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Effects of *Parthenium hysterophorus* L. on Soil Characteristics Initially Inhabited to *Cannabis sativa* L.

¹Rizwana Aleem Qureshi, ²Syed Aneel Gilani,

¹Muhammad Asad Ghufuran and ²Kishwar Nazir Sultana

¹Department of Plant Sciences, Quaid-i-Azam University, Islamabad, Pakistan

²Pakistan Museum of Natural History, Shakarparian, Islamabad, Pakistan

Abstract: *Parthenium hysterophorus* is a new entry and successfully growing on all types of soils in fields and waste lands. *Parthenium* is drought resistant highly resistant weed which sustain its survival in highly unfavorable conditions where other delicate flora can not grow. Due to its allelopathic nature, no other plant can grow near it successfully and the chemical nature of the soil also changes which further accelerate the unfavourness for the other species. Because of the weedy characteristics and production of large number of seeds, it grew on an alarming rate and presently it has occupied the large areas in NWFP and Punjab with increasing tendency. It has been found that this weed can grow in association of many other plants of which *Cannabis sativa* is more important but further studies indicated that even *Cannabis* is replaced by this weed which means it is highly tolerant and hardy in its nature and due to absence of some natural enemy (Predate) it tends to grow on unprecedented rate. During the present study it has been observed that *Parthenium* can grow in variety of soil types with different pH values. Mostly sandy loam and sandy clay loam are found highly conductive for its growth. It is nature of its wide adaptability of various soil types due to which it is found replacing the *Cannabis* and other natural flora. However, well grown *Cannabis* plants compete for survival with this weed.

Key words: Allelopathy, *Parthenium hysterophorus*, *Cannabis sativa* L., soil

INTRODUCTION

The origin of this serious weed is South of USA, Central America and West Indies (Hind *et al.*, 1993), thus have original home across the Atlantic. Today, this annual herb has got pantropic distribution and is a widespread weed of arid cultures, follow lands, waste places and road sides and is commonly called as Ragweed, Congress grass and Carrot grass (Evans, 1997).

The introduction of this plant in sub continent was first recorded in 1956 from Poona (India). In Pakistan, Khatoon (1980) was the first to record it. *Parthenium hysterophorus*, being drought resistant and aggressive in nature, can grow well in almost all types of soil that is why it grows easily and successfully in crop fields and waste lands, particularly on verticals (Mahedavapa *et al.*, 1999). According to Daubenmire (1974), soil is the part of earth crust that anchors plant so both soil and plants are influenced by each other and therefore undergo a continuous change. Changes in soil characteristic are caused by this serious weed because of having conservation efficiency for H₂O and phosphorus and also plays role in binding of soil (Kumar *et al.*, 1992).

Parthenium weed, because of its invasive capacity and allelopathic nature, has the potential to disrupt

natural ecosystem (Evans, 1997). The soil inhabited by it has got maximum of soil chemicals but the production of other crops (e.g., *Phaseolus*, *Vigna* etc.) on that soil is greatly reduced (Kohli and Batish, 1994). This shows its allelopathic nature, thus, affects the soil characteristics and ultimately the ecosystem, on the other hand, if it is grown with Rice and increase in yield is observed without any allelopathic suppression (Kandasamy and Raja, 1999). In Pakistan, this vigorous plant is found in association with *Cannabis sativa*, *Conyza bonariensis*, *Xanthium strumarium*, *Rumex dentatus* etc. and has spread rapidly in the arid regions of Rawalpindi-Islamabad. In 1993, only few plants of this species were found but up to the end of 2000, it has occupied a large area of NWFP and Punjab. At present, *Parthenium* continues to expand its range that starts from Attock and reaches up to Rawalpindi district. Although this noxious weed can grow in association with several other plant but *Cannabis sativa* a less aggressive invasive in vicinity where *Part henium* is being replaced by this weed and does not grow (Khalid, 2000).

Parthenium is causing a change in vegetation that ultimately results in changing soil characteristics (Daubenmire, 1974). Moreover, *Cannabis* for best development requires mild, humid climate and a rich loamy soil with an abundance of humus. Calcareous soil is

particularly well adapted to hemp culture. *Cannabis sativa* is a source of fiber, soil and drugs for natives and is therefore more important than *Parthenium* because beside agricultural losses it is causative agent of bronchitis, acute dermatitis and eczema in human beings (Evans, 1997).

The objectives of the present study are:

- To determine the nature of soil for the growth of *Parthenium hysterophorus* and *Cannabis sativa*.
- To determine the effects of *Parthenium* and *Cannabis* on soil characteristic.
- To find the relationship of these two plants on basis of soil analysis.
- To note the vegetational changes taking place due to over growth of *Parthenium hysterophorus*.

MATERIALS AND METHODS

General description of area: The soil for this study is obtained from different areas in Islamabad including QAU Campus, having scenic background of hills which form the Himalayan Foot Hills the conditions prevailing here are dry and rainfed with sub-tropical, semi-ever green forests.

The original xerophytic vegetation has been changed into mesophytic by large scale Cultivation of *Broussonetia papyrifera*, *Grevillea robusta*, *Acacia nilotica*, *Ca/listemon citrinus*, *Eucalyptus* sp. *Ficus* etc. Buffalos, Cows, bulls, goats and sheep are generally found in the area and as are kept by natives. This land is uneven having gravels and stone but fine soil is not present much fresh water spring exists near campus but supply of water is done from Rawal and Simli Dams. However, in the near by villages old and orthodox methods of irrigation are some times seen. The climate of the area studied falls into the category of subtropical continental low lands, sub humid Pothowar Plateau.

Field procedure

Soil sampling: Sampling was carried out in the summer of 2001 total of 9 soil samples were obtained from the depth of 2 inch 5 and 10 inches for 3 soils i.e., soil of *Cannabis sativa*, *Parthenium hysterophorus* and *Cannabis sativa* plus *Parthenium hysterophorus*. These samples were air dried and crushed gently, the stones and larger roots ere separated and then sieve through 2 mm sieve and stored in polythene bags.

Parameters studied

Physical

- Soil moisture
- Soil textural class

Chemical

- Soil pH
- Soil organic matter

Physical analysis

Soil moisture: For the determination of moisture contents in the air dried soil. Twenty gram of the soil sample was weighed out and placed into a dry, aired Petri dish which was kept in an air circulation oven at 105°C for 24 h. The Petri dish was cooled and re-weighed. Percentage moisture was calculated using the formula.

$$\text{Moisture \%} = \frac{\text{Loss in wt on drying (g)}}{\text{Initial sample weight}} \times 100$$

Particle size analysis: Soil Texture gives percentage of the different soil separates i.e., sand, silt and lay. Determination of soil texture is important in classifying the soils according to their texture i.e. whether the soils are sandy, silty, clayey or loamy. It is helpful in determining the ability of the soil to supply nutrients, air and water. The soil texture also influences the other property like aggregate permeability etc. which in turn affect the soil fertility.

Chemical analyses

pH: The pH value of an aqueous solution is the negative logarithm of hydrogen Ion activity. This is done to access the water status of the soils and variations in the soil water content. The pH of soil water extract was determined by using Horiba M.8e pH meter with a glass electrode. The meter was standardized with acidic (pH = 4.2), neutral (pH = 7.2) and alkaline (pH = 9.2).

Soil organic matter: Almost all life found in soil is dependent on organic matter for energy and nutrients. As a result of decomposition of plant residues and the synthesis of many compounds, soil contain and enormous number of organic compounds in various states of decomposition. Organic matter influences physical and chemical properties of soil. It protects soil from compaction by the beating action of rain drops. It prevents run off of water. It is helpful in the maintenance of soil fertility.

RESULTS

Results for analysis of soil moisture displays that the highest percentage of moisture is found at 10 depth, under *Parthenium hysterophorus* where as the lowest soil moisture content is found from surface soil (3.5%) under *Cannabis sativa*. (Table 1). The rest of soil samples

Table 1: Analysis of soil moisture

Samples moisture (g)	Initial wt.	Loss in wt. (%)	Moisture (%)
<i>Parthenium hysterophorus</i> (surface)	71.8	1.8	9.0
<i>Parthenium hysterophorus</i> 5"	65.5	1.7	8.5
<i>Parthenium hysterophorus</i> 10"	71.4	2.0	10.0
Group II			
<i>Cannabis sativa</i> (surface)	73.0	0.7	3.5
<i>Cannabis sativa</i> 5"	60.6	1.8	9.0
<i>Cannabis sativa</i> 10"	63.4	1.4	7.0
Group III			
<i>Parthenium</i> and <i>Cannabis</i> (surface)	63.4	1.5	7.5
<i>Parthenium</i> and <i>Cannabis</i> 5"	63.4	1.8	9.0
<i>Parthenium</i> and <i>Cannabis</i> 10"			
	42.6	1.8	9.0

Table 2: Analysis of soil texture

Samples of soil	Sand (%)	Silt (%)	Texture class	Texture class
Group I				
<i>Parthenium hysterophorus</i> (surface)	87.95	20.00	12.05	Sandy loam
<i>Parthenium hysterophorus</i> 5"	51.65	30.00	18.35	Sandy loam
<i>Parthenium hysterophorus</i> 10"	62.65	21.00	16.35	Sandy loam
Group II				
<i>Cannabis sativa</i> (surface)	65.70	18.85	15.45	Sandy loam
<i>Cannabis sativa</i> 5"	59.55	24.00	16.45	Sandy loam
<i>Cannabis sativa</i> 10"	59.70	22.85	17.45	Sandy loam
Group III				
<i>Parthenium</i> and <i>Cannabis</i> (surface)	56.70	21.85	21.45	Sandy clay loam
<i>Parthenium</i> and <i>Cannabis</i> 5"	52.95	26.00	21.05	Sandy clay loam
<i>Parthenium</i> and <i>Cannabis</i> 10"	58.95	23.00	18.05	Sandy loam

Table 3: Analysis of soil pH

Samples	pH meter reading
Group I	
<i>Parthenium</i> (surface)	7.9
<i>Parthenium</i> (5")	8.1
<i>Parthenium</i> (10")	7.3
Group II	
<i>Cannabis</i> (surface)	8.0
<i>Cannabis</i> (5")	7.3
<i>Cannabis</i> (10")	7.4
Group III	
<i>Parthenium</i> and <i>Cannabis</i> (Surface)	8.0
<i>Parthenium</i> + <i>Cannabis</i> (5")	7.5
<i>Parthenium</i> + <i>Cannabis</i> (10")	7.6

Table 4: Analysis of soil organic matters

Samples	Soil organic matter (%)
Group I	
<i>Parthenium</i> (surface)	3.46
<i>Parthenium</i> (5")	3.18
<i>Parthenium</i> (10")	2.69
Group II	
<i>Cannabis</i> (surface)	2.39
<i>Cannabis</i> (5")	3.21
<i>Cannabis</i> (10")	1.83
Group III	
<i>Parthenium</i> + <i>Cannabis</i> (Surface)	2.71
<i>Parthenium</i> + <i>Cannabis</i> (5")	2.4
<i>Parthenium</i> + <i>Cannabis</i> (10")	2.11

retained moisture from 7-9% which were collected from soil under *Parthenium hysterophorus*, *Cannabis sativa* both. Soil texture shows that there is no significant

difference in soil texture class as all the soil samples possessed sandy loam nature except for *Parthenium* and *Cannabis* (Surface) and *Parthenium* and *Cannabis* where the soil texture is sandy clay loam (Table 2). Soil collected under *Parthenium* shows an overall higher pH values than the rest of the soil samples (Table 3). There is a definite trend between the samples collected from *Parthenium*, *Cannabis* or both. However a tendency towards salinity is dominating which is more pronounced at the surface soil. Soil organic matter is found in range of 783- 3.46% in all the three groups of soil samples collected in triplicate at different depths (Table 4). It is found that in general at the surface soil organic matter is highest and lowers as the soil depth increases. In group I, it is elucidated that there is co definite relationship in soil organic matter and soil pH. It is clear that at higher soil organic matter value of pH descends. In group II, where samples were collected from soil having *Cannabis* plants, presents that soil organic matter and pH are inversely proportional. The decrease in soil organic matter results an increase in pH. In Group III, having soil samples of both plants i.e. *Parthenium* and *Cannabis* it is Concluded that higher the soil organic matter, lower the pH (Table 5).

Parthenium hysterophorus is a new entry and successfully growing on all type of soils in field crops and waste lands, *Parthenium* drought resistant highly aggressive weed which sustain its survival in highly unfavorable conditions where other delicate flora can't grow. Due to its allelopathic nature, no other plant can grow near it and the chemical nature of soil also changes which further accelerate the unfavourness for other species. It has found that this weed can grow in association of many other plant of which *Cannabis sativa* is more important but further studies indicated that even *Cannabis* is replaced by this weed which means it is highly tolerant and hardy in its nature and due to absence of some natural enemy (Predate) it tends to grow on unprecedented rate.

During the present investigation it has observed that *Parthenium* can grow on variety of soil types with different pH values. Mostly sandy loam and sandy clay loam are found highly conducive for its growth. Due to its tolerance to various pH values. it grow well in acidic, basic and neutral pH values. That is the reason it grows in all kind of climatic and soil conditions i.e., found equally well in, forest, grass lands, pastures and meadows.

It is also concluded that in general at the surface soil organic matter is highest and lowers as the soil depth Increases. *Parthenium* plant produces organic

Table 5: Comparison of soil moisture, organic matter, soil pH and soil texture

Samples	Organic matter (%)	Soil pH	Soil texture	Soil moisture (%)
Group I				
<i>Parthenium hysterophorus</i> (surface)	3.46	7.9	Sandy loam	9.0
<i>Parthenium hysterophorus</i> (5")	3.18	8.1	Sandy loam	8.5
<i>Parthenium hysterophorus</i> (10")	2.69	7.3	Sandy loam	10.0
Group II				
<i>Cannabis sativa</i> (surface)	2.39	8.0	Sandy loam	3.5
<i>Cannabis sativa</i> (5")	3.21	7.3	Sandy loam	9.0
<i>Cannabis sativa</i> (10")	1.83	7.4	Sandy loam	7.0
Group III				
<i>Parthenium</i> + <i>Cannabis</i> (Surface)	2.71	8.0	Sandy clay loam	7.5
<i>Parthenium</i> + <i>Cannabis</i> (5")	2.40	7.5	Sandy clay loam	9.0
<i>Parthenium</i> + <i>Cannabis</i> (10")	2.11	7.6	Sandy clay loam	9.0

matter which is quickly made available for ready uptake that's why soils from *Parthenium*, vegetation collected more organic matter than the soil taken from other plant species.

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