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Soil Application of Carbofuran and its Influence on the Rhizosphere Actinomycetes of Rice Plants

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Soil application of carbofuran, a systemetic insecticide, increased the population of actinomycetes in the rhizosphere of healthy rice plants. The treatment markedly enhanced the number of actinomycetes antagonistic to five pathogenic fungi.

Key Words Actinomycetes Carbofuran Population Rhizosphere

During the course of investigation on rice tungro virus disease and the effect of the systemic insecticide carbofuran, I observed that carbofuran application caused both quantitative and qualitative changes in the exudation pattern of rice plants (Rana Kausar, 1985). This paper reports on the results of the effect of carbofuran on the rhizosphere actinomycetes of healthy rice plants.

MATERIALS & METHODS Cultivation of Plants - Taichung (Native) 1 seedlings 20 days old were transplanted into puddled soil in 50 plastic pots at the rate of two seedlings per hill and one hill per pot. The soil was adequately fertilized (NPK - 100:30:30 kg/ha).

Chemical treatment - Half the number of plants were treated with Furadan 3G (carbofuran) at the rate of 1 kg a.i./ha. The carbofuran granules were applied to the soil. Plants were treated immediately after transplanting i.e. when the plants were 20 days old and at panicle initiation stage when the plants were 60 days old. Untreated plants were maintained as control.

Rhizosphere studies - Soil samples were collected from the rhizosphere of both untreated and treated plants at 20 day interval from the time the plants were 20 days old until 100 days. Rhizosphere soil for each set was collected from 10 plants and mixed thoroughly. Serial dilutions were prepared from the soil solution (Johnson & Curl, 1972). Starch ammonium agar medium (Kuznetsov & Arjunarao, 1972) was used to isolate actinomycetes. Five replicates were maintained for each set and the plates were incubated at room temperature (28 - 32 C). The colonies were counted after 1 week. Individual colonies different from each other in size, colour and nature of growth were picked and transferred to yeast-extract agar slants.

Antagonism studies - The test fungi ***Alternaria padwickii***, ***Drechslera oryzae***, ***Pyricularia oryzae***, ***Rhizoctonia solani*** and ***Sclerotium oryzae*** cause diseases in rice. The cultures were kept on Czapek's Dox medium (Raper & Thom, 1949). For detection of antibiosis, the spot-inoculum procedure (Lochhead & Landerkin, 1949) was followed. The tests were conducted in triplicate. The degree of antagonism of each isolate showing inhibition to 3 or more pathogens, was measured.

RESULTS & DISCUSSION The carbofuran treated rhizosphere soil supported higher population of actinomycetes than the untreated rhizosphere soil (Table 1). This trend was observed in all the samples. Carbofuran significantly stimulated root growth in rice, enhanced plant height, stimulated total and productive tillers and promoted rapid maturity (Venugopal & Litsinger, 1980). The increase in overall metabolism on carbofuran application obviously leads to increased exudation of nutrients like sugars and aminoacids, thus leading to increased microbial activity in the root zone. However, Visalakshi *et al* (1980) found no significant variation in the microbial population between the carbofuran treated and untreated rhizosphere, when the insecticide was applied at the rate of 0.5 kg a.i./ha. Doubling the dosage to 1 kg a.i./ha caused a pronounced increase in the actinomycete population.

Actinomycete population increased substantially until the last sampling (Table 1). This increase, which is more significant from the 40th day after first treatment could be due to application of the second dose of carbofuran.

The antagonistic actinomycetes were twice in the rhizosphere soil treated with carbofuran. While 40% of the actinomycetes isolated from the treated soil were antagonistic to the fungal pathogens, only 18% of them from the untreated soil showed antagonism.

Table 1 Effect of Carbofuran on the Rhizosphere Actinomycetes

Rhizosphere Soil	Actinomycete population (10^3/g soil)				
	Days after first treatment				
	Start	20	40	60	80
Control	41.36	43.60	32.00	22.40	15.70
Carbofuran treated	43.10	48.39	45.24	38.94	33.00
% increase	4.21	10.99	41.38	73.84	110.20

Table 2 Antagonistic Effect of Actinomycetes from Treated Plants

Rhizosphere actinomycetes	Inhibition (mm)				
	Test fungi *				
	Ap	do	Po	Rs	So
R_1	14	9	5	7	9
R_2	4	2	1	1	0
R_3	2	0	0	2	2
R_4	11	6	3	5	9
R_5	6	5	1	3	3
R_6	7	6	3	0	1
R_7	3	3	2	1	2
R_8	5	0	1	0	2
R_9	15	10	6	9	7
R_{10}	12	9	4	10	9
R_{11}	3	3	0	1	1
R_{12}	5	4	4	3	3
R_{13}	3	0	0	3	3
R_{14}	4	3	3	2	3
R_{15}	3	2	0	1	2
R_{16}	6	3	1	2	3
R_{17}	2	2	0	0	1
R_{18}	5	5	4	4	3
R_{19}	8	4	3	7	6
R_{20}	4	2	1	2	2
R_{21}	3	1	1	0	0
R_{22}	13	5	4	10	6
R_{23}	9	2	1	3	4
R_{24}	7	4	1	2	4

* Ap = *Alternaria padwickii* Rs = *Rhizoctonia solani*
Do = *Drechslera oryzae* So = *Sclerotium oryzae*
Po = *Pyricularia oryzae*

Table 3 Antagonistic Effect of Actinomycetes from Untreated Plants

Rhizosphere actino-mycetes	Inhibition (mm)				
	Test fungi *				
	Ap	Do	Po	Rs	So
R_{25}	12	5	4	9	5
R_{26}	4	4	2	0	0
R_{27}	3	2	1	1	3
R_{28}	2	0	0	1	3
R_{29}	3	2	0	1	3
R_{30}	2	1	0	0	1
R_{31}	14	7	3	10	10
R_{32}	9	6	5	8	6

* Ap = *Alternaria padwickii* Rs = *Rhizoctonia solani*
Do = *Drechslera oryzae* So = *Sclerotium oryzae*
Po = *Pyricularia oryzae*

Such changes are significant from the view point of biological control.

The degree of antibiosis of each isolate varied with the pathogen (Table 2 and 3). Highest number of rhizosphere actinomycetes were antagonistic to *A. padwickii.* followed by *S. oryzae. D.oryzae, R.solani* and *P.oryzae*

We did not attempt to identifiy the actinomycetes. Some of them (R1, R4, R9, R19, R22, R25, R31 and R32) are strongly antagonistic to important fungal pathogens of rice and are of interest. Selective stimulation of such actinomycetes in the root region could be advantageously exploited in biological control.

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