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Effect of Paushamycin on Paddy field soil algae of Umrer, Nagpur District, Maharashtra

K. J. Cherian

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Abstract

Antibiotics are used to protect the crop plants from bacterial diseases by spraying it on the crop plants. Some of it may fall on the soil and create an impact on the soil micro flora. The soil micro flora condition the soil for better crop production. The author studied the impact of Paushamycin on the soil algae of paddy field of Umrer in Nagpur district, Maharashtra. Total 64 algal taxa could be indentified from the experiment field of which 38 belongs to Cyanophyta, 18 to Chlorophyta and 8 to Bacillariophyta. The different paddy field soil algal taxa show variable resistance to Paushamycin. The blue green algae show more resistance to the antibiotic than the green algae. Higher concentration of antibiotic used in this experiment gave 100% algicidal value in both Cyanophyta and Bacillariophyta, but Chlorophyta could not respond so, due to the two species of the genera, Chlorococcum. C. humicolo and C. vitiosum were highly resistant to antibiotic used. It may be due to their sheath or cell wall organization.

For Correspondence

Department of Botany, Hislop College, Nagpur, India
Email: cherian_kj@yahoo.in

Introduction

The antibiotics are used to control bacterial diseases on crop plants. They are sprayed on the crop field and a major part of it may fall on the soil. Introduction of any chemicals organic or inorganic will definitely create an impact on the soil micro flora. Usually it is negative impact rather than positive. The present investigation is aimed to find out the effect of such antibiotic on the growth of soil algae. The soil algae play an important role in soil conditioning by increasing the humus and other nutrients available to crop plants. It also prevents the erosion of soil. Thus any negative impact on these important soil organisms will adversely affect the crop production.

Pure cultures of algae were obtained by several phycologists using different antibiotics (Provasoli *et al*., 1951, Shelubsky 1951, Pappus & Hoffman 1952, Barkley 1956, Zender & Hughes 1958). The inhibitory effects of antibiotics on some groups of algae were reported by the observations made by Hunter & Veigh (1961), Kumar (1964a), Taylor (1965), Tarar & Kelkar (1978). The potential value of antibiotics in relation to their action on algal forms have been investigated by Foiter et al., (1953), Hunter & Veigh (1961), Lampmen & Arnow (1961), Perlman (1964) and Zehnder & Hughes (1958). They opined that algae are less

sensitive towards antibiotics than bacteria and fungi.

The experiments were conducted in the paddy fields of Umrer in Nagpur districts, which is about 45 km. away from Nagpur city. It receives approximately 75-85 cm of rain fall and the temperature varies from 7.5 c. in January to 46 c in May. The soil is of clay type and it is light brown in colour. The field is located about 6 km away from Umrer town.

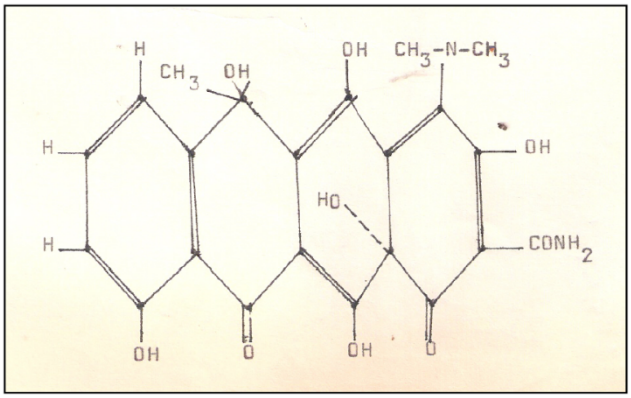
Material and Methods

Paushamycin

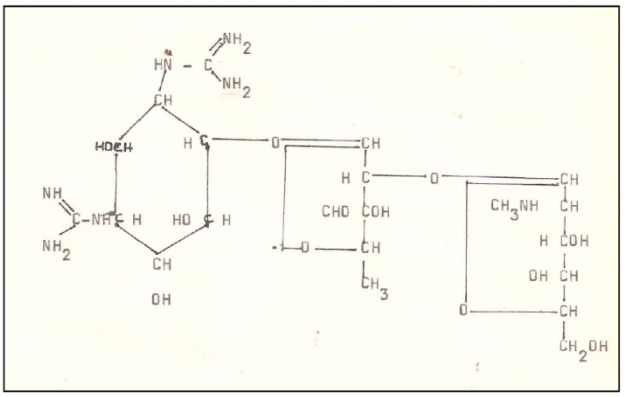
It is an antibacterial plant spray formulation recommended for effective control of no. of bacterial plant diseases. It is stable, free flowing, fine wettable antibiotic powder. Oxytetracyclin has been added to streptomycin to synergize the activity of streotomycin and easily absorbed through the foliage and does not wash off in rain. It is non toxic to human.

Composition: Oxytetracyclin base activity 1.5%
Streptomycin activity 15% With suitable wetting agent.

Terramycin (Oxytetracyclin) $C_{22}H_{24}N_2O_9$



Streptomycin



To study the algicidal potential of Paushamycin on algae, different concentrations were prepared and treated with the culture of algae. Five concentrations were used as 0.2%, 0.4%, 0.6%, 0.8% and 1.0%. These concentrations of the antibiotic solution are prepared by dissolving the required quantities of antibiotic in distilled water. Paushamycin do not dissolve completely in water and hence its suspension is used as stock solution.

Algal cultures

Multiple sets of cultures were made in De's modified Beneck's media, Allen & Arnon's media and Chu 10 media for each percentage treatment.

1. De's (1939) modified Beneck's medium:

KNO_3	-	0.2 gm
$Mgso_4\ 7H_2O$	-	0.2 gm
K_2HPO_4	-	0.2 gm
$CaCl_2\ 2H_2O$	-	0.1 gm
$FeC1_3$ (1%)	-	2 drops
EOTA	-	Traces
Distilled water	-	1000 ml

2. Allen and Arnon's (Modified) medium (Allen&Arnon, 1955, b):

$MgSO_4\ 7H_2O$	-	0.001 M
$CaC1_2$	-	0.0005 M

NaCl	-	0.004	M
K_2HPO_4	-	0.002	M

Minor elements:

$MnSO_4$ $4H_2O$	-	0.5	ppm
MoO_3	-	0.50	ppm
$ZnSO_4$. $4H_2O$	-	0.05	ppm
$CuSO_4$.$5H_2O$	-	0.02	ppm
H_3Bo_3	-	0.50	ppm
NH_4 VO_3	-	0.01	ppm
CO $(NO_3)_2 \cdot 6H_2O$	-	0.01	ppm
N iSO_4.6 H_2O	-	0.01	ppm
Cr_2 $(SO_4)_3$ $K_2SO_4 \cdot 24H_2O$	-	0.01	ppm
Na_2WO_4 $2H_2O$	-	0.01	ppm
TiO $(C_2$ $O_4)$ x.YH_2O	-	0.01	ppm
Fe EDTA	-	4 ppm	

3. Chu. No. 10 (Modified) Medium (Gerloff *et al.*, 1950) :

Ca $(NO_3)_2$	-	0.04	gm
K $_2$ $HP0_2$	-	0.01	gm
$MgSO_2$. $7H_2O$	-	0.025	gm
Na_2 $C0_3$	-	0.020	gm
Na_2 SiO_2	-	0.025	gm
Ferric Citrate	-	0.003	gm
Citric acid	-	0.03	gm
A_5 solution	-	1.0	ml
Distilled water	-	1000	ml

A5 trace element stock solution:

H_3B0_3	-	2.86	gm
$MnCI_2$ $4H_2O$	-	1.81	gm
$ZnSO_4$.$7H_2O$	-	0.222	gm
MoO3 (85%)	-	0.0177	gm
$CuSO_4$. $5H_2O$	-	0.07	gm
Distilled water	-	1000	ml

The inoculated culture media were kept in racks with illumination for 12 hrs. per day.

Treatment

The desired concentrations i.e. 0.2%, 0.4%, 0.6%, 0.8% and 1.0% of Paushamycin were prepared by dilution of the stock solution with sterilized distilled water. 7.5 ml of solution of 5 different concentrations were added to separate flasks containing 5 gm of soil sample and 75 ml of nutritive media. After inoculation of the antibiotic all the culture samples were agitated to ensure a uniform distribution. A control sample is also kept with each set without treatment of Paushamycin.

Algal culture is made from soil with each type of media and another set of the same treatments were done with fresh culture obtained previously. Each flask with required media and Paushamycin is inoculated with 5ml of well stirred algal cultures. The treated and control culture flasks were kept in ideal condition of light and temperature for 45 days for the growth of algae.

Results and Discussion

The algal flora of experiment field is observed by culture as well as collection studies. The total algal taxa observed from the experiment field is 64 of which 38 belongs to Cyanophyta, 18 to Chlorophyta, and 8 to Bacillariophyta. The cyanophycean members consists of 12 genus. The genus Microcystis, Chlorogloea and Anabaenopsis were represented by one species each. Aphanothece, Lyngbya and Anabaena were represented by 2 species each. The rest genus were represented as Chroococcus with 5 species, Gloeothece with 3 species, Aphanocapsa with 4 species, Oscillatoria with 9 species, Phormidium with 5 species and Nostoc with 3 species. The nitrogen fixing blue greens were represented by

Anabaenopsis (1 taxa), Nostoc (3 taxa) and Anabaena (2 taxa).

The 18 Chlorophycean members were represented by Chlamydomonas (2 taxa), Chlorococcum (2 taxa), Scenedesmus (3 taxa), Ulothrix (5 taxa), Geminella (2 taxa), Closterium (3 taxa) and Cosmarium (1 taxa). The 8 members of bacillariophyta were represented by Fragillaria (1 taxa), Synedra (1 taxa), Achnanthes (1 taxa), Navicula (2 taxa), Cymbella (1 taxa) and Nitzschia (2 taxa). Thus the experiment field of Umrer paddy field is dominated by Cyanophyta.

Effect of Paushamycin

The Table I shows the total number of algal taxa along with their presence in different concentration treatment of Paushamycin. It is observed that the lower concentrations i.e. 0.2% and 0.4% of Paushamycin did not have any effect on all the Cyanophycean members. Microcystis stagnalis was found to be resistant up to 0.6% concentration treatment. Chroococcus minutes and Chroococcus turgidus v. fuscescens are more sensitive as compared to the other spcies of chroococcus which made their occurrence up to 0.6% treatment. Gloeothece palea is more resistant (o.6%) than Gloeothece samoensis which occurred only up to 0.4% treatment. The genus Aphanocapsa showed a variable sensitivity to the different percent treatment of Paushamycin. Aphanocapsa nivalis found to be more resistant and occurred up to 0.8% treatment. Aphanocapsa pulchra found to be less resistant and occurred only up to 0.4% treatment. Other species of Aphnocapsa occurred in 0.6% whereas Aphanocapsa microscopica occurred up to o.4% treatment. The lone species of Chlorogloea microcystoides was resistant up to 0.6% treatment. All the species of Oscillatoria were resistant up to 0.8% treatment except Oscillatoria princeps which occurred only up to 0.6% treatment. Phormidium africanum was more sensitive and occurred only up to 0.4% treatment. Phormidium ceylanicum and P. uncinatum was more resistant than P. foveolarum and P. jenkelianum which occurred only up to 0.6% treatment, where as the former 2 species occurred upto o.8% treatment. Lyngbya lachneri occurred up to 0.6% while L. aerugineo-coerulea occurred up to 0.8% treatment. Anobaenopsis, Nostoc and Anabaena were found resistant up to 0.6% treatment.

In Chlorophyta some forms i.e. all species of Chlamydomonas, Geminella, Closterium and Cosmarium were found to be very sensitive and was absent in all the concentration treatment. The Chlorococcum humicolo and C. vitiosum were much resistant and were observed in all the concentration treatment. Scenedesmus bijugatus v. bicellularis was resistant up to 0.8% treatment whereas other species of the genus was found resistant up to 0.6% treatment. The Ulothrix tenuissima was more resistant (o.6%) as compared to other species of the genus which occurred only up to 0.4% concentration treatment.

In Bacillariophyta, Fragillaria brevistrata F. elongate was more resistant since it occurred up to 0.8% treatment. Out of the rest both species of Navicula were more resistant as compared with the rest, which occurred up to 0.4% treatment whereas the former occurred up to 0.6% treatment. Cymbella austriaca was found to be most sensistive as it occurred only up to 0.2% treatment.

In all the number of species survived in 0.2%, 0.4%, 0.6% 0.8% and 1.0% treatment were 56, 55, 41, 17 and 2 respectively. The survival percentage and algicidal value of different

concentration of Paushamycin is given in Table II. The 0.2% Paushamycin has no algicidal value in case of Cyanophyta and Bacillariophyta, whereas the Chlorophyta has 44.45% algicidal value. The 0.4% Paushamycin has no algicidal value in Cyanophyta but in Chlorophyta and Bacillariophyta it has 44.45%, 12.5% algicidal values respectively. The 0.6% Paushamycin has 18.43%, 67.67% and 50.0% algicidal value in Cyanophyta, Chlorophyta and Bacillariophyta respectively. The 0.8% Paushamycin has 65.79%, 83.34% and 87.5% algicidal value in Cyanophyta, Chlorophyta and Bacillariophyta respectively. The Cyanophyta and Bacillariophyta responded 1% Paushamycin with 100% algicidal value whereas 88.89% algicidal value was observed in Chlorophyta.

The different paddy field soil algal taxa show variable resistance to Paushamycin. The blue green algae show more resistance to the antibiotic than the green algae. Higher concentration of antibiotic used in this experiment gave 100% algicidal value in both Cyanophyta and Bacillariophyta, but Chlorophyta could not respond so, due to the two species of the genera, Chlorococcum. C. humicolo and C. vitiosum were highly resistant to antibiotic used. It may be due to their sheath or cell wall organization.

Sr. No.	Name of Algae	Paushmycin concentration				
		0.2%	0.4%	0.6%	0.8%	1.0%
I.	CYANOPHYCEAE					
1.	*Microcystis stagnalis*	p	p	p	-	-
2.	*Chroococcus macrococcus*	p	p	p	-	-
3.	*Chroococcus minutes*	p	p	-	-	-
4.	*Chroococcus schizodermaticus*	p	p	p	-	-
5.	*Chroococcus spelaeus*	p	p	p	p	-
6.	*Chroococcus turgidus Var. fuscescens*	p	p	-	-	-
7.	*Gloeothece membranacea*	p	p	-	-	-
8.	*Gloeothece palea*	p	p	p	-	-
9.	*Gloeothece samoensis*	p	p	-	-	-
10.	*Aphanocapsa biformis*	p	p	p	-	-
11.	*Aphanocapsa grevillei*	p	p	p	-	-
12.	*Aphanocapsa nivalis*	p	p	p	p	-
13.	*Aphanocapsa pulchra*	p	p	-	-	-
14.	*Aphanothece microscopica*	p	p	-	-	-
15.	*Aphanothece naegelii*	p	p	p	-	-
16.	*Chlorogloea microcystoides*	p	p	p	-	-
17.	*Oscillatoria animalis*	p	p	p	p	-
18.	*Oscillatoria curviceps Var. anqusta*	p	p	p	p	-
19.	*Oscillatoria decolorata*	p	p	p	p	-
20.	*Oscillatoria grunowiana*	p	p	p	p	-
21.	*Oscillatoria jenensis*	p	p	p	p	-
22.	*Oscillatoria limosa Var. disperse-granulata*	p	p	p	p	-
23.	*Oscillatoria princeps*	p	p	p	-	-
24.	*Oscillatoria subbrevis*	p	p	p	p	-
25.	*Oscillatoria terebriformis*	p	p	p	p	-
26.	*Phormidium africanum*	p	p	-	-	-
27.	*Phormidium ceylanicum*	p	p	p	p	-
28.	*Phormidium foveolarum*	p	p	p	-	-
29.	*Phormidium jenkelianum*	p	p	p	-	-
30.	*Phormidium uncinatum*	p	p	p	p	-
31.	*Lyngbya aerugineo-coerulea*	p	p	p	-	-
32.	*Lyngbya lachneri*	p	p	p	p	-
33.	*Anabaenopsis circularis*	p	p	p	-	-
34.	*Nostoc microscopicum*	p	p	p	-	-
35.	*Nostoc muscorum*	p	p	p	-	-
36.	*Nostoc piscinale*	p	p	p	-	-

37.	*Anabaena circinalis Var. crassa*	p	p	p	-	-
38.	*Anabaena laxa*	p	p	p	-	-
II.	**CHLOROPHYCEAE**					
39.	*Chlamydomonas globosa*	-	-	-	-	-
40.	*Chlamydomonas mucicola*	-	-	-	-	-
41.	*Chlorococcum humicolo*	p	p	p	p	p
42.	*Chlorococcum vitiosum*	p	p	p	p	p
43.	*Scenedesmus bijugatus Var. bicellularis*	p	p	p	p	-
44.	*Scenedesmus arcuatus*	p	p	p	-	-
45.	*Scenedesmus dimorphus*	p	p	p	-	-
46.	*Ulothrix oscillarina*	p	p	-	-	-
47.	*Ulothrix subtillisima*	p	p	-	-	-
48.	*Ulothrix tenuissima*	p	p	p	-	-
49.	*Ulothrix variabilis*	p	p	-	-	-
50.	*Ulothrix zonata*	p	p	-	-	-
51.	*Geminella minor*	-	-	-	-	-
52.	*Geminella protogenita*	-	-	-	-	-
53.	*Closterium acerosum*	-	-	-	-	-
54.	*Closterium acutum*	-	-	-	-	-
55.	*Closterium parvulum*	-	-	-	-	-
56.	*Cosmarium oranatum*	-	-	-	-	-
III.	**BACILLARIOPHYCEAE**					
57.	*Fragillaria brevistriata f. elongata*	p	p	p	p	-
58.	*Synedra affinis*	p	p	p	-	-
59.	*Achnanthes delicatula*	p	p	-	-	-
60.	*Navicula clavata*	p	p	p	-	-
61.	*Navicula grivilleri*	p	p	p	-	-
62.	*Cymbella austriaca*	p	-	-	-	-
63.	*Nitzschis dissipata*	p	p	-	-	-
64.	*Nitzschia gracilis*	p	p	-	-	-
	(P) = Present Total **(-) = Absent**	**56**	**55**	**41**	**17**	**2**

TABLE – I: Algae observed in different types of treatment of antibiotics

Antibiotics gm/100ml	**Cyanophyceae**			**Chlorophyceae**			**Bacillariophyceae**		
	No. of Survival forms.	**Survival %**	**Algicidal Value %**	**No. of Survival forms.**	**Survival %**	**Algicidal Value %**	**No. of Survival forms.**	**Survival %**	**Algicidal Value %**
Paushamycin									
0.2	38	100.0	00.0	10	55.55	44.45	8	100.0	0.0
0.4	38	100.0	0.0	10	55.55	44.45	7	87.5	12.5
0.6	31	81.57	18.43	6	33.33	67.67	4	50.0	50.5
0.8	13	34.21	65.79	3	16.66	83.34	1	12.5	87.5
1.0	0	0.00	100.0	2	11.11	88.89	0	0.0	100.0

TABLE – II: Total Number of viable forms, their survival percentage in various conditions of antibiotics used in the present investigation with their respective Algicidal value.

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