants. It is affected greatly by physiological processes, evapo-transpiration rate (which is related to the energy conditions of the atmosphere) and relative humidity which affects the rate of transpiration. One important factor, in this regard, is the soil texture which affects the moisture availability through its specific properties like porosity, water holding capacity, soil aeration, temperature etc. Besides this, the success of a particular species also depends upon its root system as the resistance offered by clayey soil is different than that of a sandy soil. Studies made in

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this regard clearly reveal that the success of a species is greatly related to the soil texture in most of the cases (Trivedi and Tripathi, 1982; Zizewitz, 1982 and others). Thus, it is expected that under same rainfall conditions the weed flora composition may differ from site to site in case the soil texture is different.

In view of the above mentioned facts the present study was conducted in Islamabad/Rawalpindi, in wheat field.

Materials and Methods

In the study area, i.e., Islamabad/Rawalpindi, the average annual rainfall is 500-1000 mm. The climate is sub-humid and moderate. For the purpose of study, following two sites were selected:

Site 1: (Sandy Clay Loam) District and Tehsil Islamabad, Village Rawat (near G.T. Road, next to Rawat Fort).

Site 2: (Clay Loam) District and Tehsil Islamabad, Village Dhok Paracha (2 Km away from Turnol towards Peshawar).

At both the sites wheat (*Triticum aestivum* L.) is grown under rainfed conditions during October to April. At each site, three adjacent fields with the same field history were selected. Following observations were recorded in each field:

Soil Analysis

The soil samples were collected with an auger of 10 cm (4") diameter according to the procedure described by Saleem *et al.*, (1983). Approximately the top 15 cm layer was taken out. The composite samples for each field were brought to the laboratory where they were reduced to the required amount as described by Govinda and Gopala (1971).

A part of the composite sample was kept in plastic bags separately from each field, labelled for identification and placed in refrigerator for further analysis.

Physical soil characteristics given in Table 1 were estimated.Each estimation was made three times and then averaged.

Table 1. Physical Characteristics of Soil in Wheat Fields of Islamabad/Rawalpindi

	Site 2	Soil 2
Soil Moisture % (average)	7.47 (12.88)	15.92 (5.29)
Water Holding Capacity	27.93 (10.84)	33.66 (2.81)
Clay %	17.00 (5.88)	27.00 (3.70)
Silt %	17.00 (11.76)	43.00 (4.03)
Sand %	66.00 (4.01)	30.00 (8.82)
Texture Class	Sanday Clay Loam	Clay Loam
O. M. (%)	0.60 (9.66)	1.07 (38.10)

Soil Moisture

Soil Moisture was calculated by following the procedure given by Winkleman *et al.*, (1990).

Water Holding Capacity

Water holding capacity was determined by following the procedure described by Wilde *et al.*, (1985).

Soil Texture

The soil texture was determined by the method stated by Bouyoucos (1962) with the help of Bouyoucos hydrometer.

Organic Matter (O.M.)

The soil organic matter was determined by Walkley - Black method as described by Nelson and Sommers (1982).

Vegetative Analysis Weed Density (density/m^2)

Observations on weed density were recorded with the help of a quadrate each side measuring 50 cm, randomly thrown twenty four times according to random systematic sampling method in a way that field borders as well as the central area were equally represented (Cochran, 1977). Weeds with their roots growing inside the frame of the quadrate were counted species wise. Observations were made for three years in February 1987, 1988 and 1990 during 14-16 Weeks After Sowing (WAS). The density was calculated as average number of plants per m^2 (density/m^2).

Percent Frequency (%F)

Percent frequency was calculated on the basis of the number of quadrates in which a particular species occurred in each field while recording the weed density, as described by Raunkiaer (1934).

Plant Analysis
Sample Collection

At the time of observation of weed density, different weeds were carefully pulled out along with the roots within the quadrate thrown in the field for the study of weed density. The collected plant samples were kept in labelled paper bags, placed at cool place and brought to the laboratory. Soil particles adhering to the plant roots were carefully removed by washing with the help of a brush. Every care was taken to save the fine roots from any damage. The extra moisture was removed with the help of blotting paper and following observations were made:

Fresh Weight (Fr. Wt. g/m^2)

The plants of each weed species were weighed separately to obtain the fresh weight. This data was used to compute fresh weight per square meter for each weed species.

Biomass/Dry Weight (Dry Wt. g/m^2)

The plant samples of fresh weight were carefully packed in large labelled paper bags separately for each species. The samples were oven dried at 70°C for 48 hours to determine plant dry weight in gram per square meter (g/m^2).

Plant Moisture (g/m^2)

Plant moisture (g/m^2) -- moisture retention at a given time (observed -- 14-16 WAS) was calculated with the help of following equation:

Plant Moisture: Fr. Wt. -- Dry Wt.
In the subsequent text it is also referred as weed moisture.

Dominance Value (D.V.)

The Dominance Value (D.V.) of each species was calculated with the help of following parameters in each zone:

$$\text{D. V.} = \text{Density} + \text{\% F} + \underbrace{\text{Dry Wt.} + \text{Plant Moisture}}_{\text{Fresh Weight}}$$

Results and Discussion

In the study area, site 1 was a sandy clay loam (clay 17%, silt 17%, sand 66%) whereas site 2 was clay loam (clay 27%, silt 43% and sand 30%). The average soil moisture at site 1 was almost half of that found at site 2. Similarly, the water holding capacity was also less at site 1.

Table 2 shows the distribution/dominance of the weeds at site 1 where the soil was sandy clay loam. The nineteen different weeds recorded at this site belonged to family Primulaceae, Liliaceae, Boraginaceae, Compositae, Chenopodiaceae, Convolvulaceae, Cruciferae, Euphorbiaceae and Fumariaceae (one member each), two members of family Poaceae, five of family Leguminosae and three of Caryo-phyllaceae. Thus Leguminosae was the most dominating family of this site. The total weed density was 376.83/m^2, the biomass was 85.27g/m^2 whereas the weed moisture retention was 444.82g/m^2. On the basis of the D.V. the first five dominant weeds were *Fumaria indica, Buglossoides arvensis, Avena fatua, Medicago polymorpha* and *Silene conoidea*.

Table 3 shows the distribution/dominance of different weeds at the site where the soil was clay loam. At this site twenty weed species were recorded. Out of these, one species belonged to each of family Primulaceae, Poaceae, Boraginaceae, Compositae, Chenopodiaceae, Convolvulaceae, Euphorbiaceae, Fumariaceae, Labiatae, Ranunculaceae, Scrophulariaceae and Caryophyllaceae, whereas six belong to family Leguminosae and two to that of Umbelliferae. Thus, family Leguminosae dominated this site as well. At clay loam site the total weed density was 371.58/m^2 with a biomass of 22.05g/m^2 and weed moisture retention of 77.04g/m^2/ The first five dominating weeds of this site were *Ranunculus muricatus, Medicago polymorpha, Anagallis arvensis, Lathyrus aphaca* and *Vicia sativa*.

Table 4 shows the correlation of weeds with physical characteristics of soil at study sites. The comparison of Tables 2 and 3 shows that both the sites were equally rich in the qualitative and quantitative distribution of weed flora with little difference in the weed species number and their total density. However, the species types, the net productivity of the weed population (biomass) and the moisture retention was found much higher in sandy. The high biomass and moisture retention at sandy clay loam seems to be because of *Fumaria indica* which was the most dominant weed of the site with sandy clay loam and which produces high biomass as compared to that of *Ranunculus muricatus* which dominated the flora of site with clay loam.

The perusal of the qualitative description reveals that the weed spectra of the study sites differed greatly and the parameters of some of the species, studied for this purpose, were also different at different soil textures. At sandy clay loam *Fumaria indica* is the most established species which shows its significantly negative correlation with soil moisture, water holding capacity, clay, silt and O.M. However, it was positively correlated with sand % (Table 4). The sandy clay loam offers less resistance to the root penetration, holds enough moisture to fulfill the requirements of *F indica* and seems to provide suitable temperature range for the seed germination. Similarly, *Chenopodium album, Buglossoides arvensis* and *Avena fatua* also show more or less the same correlation with different physical characteristics of soil. Then establishment on sandy clay loam seems to be more as compared to that of clay loam. Pavlychenko and Harrington (1935) have also stated that *A. fatua* can establish better in dry land farming because of its ability to develop more extensive root system, which can only be developed if the soil texture is coarse. Thus, in case of *A. fatua*, the positive correlation with sand % is an important factor as parameters like moisture and water holding capacity also depend greatly on the ratio of coarse and fine particles in the soil.

Silene conoidea, the fifth dominant weed of site 1 also shows its positive correlation with sand % and negative with that of silt % and O.M. %.

The establishment of *Ranunculus muricatus* and *Torilis leptophylla* at clay loam seems to be the result of its positive correlation with O.M. %. Organic matter works more in collaboration with the fine textured soil and improves the water holding capacity. Thus, though indirectly, yet the weed establishment is through textural impact of soil. Contrary to this is *Trigonella monantha* which shows its negative correlation with soil O.M. %.

The third dominant weed of this site, *Anagallis arvensis* showed positive correlation with soil moisture, water holding capacity and organic matter. *A. arvensis* shows a wide distribution in the rainfed area of Punjab (Naeem, 1994) and appears under a wide range of moisture levels. However, the present study shows its likeness for high moisture content, water holding capacity and organic matter.

At the same time the success of *Medicago polymorpha* at both the sites, that of *Asphodellus tenuifolius, Euphorbia helioscopia,* and *Phalaris minor* at site 1 (sandy clay loam) and comparative success of *Lathyrus aphaca* and *Veronica didyma* do not show any significant correlation with any soil parameter measured for this purpose. Therefore, their establishment at this site might be the outcome of some other environmental characteristics of the area.

Thus, on the basis of the data of present study, it can be concluded that soil texture holds an important position in determining the floral composition of weeds through its specific properties like porosity, moisture, water holding capacity and organic matter. Thus, any weed survey/management, programme should concentrate at this variable before designing any methodology.

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