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IMFACT OF PARTHENIUM HYSTEROPHORUS L. ON NATIVE SOIL ALGAL FLORA

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ABSTRACT :

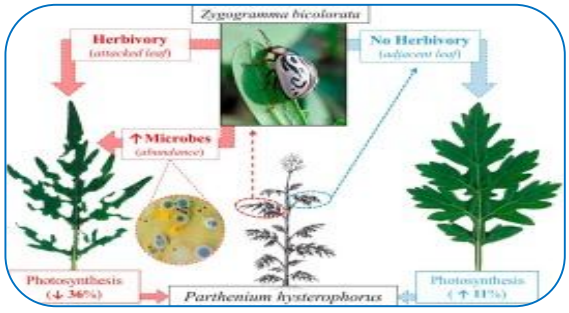
Soil was amended with powder from air-dried leaves, inflorescences or roots of Parthenium hysterophorus L. at 1,2 and 5 per cent (w/w) levels, and inhibitory effect towards indigenous algal population was assessed. The inhibition of algae was more pronounced in the soil amended with leaf material followed by treatments with inflorescence and least with root powder. Higher levels (2 and 5%) ofleaf and inflorescence amendment resulted in a greater inhibition of the algae.

KEYWORDS :*amendment, inhibition, Parthenium hysterophorus L., soil algae.*

INTRODUCTION

Parthenium hysterophorus L., a noxious weed, occurring widely in tropics and sub-tropics, is a major problem in India and Australia (Khosla and Sobti, 1979; McFadyan, 1984). Allelopathic activity of different parts of this cosmopolitan weed has been well documented (Mall and Dagar, 1979; Rajan, 1973; Sarma *et* a/., 1976; Sukhada and Jayachandra, 1980). In pure culture studies, inhibition of growth of *Rhizobium phaseoli* and *Az-otobacter vinelandii,* and activity of Nitrosomonas (Sukhada and Jayachandra, 1981) and antifungal properties (Char and Bhat, 1975) of Parthenium were also reported. Studies on the inhibitory effects of seed plants on soil algae, an ecologically beneficial group of the soil ecosystem, are very limited (Parks and Rice, 1969; Rice, 1974). There are no reports on the toxic effects of the residues of Parthenium on soil algae. The intent of the present study is, therefore, to evaluate the possible toxic effect of different parts of the weed on soil algal population under laboratory conditions.

MATERIALS AND METHODS



A black soil, collected from a fallow cotton field to a depth of 8cm, was air-dried and passed

through a 2 mm mesh sieve. The soil had pH 7.4 (1:1.25 soil to water ratio), 1.82% organic matter and 0.044% total nitrogen.

Plant samples of *Parthenium hysterophorus* were collected at the time of flowering. The leaves, in-florescence and roots were separated, air-dried, ground to a fine powder and sieved.

From the above soil sample, 20-g portions were taken in tubes (25 x 150mm), amended with either the leaf or inflorescence or root powder to provide final concentrations of 1, 2 and 5% (w/w) on soil dry weight basis. Each portion was thoroughly mixed to ensure homogeneity. Unamended soil samples served as controls. In all the treatments and controls the soil moisture potential was maintained at 0.075 M Pa.

The tubes were incubated at room temperature (28 ± 4°C) and samples were withdrawn after 15 and 30 days of incubation for estimation and characterization of algae by the most probable number (MPN) method, as outlined by Muralik-rishna and Venkateswarlu (1984). Fiducial limits for the estimates of viable counts at the 95% confidence level were also calculated following the formula of Fisher and Yates (1963). Most of the predominant algal forms were identified, at least to the generic level.

RESULT

The viable counts of algae in the soil were affected differentially under leaf, inflorescence and root-amendments of *Parthenium hysterophorus* (Table 1). In general, the inhibitory effect was in the order:leaf > inflorescence > root. Even a 1% amendment significantly inhibited the algae in soil. Increased toxicity towards the algae was observed with increasing levels of each plant part. The exact MPN could not be calculated with 2 and 5% amendments of leaf and inflorescence after 15 days of incubation as only less than 8 tubes were scored positive for algae out of 30 MPN tubes employed. Leaf-amendment, at the 5% level, resulted in total elimination of algae by 30 days after treatment and only one MPN tube was scored positive for algae in amendments with inflorescence at the end of 30 days as against six positive tubes by the end of 15 days. Root-amendment, at 5%, also exhibited a similar toxic effect in the 30 day sampling.

In untreated soil samples 10 genera of algae were present, 7 belonging to the Cyanophyta and 3 to the Chlorophyta (Table 2). Only the filamentous forms were encountered consistently with all the three amendments compared to the unicellularforms like *Chlorella vulgaris, Chlorococcum hum-icola.*

DISCUSSION

While demonstrating the allelopathic effects of *Parthenium hysterophorus,* Sukhada and Jayachan-dra (1980) reported the accumulation of large quantities of inhibitors, such as parthenin, a ses-quiterpene lactone and phenolics in leaves followed by lower quantities in inflorescence, root and stem. The levels of toxicity caused by different plant parts reported in the present study conforms to this observation. Ravindranath (1981) opined that the inhibitors are synthesized in the leaf and then translocated to other parts of the plant.

Accumulation of leaf material at higher concentrations in the soil can be expected as a dense stand of Parthenium produces about 333 gnrr^2 of dry leaves (Sukhada and Jayachandra, 1980). Air-dried plant parts contribute large amounts of phenols and sesquiterpene lactones to soil by rain wash or by death and decay of plant residues of Parthenium (Sukhada and Jayachandra, 1980).

The increased algicidal effect associated with 5%

Table /.* Algal population in soil as affected by the amendments of leaf, inflorescence and root of *Parthenium hysterophorus L.

Soil	MPN (x 10^3g-' soil) of algae"					
amendment (per	15"			30		
	Estimate	95% Fiducial limits		Estimate	95% Fiducial	limits
		Upper	Lower		Upper	Lower
Unamended	13.6	25.1 11.7	7.4	11.7	21.6	6.4
Leaf						
I	6.4	11.7	<4.1	6.4	11.7	<4.1
2	<4.2[c]	< 7.0[s]	< 4.1		<7.0	<4.1
5	<4.2	< 7.0	< 4.1		0	0
Inflorescence						
I	4.6	8.4	< 4.1	<4.2	<7.0	<4.I
2	<4.2	< 7.0	< 4.1	<4.2	<7.0	<4.1
5	<4.2	< 7.0	< 4.1	<4.2	<7.0	<4.I
Root						
I	8.7	16.0	4.7	8.7	16.0	4.7
2	5.4	10.0	<4.1	5.4	10.0	<4.1
5	4.6	8.4	<4.1	<4.2	<7.0	<4.1

* 0-day (initial) population was 13.6 x 10^3g~'soil. [b] Sampling time, in days after amendment.
[c] Not feasible to calculate exact MPN or fiducial limits as less than 8 tubes were scored positive.

Table 2. Occurrence of algae in soils amended with different parts of Parthenium hysterophorus

Organism	Unamended		Leaf						Inflorescence						Root					
	15	30	15			30			15			30			15			30		
			1	2	5	1	2	5	1	2	5	1	2	5	1	2	5	1	2	5
Anabaena variabills	+	+	+	-	-	+	-	-	+	+	+	+	+	+	+	-	+	+	+	+
Chloralla vulgaris	+	-	-	+	-	-	-	-	-	+	-	+	-	-	-	-	+	-	-	-
chlorococcum hmicola	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gleocystis gigas	+		+	+	-	-	-	-	-	-	-	+	-	-	-	+	+	-	-	-
Lyngbya gracills	+	+	-	-	-	+	+	-	+	-	+	-	+	+	+	-	+	+	+	+
Nostoc sp.	+	+	-	-	-	+	-	-	-	-	-	-	-	-	+	+	-	-	-	-
Oscillatoria sp	+	+	-	-	-	+	-	-	+	+	+	+	-	+	-	+	-	+	-	+
Phormidium lenue	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	-	+	+	+	+
Spirulina sp.	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	+	-	-	p	-
Synchococcus elongatus	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

a. Sampling time, in days, after incubation.
b. Soil amendment (per cent, s/w basis).

amendment of leaf material might be due to the release of large amounts of inhibitors into the soil after its partial or complete decomposition.

Dedonder and Van Sumere (1971) observed stimulated respiration in *Chlorella vulgaris* at higher concentrations of the phenolics which ultimately caused growth inhibition of the alga. This could be a possible reason for the complete elimination of soil algae observed here at the end of 30 days after leaf amendment. The occurrence of *Anabaena va-riabilis, Phomidium tenue* and *Lyngbya gracilis* even at higher levels of the plant parts indicates that filamentous blue-greens are relatively more tolerant to the inhibitors of the weed.

The present investigation reveals that inhibitors from *Parthenium hysterophorus* reaching soil through different plant parts would exert pronounced inhibitory effects on beneficial algae in soil.

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