Indian J.Sci.Res. 18(2): 97-101, 2018

ISSN: 0976-2876 (Print)
ISSN: 2250-0138(Online)

ALLELOPATHIC EFFECTS OF *Eichhorniacrassipes* ON A GREEN ALGA

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ABSTRACT

An attempt has been made to investigate the allelopathic effects of an aquatic angiosperm like *Eichhornacrassipes* on a fresh water green alga *Stigeoclonium variable*. *Stigeoclonium variable* was cultured in the Bold's Basal medium in a thermostatically controlled room conditions for 30 days which served as stock culture. Different concentrations [20%, 40%, 60%, 80% and 100%] of the leaf extracts of *Eichhorniacrassipes* were prepared separately and their effects studied on the filaments of *Stigeoclonium variable* for 28 days. The parameters taken were [I] Bio-chemical i.e. (a) growth measurement (b) determination of % growth inhibition and (estimation of total chlorophyll, chlorophyll a and b.[II] Morphological features such as nature of the algal thallus , colour , presence or absence of hairs, formation of mucilage, zoospores and akinetes. This research has revealed the significant alleopathic effects between two pollution tolerant species i.e. *Stigeoclonium variable* and *Eichhorniacrassipes*. The formation of akinetes in *Stigeoclonium variable* was found in 60% and 80% concentrations and the percentage of inhibition of the alga was found to be 60% and 100% concentration of *Eichhorniacrassipes*. The bio-chemical parameters (total pigments, chlorophyll a and b) also provide the supporting evidences for the above said features.

KEYWORDS: Alleopathic Effects, *Eichhorniacrassipes* and *Stigeoclonium variable*

The term "Allelopathy" (In Greek, Allelopathic - Mutual harm) was coined by Molisch (1937) to denote bio-chemical interactions between all types of plants including micro-organisms. He meant the term to cover both detrimental and beneficial reciprocal bio- chemical interactions**.** Allelopathy is the growing interest in the practical application of studies in the management of natural resources (eg: forestry, agriculture) and control of plant and animal pests (Szczepanska, 1977; Whittaker and Feeney, 1971; Yeo 1980; Yeo and Thurston 1984).

Eichhorniacrassipes Solms-Laub (Water hyacinth) is a native of South Americia, belonging to the family pontederiaceae. It is a free floating hydrophyte (macroplankton). It is known for its absorbing capacity and removal of the heavy metals from highly polluted waters.

Stigeocloniumvariabile, a heterotrichous green alga, is said to be tolerant to high pollution in the aquatic ecosystem (Bold and Wynne, 1978; Livingston, 1905).

In the present study, an attempt has been made to investigate whether the highly pollution tolerant angiospermic species of *Eichhorniacrassipes* has any effect on equally pollution tolerant species of *Stigeocloniumvariabile* (Nag) Islam.

MATERIALS AND METHODS

The green alga *Stigeocloniumvariabile* (Nag) Islam (Chaetophorales) was collected from a fresh water pond in Adambakkam, Chennai.

Eichhorniacrassipes Solms - Laub is an angiosperm collected from a pond at Y.W.C.A. Hostel, Chennai.

Eichhorniacrassipes Solms-Laub was grown in cement-tanks containing fresh water.

Stigeocloniumvariabile (Nag) Islam was cultured in the Bold's Basal medium (Bischoff and Bold, 1963) maintained at a temperature 22 ± 1°C in a thermostatically controlled room illuminated with cool day light fluorescent bulbs having an intensity of 1500 Lux units in a 12 : 12 light : dark regime for 30 days which served as stock culture.

Different concentrations [20%, 40%, 60%, 80% and 100%] of the leaf extracts of *Eichhorniacrassipes* was prepared separately and their effects was studied on the filaments of *Stigeocloniumvariabile* for 28 days.(Figure 4,5,6) Leaf extracts of *Eichhorniacrassipes* was prepared based on the method given by Kleivan and Szczepanska (1988).

The parameters taken were [I] Bio-chemical i.e. (a) growth measurement (b) determination of % growth inhibition and (c) estimation of total chlorophyll, chlorophyll a and b. [II] Morphological features such as nature of the algal thallus, colour, presence or absence of hairs, formation of mucilage, zoospores and akinetes.

RESULTS AND DISCUSSION

Increased period of treatment of leaf extract has inhibitory effect on the alga in *Eichhorniacrassipes* from 12th day. As the leaf extract concentrations of

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Eichhorniacrassipes increases (20% to 40%) there is gradual decrease in the growth rate and also the percentage inhibition of the growth rate from 16th day (Table 1 and Table 2).

All the concentrations of *Eichhorniacrassipes* leaf extracts have stimulatory effect on the length and width of the cells of the prostrate as well as erect systems of the alga until 12th day (Table 3, 4 & 5). The percentage of growth inhibition has been found directly proportional to the concentration of the leaf extracts of *Eichhorniacrassipes*. (Fig 1,2,3 and Fig 4,5,6).

Table 1: Effect of the Leaf Extracts of *Eichhornia crassipes* on Growth Characteristics of *Stigeoclonium variabile*

Treatment Period In Days	Concentration Of Extracts In Percentage											
	Control		20		40		60		80		100	
	F.W.	D.W.	F.W.	D.W.	F.W.	D.W.	F.W.	D.W.	F.W.	D.W.	F.W.	D.W.
4	426.3	109.6	450.1	116.3	473.3	122.3	492.6	134.2	514.2	139.1	540.8	150.8
8	513.4	120.3	542.4	130.6	601.3	170.1	632.8	192.0	690.0	212.5	701.6	228.6
12	532.6	180.4	585.1	162.3	622.7	198.4	652.8	203.4	712.1	220.5	753.3	247.3
16	620.1	240.9	412.2	151.0	356.2	143.5	310.2	131.6	284.5	115.8	190.3	89.9
20	690.3	360.2	387.5	133.4	323.4	121.1	283.6	109.7	265.7	93.4	144.1	72.5
24	850.1	489.3	283.7	97.6	212.3	85.3	205.8	65.8	191.1	74.2	161.5	58.9
28	900.1	500.0	225.1	75.2	189.9	67.7	156.7	54.2	121.5	40.9	97.4	32.3
O.D.	0.62		0.29		0.19		0.16		0.10		0.6	

F.W.: Fresh Weight in milligrams.

D.W.: Dry Weight in milligrams.

O.D.: Growth rate based on the Calculation of optical density of the total Pigment extract taken on 28th day.

Table 2: Effect of Leaf Extracts of *Eichhornia crassipes* on the growth of *Stigeoclonium variabile* percentage inhibition of growth

Treatment Period In Days	Concentration Of Extracts In Percentage				
	20	40	60	80	100
4	5.58	11.02	15.53	20.62	26.86
8	5.64	17.12	23.25	34.39	36.66
12	9.85	16.92	22.57	33.70	41.44
16	33.53	42.56	49.97	54.12	69.31
20	43.86	53.15	58.92	61.51	79.12
24	66.62	75.02	75.79	77.52	81.00
28	73.52	78.90	82.59	86.50	89.18

Table 3: Effect of Leaf Extracts of *Eichhornia crassipes* on the cell length of the prostrate system of *Stigeoclonium variabile*

Treatment Period In days	Concentration Of Extracts In Percentage					
	Control (L)	20 (L)	40 (L)	60 (L)	80 (L)	100 (L)
4	5-8	6-8	6-10	6-12	6-14	6-15
8	6-9	6-10	7-10	7-12	8-14	8-16
12	8-11	8-12	10-12	10-12	10-14	12-14
16	8-12	8-11	8-10	7-10	7-8	6-8
20	10-14	8-10	6-10	6-10	5-10	5-8
24	10-16	6-8	5-10	5-10	5-8	4-6
28	12-18	6-8	5-8	5-6	4-8	3-4
$\overline{m}$	10.3	8.6	8.0	7.5	6.9	6.0
σ	3.4	3.1	3.0	2.9	2.6	2.4
$\sigma_{\overline{m}}$	0.416	0.374	0.363	0.349	0.319	0.291
σ_{σ}	0.294	0.264	0.257	0.247	0.226	0.205

L Length of cell size in micrometer (μm)

Table 4: Effect of leaf extracts of *Eichhornia crassipes* on the cell width of the prostrate system of *Stigeoclonium ariabile*

Treatment Period In Days	Concentration Of Extracts In Percentage					
	Control (W)	20 (W)	40 (W)	60 (W)	80 (W)	100 (W)
4	4-6	4-8	5-8	5-10	6-10	6-11
8	4-8	5-8	6-8	6-11	6-12	8-12
12	6-10	8-10	8-10	9-12	10-12	10-14
16	8-10	7-10	6-10	6-10	6-8	6-7
20	8-12	6-10	5-10	5-7	5-8	4-6
24	10-12	5-10	5-8	4-8	4-6	3-6
28	10-14	5-8	5-6	4-6	3-6	2-4
$\overline{m}$	8.1	7.7	7.6	6.7	5.8	5.2
Σ	2.7	2.6	2.5	2.4	2.3	2.1
$\sigma_{\overline{m}}$	0.328	0.318	0.305	0.295	0.284	0.252
σ_σ	0.231	0.224	0.216	0.209	0.201	0.178

W Width of the cell size in micrometer (µm)

$\overline{m}$ Mean

σ Standard deviation

$\sigma_{\overline{m}}$ Standard error of the mean

σ_σ Standard error of the Standard deviation

Table 5: Effect of leaf extracts of *Eichhornia crassipes* on the cell width of the erect system of *Stigeoclonium variabile*

Treatment Period In Days	Concentration Of Extracts In Percentage					
	Control (W)	20 (W)	40 (W)	60 (W)	80 (W)	100 (W)
4	4-8	4-9	4-10	5-10	6-10	6-11
8	4-9	5-9	5-10	6-10	7-11	7-12
12	5-9	5-10	6-10	7-10	8-10	8-12
16	6-9	5-9	5-8	4-8	4-7	4-5
20	6-10	5-8	5-7	4-7	4-6	3-6
24	8-10	4-8	4-6	4-5	3-6	3-5
28	8-12	4-6	4-5	3-5	2-5	2-3
$\overline{m}$	7.1	6.0	5.9	5.3	4.3	4.0
Σ	2.5	2.4	2.3	2.2	1.8	1.5
$\sigma_{\overline{m}}$	0.301	0.291	0.283	0.266	0.225	0.188
σ_σ	0.212	0.206	0.200	0.188	0.159	0.133

W Width of the cell size in micrometer (µm)

$\overline{m}$ Mean

σ Standard deviation

$\sigma_{\overline{m}}$ Standard error of the mean

σ_σ Standard error of the Standard deviation

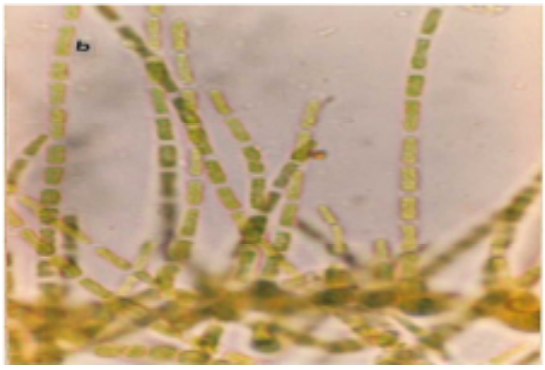

Figure 1: Control 12th day

Figure 2: Control 16th day

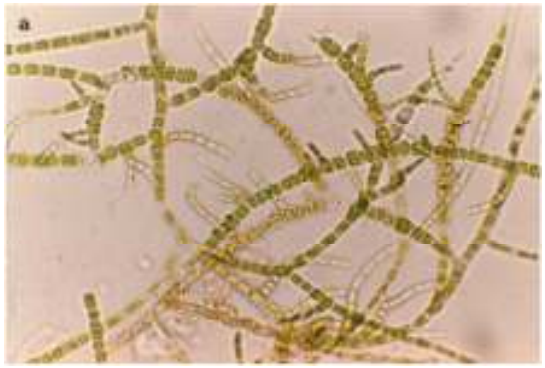

Figure 3: Control 28th day

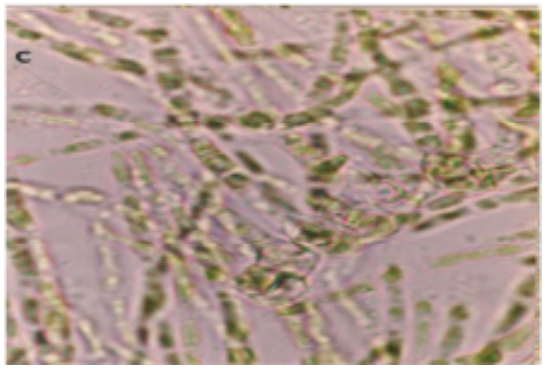

Figure 4: Treated with *Eicchornia crassipes* 60% concentration 12th day

Figure 5: Treated with *Eicchornia crassipes* 20% concentration 16th day

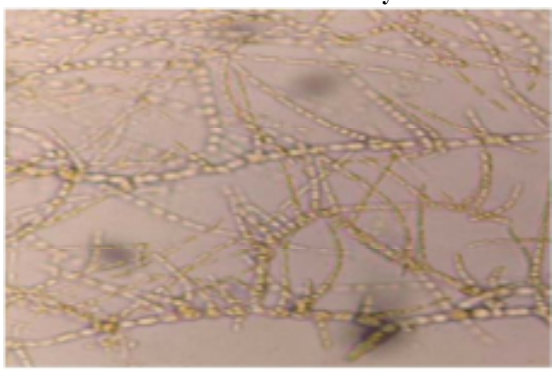

Figure 6: Treated with *Eicchornia crassipes* 100% concentration 28th day

There have been a few reports earlier (Parija, 1934; Sharma, 1985; Chadwick and Obeid, 1966; Gopal, 1987 and Seidel, 1965) on the allelopathic effects of *Eichhorniacrassipes* on other plants. Parija (1934) observed that the water hyacinth kills *Pistia,* Chadwick and Obeid (1966) reported that the competitive advantage of water hyacinth over *Pistia*is related to the pH of the medium. Gopal (1987) and Seidel (1965) have investigated that some species of *Eichhorniacrassipes* have the ability to remove allelo-chemicals like phenols from their surroundings. It is also reported that the leaves of *Eichhorniacrassipes* contain tannins. However, the present study deals with the allelopathic effects between the two polluted tolerant aquatic plants i.e. *Eichhorniacrassipes* and *Stigeoclonium variabile* which aspect has not been studied earlier. Xiaoxia Wu et al (2012) studied on the Allelopathic Effects of *Eichhorniacrassipes* on the Growth of *Microcystisaeruginosa* They suggested that water hyacinth might contain growth inhibitory substances and possess allelopathic potential.

In my study the formation of akinetes in *Stigeoclonium variabile* on the 8th, 12thand 20th day in

60% concentration and 4th and 8th day in 100% concentration of the leaf extract of *Eichhorniacrassipes* is a unique feature observed.

It is evident from other researchers report that inhibition of *Eichhorniacrassipes* on algae was due to the presence of alkaloid in further study the exact compound of inhibition has to be identified.

ACKNOWLEDGENT

The author expresses her profound sense of gratitude and indebtedness to her guide Prof. A.V. Govindaraj, M.Sc, M.Phil., F.B.S.,(Retired) Post Graduate Department of Botany, Pachaiyappa's College,

I thank the authorities of 27th swadeshi science congress for giving the opportunity to publish this research work.

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