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Studies of Mycoflora on Decomposing Leaf of Parthenium in relation to different Climatic Factors

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Abstract

Parthenium hysterophorus L. is a dominating weed on uncultivated land and on roadsides which creates health hazard to human being and cattle. The weed was left on the site after cutting where the decomposition of weed takes place. The decomposition was studied by using the nylon net bag technique. The weight loss and leaf litter inhabiting mycoflora was estimated both quantitatively and qualitatively and its relationship to environmental factors i. e. moisture content, temperature, rainfall and relative humidity were studied by using standard techniques. The maximum number of fungi (74.15 x 10^4 /g of dry leaf) in the month of August and minimum (28.41 x 10^4/g of dry leaf) in the month of April were recorded during decomposition. The weight loss was maximum in the month of September (30.58%). It is observed that a significantly greater amount (94.42%) of litter disappeared in one year.

1 Introduction

Production and decomposition are two vital processes of an ecosystem. The process of decomposition is extremely complex and is controlled by a multitude of organisms, the chemical and physical properties of litter and by the abiotic environment. Fungi, an important component of the microbial community, plays a major role in litter decomposition.

Parthenium hysterophorus L., popularly known as 'Congress Weed', 'Carrot Weed', 'Carrot Grass', 'Gazar Ghas', 'White top', 'Chatak chandani' and 'Gandhi Booti' belongs to the sub-family Heliantheae of the family Compositeae (Asteraceae). It is an exotic noxious weed accidentally introduced to India in 1956. It is an annual herbaceous plant, a native to the area around the Gulf of Mexico including the West Indies and Central South America. The plant is now widely distributed in India, Africa, China, Vietnam, Pacific islands and Australia. It was first reported in India by Pune (Rao, 1956). *Parthenium* has invaded virtually all the states of India. Its infestation has posed alarming problems in Maharashtra, Karnataka, Andhra Pradesh, Delhi, Madhya Pradesh, U.P. and the Punjab. At present, it is the dominating weed of uncultivated lands, roadsides,

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unbuilt areas of underdeveloped residential colonies etc.. However, *Parthenium* has also entered into orchards and other crops like sugarcane and sorghum.

This weed is not only a serious threat to Agriculture, but is also known to cause hazards to human health in addition to being highly toxic to the cattle. *Parthenium* contains sesquiterpene lactones which induce severe allergic reactions in susceptible individuals who are continuously exposed to the noxious weed. Itching eruptions develop on exposed parts of the body, particularly eyelids, sides of the neck, part of face, V of neck, front of elbows and back of knee. The general public who are not in direct contact with *Parthenium* also suffer respiratory problems which sometimes lead to asthma and bronchitis (LONKAR et al. 1974, TOWER et al. 1977). The pollen grains are reported to inhibit fruit set in crops like tomato, brinjal, bean, capsicum and maize (SINGH, 1993). Some work has been done on the distribution, management and control of this weed by various workers (GIDWANI, 1995, ANEJA et al. 1991, BRAR and WALIA, 1991 and SINGH 1993). So far, no attempt has been made to study the decomposition of this weed after cutting. In view of this, the present work has been undertaken which may provide some clue about quick disposal of this plant.

2 Materials and Methods

An experimental site was selected in the campus of Banaras Hindu University, Varanasi, India, where the weed is dominant on the roadsides and unbuilt areas of underdeveloped residential colonies. The leaves of *Parthenium hysterophorus* L. were collected in the month of June, 1996 from the above sites after cutting. The decomposition was studied by nylon net bag technique (GROSSLAY AND HUDSON, 1962). 50 g of air dried leaf litter was kept in each nylon bag (30 x 25 cm). The mesh size of 1 mm^2 was chosen because it facilitated the microbial decomposition and reduced the macrofaunal disturbances. Forty four such bags were prepared in order to get an adequate number for sampling during the investigation. All the nylon bags were kept on the surface of the soil. The sampling programme ran from June 1996 to May 1997 at monthly intervals. At the beginning of each month four bags were picked up randomly out of which one was kept for analysis of fungal population and the other three bags were dried at 105 °C for 24 hours for dry weight estimation and for estimation of moisture content.

1 Direct observation of the litter samples: The litter from the nylon bags was observed under a binocular microscope.

2 Damp chamber incubation: The litter was cut into 5 mm disks by a sterilised cork borer and the disks were placed on a wad of wet blotting paper in petridishes. The plates were incubated at 25 ± 2 °C for 15 days.

3 Dilution plate technique: The litter sample was powdered. 10 g of this powder was suspended in 10 ml of sterilised distilled water. Further dilution series (1:10^3, 1:10^4,

1:10^5) were prepared and 1 ml of each dilution was inoculated on Czapek's Dox Agar (+ 0.5 % yeast extract) medium with 100 ppm streptomycin for isolation of fungi. Five replicates of each dilution were incubated at 25 ± 2 °C for a week and fungi were recorded. The fungal species were identified with the literature available (GILLMAN, 1975; SUBRAMANIAM, 1971; ELLIS 1971 and BARNETT AND BLUNTER, 1972). The total number of fungi was calculated.

The climate is typically mansoonic, Indogangatic plains, characterized by a dry and hot summer (March to June) followed by a warm rainy-season (July to October) and mild winter (November to February). The meteorological data showing monthly average rainfall, temperature and relative humidity were obtained from the Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (U. P.).

3 Results and Disscussion

Table 1 shows the weight loss, moisture content, pH, relative humidity, temperature and total number of fungi at different stages of decomposition of the leaves. It can be seen that the weight loss is maximum due to increased microbial activity which attains its peak in September (11.50g) and there after the rate gradually declines in winter and summer. It was observed that a significantly greater amount (94.42%) of the litter disappear in only one year and the rest is left for decomposition during the following year as a carry-over which disappears in the next three months.

There was a monthly variation in the number of fungi/g dry litter in different months (Table 1). The maximum number of fungi was recorded in the month of August (74.15 x 10/g oven dry litter) and minimum in April (28.41 x 10^4/g oven dry litter). The Popu-

Table 1: Weight loss, climatic factors and average number of fungi/gm of dry weight of the leaf litter during decomposition

Month	Weight Loss (g)		Moisture Content (%)		pH	Rainfall (mm)	Relative Humidity %	Mean Temperature (° C)	Fungi /g[1]
June	50		16.00	± 4.63	6.8	228.60	64.25	31.41	65.36
July	47.44	± 0.59	50.36	± 5.81	6.6	300.60	80.80	29.83	68.38
Aug	37.60	± 0.93	47.57	± 3.74	6.9	319.60	85.87	28.66	74.15
Sept	26.20	± 1.76	38.35	± 5.82	6.5	181.20	72.83	29.47	56.67
Oct	22.14	± 1.05	10.32	± 1.86	6.8	20.00	72.83	25.79	47.34
Nov	20.00	± 1.50	11.64	± 7.22	6.5	0.00	62.47	20.45	35.30
Dec	17.54	± 1.41	10.92	± 5.62	6.8	0.00	61.66	16.10	33.82
Jan	15.83	± 0.77	20.28	± 6.44	7.0	11.20	65.80	15.14	43.84
Feb	14.68	± 0.98	10.39	± 6.43	6.8	0.00	59.00	18.57	38.07
Mar	12.71	± 0.78	4.92	± 0.86	6.7	0.00	56.75	23.57	34.68
Apr	8.83	± 0.75	4.41	± 3.38	7.1	19.00	41.80	28.93	28.41
May	2.85	± 0.66	3.80	± 0.62	6.9	10.00	38.20	30.10	26.32

[1]Average number of Fungi /g (dry leaf litter x 10 4)

Values given in ± are standard deviations

Table 2: Fungi recorded on decomposing litter by various methods. (+) - Present (-) - Absent

Fungi	Methods		
	DO	DC	DP
Mastigomycotina			
Oomycetes			
Pythium aphanidermatum (edson) Fitzpatrick	+	-	+
Zygomycotina			
Zygomycetes			
Mucor racemosus Feseuis	+	+	+
Rhizopus nigricans Ehrenberg	-	+	+
Mortierella subtillisima oudemans	-	-	+
Ascomycotina			
Chaetomium globosum Kunze	-	+	-
Deuteromycotina			
Coelomycetes			
Sphaeropsidales			
Phoma hibernica Grimes, Oconnor & Cummins	-	-	+
Macrophomina phaseoli (Maublanc) Ashby	-	-	+
Robillanda pharagmitis cunnel	-	-	+
Melanoconiales			
Pestalotia psidii pat.	-	-	+
Colletotrichum falcatum went	-	-	+
Hyphomycetes			
Moniliales			
Trichoderma koningii Oudemans	-	-	+
Trichoderma harzianum Rifaiggr	-	-	+
Aspergillus niger Van Tieghem	+	+	+
Aspergillus flavus Link	-	+	+
Aspergillus sydowi Bainier & Sastary	-	-	+
Aspergillus luchuensis Inui	-	-	+
Penicillium citrinum Thom	+	+	+
Penicillium rubrum Stoll	-	-	+
Penicillium javanicum Van Beym Thom & Church	-	-	+
Alternaria alternata (Fr.) Keissler	+	+	+
Alternaria solani Sorauer	-	-	+
Curvularia lunata (Walker) Boedijn	+	+	+
Curvularia pallescens	+	+	+
Drechslera avanacea (Curtis excooke) Shoemaker			
Bispora antennata Corda	+	+	-
Cladosporum cladosporiodes (Fresen) Devries	-	+	+
Nigrospora sphaerica (Sacc) Manson	-	+	-
Humicola grisea Traaen	-	+	-
Torula graminis Deim	-	-	+
Epicoccum purpurascens Ehren & Schlecnt	+	-	-
Diplococcium specicatum Grove	+	-	-
Tetraploa aristata Berk & Br	+	-	-
Fusarium clamydosporum Wollen Weber	-	+	-
Fusarium oxysporum Schlechtendahl	-	-	+
Fusarium semisectum Barkeleg & Revenel	-	-	+
Cephalosporium acremonium Corda	-	-	+
Mycelia sterilia			
Dark sterile mycelium	+	+	+
Pink sterile mycelium	-	-	+
White sterile mycelium	-	-	+
Unidentified I	-	-	+
Unidentified II	-	-	+
Unidentified III	-	-	+

Table 3: Distribution of Fungi and percent distribution of various of classes colonizing the decaying leaf

Class of Fungi	Number of species isolated	Distribution in %
Mastigomycotina		
Oomycetes	1	2.38
Zygomycotina		
Zygomycetes	3	7.14
Ascomycotina		
Ascomycetes	1	2.38
Deuteromycotina	31	73.80
Deuteromycetes		
Sphaeropsidales	4	9.62
Melaconiales	2	4.76
Hyphomycetes		
Moniliales	25	59.5
Moniliaceae	11	26.19
Dematiaceae	10	23.80
Tuberculasiaceae	4	9.52
Mycelia Sterilia	3	7.14
Unidentified Species	3	7.14
Total No. of Fungal Species isolated	42	

lation of fungi increases from June to August and then it decreases but in the month of January, the population increases slowly. This might be due to some rainfall (35 mm) which helps in increasing the microbial activity. The results are in agreement with the finding of several workers (KANNO et al., 1986; BOWEN AND HARPER, 1989; MAGAM et al., 1989; STEIKS et al., 1990; WAENSOTT et al., 1990 and SINHA AND PATHAK 1995).

The dynamics of microbial community can be attributed generally to abiotic variables principally moisture and temperature. Increasing moisture content is the main facotr responsible for the colonization of micro-organism (DUNN et al., 1985; MAGAN et al., 1989; BAKER et al., 1990 and VIJAY & NAIDU, 1995). Beside the moisture content, relative humidity was also responsible for colonization (DICKINSON & O'DONELL, 1977).

Tables 2 and 3 show observations of fungi on decomposing leaf litter. Different isolation techniques are used with the expectation that they would reduce the bias introduced by any single technique so the fungal flora was recorded by direct observation of litter, damp chamber and dilution plate method (Table 2). Twelve fungal species were observed directly, *Curvularia lunata*, *Alternaria alternata*, *Aspergillus niger* and Dark sterile mycelium forms are dominant. Some species like *Epicoccum nigrum*, *Tetraploa* Sp. and *Diplococcum* species are recorded by this method only. A total of fifteen fungi were recorded by damp chamber method. The species like *Aspergillus niger, Alternaria alternata, Curvularia lunata, Cladosporium cladosporioides , Fusarium chlamydosporum* were dominant. The maximum number of fungal species (34) were isolated by this technique. The species like *Mortierella subtilissima, Phoma hibernica, Macrophomina phaseoli, Robillarda phragmitis, Pestalotia psidii, Trichoderma harzianum, T. koningii, Aspergillus luchuensis, A. candidus, A. sydowi, Cephalospo-*

rium acremonium, Penicillium javanicum, P. rubrum, Collectotrichum spp., Torula graminis, Fusarium oxysporum, F. semitectum, white sterile mycelium and pink sterile mycelium were recorded by this method.

Table 3 shows that Phycomycetous and Ascomycetous forms were poorly represented 9.52 and 2.38% of the total population respectively while Deuteromycetous form represented 73.80% of total fungal population and showed better adaptability and higher competative saprophytic ability. The appearance of fungi on any substrate is governed by a number of factors viz. the water content of the substrate, temperature, relative humidity of the environment, competitive saprophytic ability of fungi, competition amongst fungi and the amount of nutrient level in the substrate.

Untersuchung der Mykoflora von verrottendem Laub von *Parthenium* bei unterschiedlichen klimatischen Faktoren

Abstrakt

Parthenium hysterophorus L. ist ein dominierendes Wildkraut auf unbestelltem Land und an Wegrändern, das gesundheitliche Gefahren für Mensch und Vieh in sich birgt. Das Wildkraut wurde nach dem Mähen an Ort und Stelle zum Verrotten belassen. Die Verrottung wurde mittels Nylonnetzbeuteltechnik untersucht. Der Gewichtsverlust und die das Laub besiedelnde Mykoflora wurden sowohl quantitativ als auch qualitativ eingeschätzt und im Zusammenhang mit Umweltfaktoren, wie Feuchtigkeitsgehalt, Temperatur, Regenmenge und relativer Luftfeuchtigkeit unter Nutzung üblicher Verfahren untersucht. Während des Verrottungsvorgangs wurde die maximale Anzahl an Pilzen ($74{,}15 \times 10^4$ /g Trockenlaub) im August und die minimale Anzahl ($28{,}41 \times 10^4$ /g Trockenlaub) im April notiert. Der Gewichtsverlust erreichte sein Maximum im September (30,58 %). Es wurde beobachtet, daß eine signifikant größere Menge an Pflanzenresten innerhalb von einem Jahr verschwunden war.

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