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Effect of O-Cresol on Microbial Composition in Soil and Rhizosphere of Onion Plants Cultivated in Presence of *Sclerotium cepivorum* Berk.

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Abstract. Total counts of bacteria and fungi in the rhizosphere of onion plants pretreated with o-cresol (250 ppm) showed an initial inhibition as compared with the surrounding non-rhizosphere soil and/or the untreated plants. This suppression was followed by a clear stimulation. The soil infestation with *Sclerotium cepivorum* caused minor fluctuations in the total counts of bacteria and fungi in both soil and rhizosphere allover the 5 months.

Sixty-nine fungal species belong to 28 genera were isolated in addition to Mycelia sterilia. The isolated fungal genera from the rhizosphere of onion plants could be arranged according to their densities in soil either non-infested or infested with *S. cepivorum* (controls A, B) where both are free of o-cresol in the following descending order: *Aspergillus* (16 spp.), *Penicillium* (15 spp.), *Fusarium* (4 spp.), *Paecilomyces* (2 spp.), *Alternaria* (3 spp.), *Cladosporium* (2 spp.), *Trichoderma* (2 spp.) and *Ulocladium* (2 spp.), Mycelia sterilia, *Mucor* (1 sp.), other genera (19).

The pretreatment of onion plants with o-cresol resulted in one of the following responses in the rhizosphere fungal spectra: a decrease, an increase or even disappearance of some genera.

In all treatments the R/S ratios for counts, most common fungal genera and species were recorded.

Introduction

Hiltner [1] suggested the term rhizosphere to describe the zone of soil subjected to the influence of roots of higher plants which is characterized by increased microbiological activities. Hoffman [2] reported that bacteria were generally more numerous adjacent to plant roots than in soil apart.

Rao [3] found that the ratio of fungal numbers in the rhizosphere to those in free soil was high when the plants reached maximum vegetative growth after 30 days, this

ratio gradually decreased until plants were 3 months old, afterwhich a small increase in the ratio set in due to increased microbial activity around dead or senescent roots. A remarkable increase in the number of bacteria and fungi in the rhizosphere of maize, as compared with those in the control soil, was stated by Martiniz [4].

Tolba and Ali [5] found that in the rhizosphere of cotton plants, *Aspergillus* spp. represented the group of fungi of highest frequency of occurrence followed by Dematiaceae *Fusarium* spp., *Penicillium* spp. and Phycomycetes. Moubasher and El-Dohlob [6] reported that the most common rhizospheric species of onion plants were *Aspergillus niger, A. terreus, A. carneus, Penicillium funiculosum, Humicola grisea, Stachybotrys atra* and *Fusarium oxysporum.*

Funck-Jensen and Hockenhull [7] showed that the rate of exudation is influenced by the age of the root, environmental factors, cultural factors and the presence of microorganisms. They also stated that root exudates may contain compounds which specially influence processes such as spore germination ... etc. They also found that the change in exudate composition led to change in composition of microflora in the rhizosphere.

The present investigation was initiated as an extention of the work previously done by the same authors [8,9]. It aimed at determining the effect of dipping roots of onion seedlings in the phenolic compound o-cresol before transplantation into soil infested with sclerotia of *Sclerotium cepivorum* Berk. on microbial counts and fungal composition in the rhizosphere and soil apart from the plant roots during its life.

This work complements another ongoing study in which o-cresol is being used as a control measure for white rot of onion [10].

Materials and Methods

Onion seedlings (2-month-old) were transplanted in cubic wooden boxes of one meter dimensions filled with sandy loam soil. The soil had pH 7.2, 0.5 % organic matter content and 0.37 total soluble salts. For each treatment, three boxes were used. About 55 seedlings were transplanted into each box. The following treatments were adopted:

Treatment A: Onion seedlings were transplanted into untreated soil (without addition of any material or inoculum). This treatment was considered as control A.

Treatment B: Seedlings were transplanted into soil infested with sclerotia of *Sclerotium cepivorum.* (control B).

Treatment C: The roots of seedlings were immersed in o-cresol solution (250 ppm) for 10 min before transplantation into soil infested with sclerotia of *S. cepivorum*. The phenolic compound o-cresol (250 ppm) was chosen in the light of our previous work [8].

The onion cultivar selected for the present investigation was Giza 6 obtained from the Department of Onion and Garlic Researches, Agricultural Research Centre, Ministry of Agriculture. The experiments were conducted under natural conditions in a fenced area within the Botanical garden of Cairo University at Giza. Superphosphate fertilizer was added to the sandy loam soil at the rate of 200 g/box one month after transplantation. The boxes were irrigated every 10-15 days as needed, following the same system applied by the Egyptian farmer.

Estimation of microflora in soil and rhizosphere zone of onion plants

To study the microflora in the rhizosphere zone, the plants were up-rooted with great care to obtain the intact root system as much as possible. The root system of the developing plants with the adhering soil was separated from the shoot with a sterile knife. The roots were then transferred aseptically to Erlenmeyer flasks (500 ml) containing 99 ml of sterile distilled water. After covering tightly, the flasks were shaken thoroughly using a mechanical shaker for 15 min [11]. This treatment gave an approximate dilution of 1 : 100 of soil suspension.

Serial dilutions were then made after discarding the root system. One ml from each dilution was plated in the specific media for isolation of fungi and bacteria. The flasks containing the rhizosphere soil were dried at 105°C for 24 hrs to estimate the dry weight of the rhizosphere soil. From this figure, microbial counts per gram dry weight of rhizosphere soil were calculated.

To study the soil microflora apart from the effects of roots, 10 g of a representative sample of soil in the root-free area of each treatment were taken and transferred to an Erlenmeyer flask (500 ml) containing 90 ml of sterile distilled water. This gave a dilution of 1 : 10. Other samples were taken from soil solution for fungal and bacterial counts. The microflora were counted and calculated per gram dry weight of soil. From the figure of the rhizosphere microflora (R) and that of soil apart from the roots (S), the rhizosphere effect could be interpreted by calculating R/S ratios (rhizosphere/soil) on a dry soil weight basis.

1 – Estimation of fungal counts

For counting the number of fungi, Martin's medium [12] was used which consisted of: dextrose, 10 g; peptone, 5 g; KH_2PO_4, 1 g; $MgSO_4 . 7H_2O$, 0.5 g; rose bengal, 1: 30.0000; agar, 20 g and streptomycin, 0.03 g/l medium; distilled water, 1000

ml. One ml of the desired dilution of the soil was transferred aseptically into each Petri-dish using three replicates for each sample. Then 12-15 ml of Martin's agar medium, cooled to 45°C, were added to each dish. The dishes were rotated by hand in a broad swirling motion so that the diluted soil was uniformly dispersed in the agar medium. After incubation at 27°C for 5-7 days, the resulting colonies were then counted and identified. The average number of colonies was multiplied by the dilution factor to obtain the number of colonies per gram dry weight in the original sample.

2 – Estimation of bacterial counts

The total counts of bacteria were determined on Topping medium modified by Skinner *et al.* [13] which consists of 2.5 g peptone, 2 g yeast extract, 20 g agar, 1000 ml distilled water and the pH was adjusted to 7.2. For enumeration of the total bacterial count, 1 ml of the selected dilution was placed in each Petri dish and 12-15 ml of the medium were added. Three replicates were used for each sample. Counts of total bacterial colonies were determined after incubation at 30°C for 5 days.

Counts of bacteria and fungi were estimated every month throughout five months.

Preparation of inoculum of *Sclerotium cepivorum*

The inoculum was prepared by growing *S. cepivorum* in 500 ml Erlenmeyer flasks containing barley grain medium (100 g of barley + 50 ml water), at 20°C for 20 days. The inoculum was mixed throughout the soil at a rate of 2 % of soil weight.

Statistical analysis

The means of the replicate results were tabulated and the Least Significant Difference (L.S.D.) was calculated at the confidence limits 1 % and 5 %.

Results

The total count of bacteria in the rhizosphere of treated onion plants (treatment C) was at a minimum value of 0.97×10^5 colony/g soil by the end of the first month (Table 1). This count began to rise gradually from the second month till the end of the experiment. The rhizosphere counts of bacteria in o-cresol-treated plants were gradually stimulated with time, while the counts in the surrounding soils showed insignificant fluctuations, thus the R/S ratios were increased gradually in treatment (C) to reach 3.29 by the end of the experiment as compared to 2.81 and 2.07 in the controls (A) and (B).

Table 1. Average total counts of bacteria ($x10^5$) per gram dry soil in either rhizosphere (R) or free soil (S) of onion plants.

Months	Treatments								
	A			B			C		
	R	S	R/S	R	S	R/S	R	S	R/S
1	1.50	1.14	1.32	0.87	1.86	0.47	0.97	2.32	0.42
2	3.16	1.90	1.66	3.02	1.97	1.53	5.35	2.91	1.84
3	4.34	1.18	3.68	5.02	2.63	1.91	7.80	3.06	2.55
4	5.27	2.19	2.41	5.10	2.22	2.30	9.22	2.93	3.15
5	4.13	1.47	2.81	4.12	1.99	2.07	9.40	2.86	3.29

L.S.D.	between treatments	within treatment
0.05	2.01	2.11
0.01	3.65	3.69

A = Untreated soil cultivated with untreated onion seedlings (control).

B = Soil infested with sclerotia of *S. cepivorum* and cultivated with untreated seedlings.

C = Soil infested with sclerotia of *S. cepivorum* and cultivated with seedlings previously immersed in o-cresol (250 ppm) for 10 minutes.

Immersion of onion transplants in o-cresol before cultivation in infested soil clearly reduced the fungal population in the rhizosphere as compared to those of untreated seedlings cultivated in non-infested soil (Table 2). The same observation holds true for only the first two months in the rhizosphere of o-cresol-treated plants as compared to those of untreated seedlings cultivated in infested soil (treatment B). No significant differences were observed between treatments (C) and (B) by the end of the third month, while the rhizosphere fungal counts were higher during the last months in these treatments.

The fungal counts in the rhizosphere of all treatments were clearly higher than their respective counts in the surrounding soil, except for the first two months in treatment C (Table 2).

The R/S ratios of o-cresol-treated plants were less than unity for the first two months and gradually increased to exceed unity for the last three months. The R/S values of controls A and B were more than unity and fluctuated between 1.41 - 4.84.

Table 3 presents the total counts of fungal genera in the rhizosphere and surrounding soil of onion plants under different treatments. The same table illustrates also the structure of genera (species counts). The frequencies of occurrence of different fungal genera and species were calculated. The R/S values of the most dominant genera and species are recorded in Tables 4,5, respectively.

Table 2. Average total counts of fungi (x10²) per gram dry soil in rhizosphere (R) and soil (S) of onion plants.

Months	Treatments								
	A			B			C		
	R	S	R/S	R	S	R/S	R	S	R/S
1	384.3	123.6	3.11	249.8	71.8	2.43	58.8	84.1	0.70
2	424.9	131.4	3.23	309.9	134.4	1.41	128.7	148.2	0.87
3	769.1	256.3	3.00	577.6	324.9	2.92	534.0	356.0	1.50
4	1052.0	217.5	4.84	702.1	240.8	2.33	841.6	379.0	2.22
5	788.0	286.4	2.75	769.5	280.0	3.91	851.9	346.2	2.46

L.S.D. at	between treatments	within treatment
0.05	50.12×10^2	51.12×10^2
0.01	64.61×10^2	63.36×10^2

Aspergillus

The genus *Aspergillus* was the most frequently isolated under control conditions. In treatment (C) the count of this genus in the rhizosphere was twice that in the surrounding soil (Table 3).

The R/S ratio of aspergilli (Table 4) indicated their stimulation under all treatments. The stimulation was more evident in treatments (A) and (B) than in treatment (C).

Aspergilli were considered to be of high frequency of occurrence since they appeared on isolation Petri-dishes of all treatments by the end of all experimental periods (5 months).

Sixteen *Aspergillus* species were recorded in R and S of treatments (A) and (B) throughout the experimental period (Table 3). Only 13 species were collected from treatment (C) where the seedlings were previously immersed in o-cresol before transplantation. *A. flavus* and *A. terreus* were of high frequency in both R and S of treatment (C) and they ranked first among *Aspergillus* species recovered from controls A and B. These two species were followed by *A. fumigatus* in both R and S of treatment (C). *A fumigatus* was not recorded in R of treatment (A). *A. nidulans* was recorded in both R and S of treatment (C) but its frequency in the latter site was higher than that in the former. The three species *A. versicolor, A. luchuensis* and *A. ustus* were recorded in both R and S in all treatments but at low frequencies.

Five *Aspergillus* species were missed in the soil but recorded in onion rhizosphere only as a result of previous treatment with o-cresol. These five species can be

Table 3. Total counts (monthly for a period of five months) of fungal species in rhizosphere (R) and surrounding soil (S) (× 10^2 colony/g dry soil) of onion plants.

Treatment	Total count of each treatment						Total count of		Total count of R+S	% of total population
	A		B		C					
Species	R	S	R	S	R	S	R	S		
Total *Aspergilli*	1268.1	447.0	913.1	323.7	631.9	316.2	2813.1	1086.9	3900.0	33.009
A. flavus	391.9	82.1	211.3	65.6	112.6	160.7	715.8	308.4	1024.2	8.669
A. terreus	174.4	44.6	194.1	73.1	171.0	51.2	539.5	168.9	708.4	5.996
A. versicolor	60.0	72.0	7.9	11.2	3.9	8.4	71.8	91.6	163.4	1.383
A. niger	117.4	54.3	22.4	0.0	7.8	0.0	147.6	54.3	201.9	1.709
A. carbonarius	35.8	0.0	0.0	0.0	0.0	8.1	35.8	8.1	43.9	0.372
A. nidulans	61.0	0.0	15.6	40.1	4.2	37.9	80.8	8.0	158.8	1.344
A. fumigatus	0.0	48.1	81.1	3.7	78.6	37.9	159.7	89.7	249.4	2.111
A. ochraceous	135.6	13.3	34.3	0.0	37.9	0.0	207.8	13.3	221.1	1.871
A. candidus	28.2	0.0	0.0	4.0	20.1	0.0	48.3	4.0	52.3	0.443
A. sydowi	0.0	0.0	140.4	7.5	74.7	0.0	215.1	7.5	222.6	1.884
A. luchuensis	71.7	12.4	11.9	76.2	4.2	7.8	87.8	96.4	184.2	1.559
A. ustus	8.8	0.0	34.4	0.0	7.8	4.2	51.0	4.2	55.2	0.467
A. sulphureus	8.0	84.4	7.9	42.3	0.0	0.0	15.9	126.7	142.6	1.207
A. okasakii	45.0	0.0	68.7	0.0	0.0	0.0	113.7	0.0	113.7	0.962
A. clavatus	117.9	0.0	48.0	0.0	109.1	0.0	275.0	0.0	275.0	2.328
A. wentii	12.4	35.8	35.0	0.0	0.0	0.0	47.4	35.8	83.2	0.704
Total *Penicillia*	751.0	284.4	820.0	245.6	598.5	370.4	2169.6	900.4	3070.0	25.984
P. coryophilum	135.0	4.4	188.3	39.0	114.9	46.9	438.2	90.3	528.5	4.473
P. citrinum	157.7	49.9	69.4	43.6	77.0	81.9	304.1	175.4	479.5	4.058
P. notatum	73.3	33.1	183.6	34.4	81.3	15.9	338.2	83.4	421.6	3.568
P. purpurogenum	61.8	72.4	116.7	0.0	3.9	37.9	182.4	110.3	292.7	2.477
P. decumbens	0.0	36.2	0.0	0.0	0.0	0.0	0.0	36.2	36.2	0.306

Table 3. Contd.

Treatment / Species	Total count of each treatment						Total count of		Total count of R+S	% of total population
	A		B		C					
	R	S	R	S	R	S	R	S		
P. nigricans	36.2	43.8	36.1	4.0	46.3	79.0	118.6	126.8	245.4	2.077
P. islandicum	0.0	4.4	0.0	0.0	4.2	0.0	4.2	4.4	8.6	0.073
P. canescens	0.0	36.2	0.0	3.7	0.0	0.0	0.0	39.9	39.9	0.338
P. chrysogenum	121.4	0.0	50.2	4.0	78.6	59.2	50.2	63.2	313.4	2.653
P. duclauxi	0.0	0.0	0.0	39.8	0.0	0.0	0.0	39.8	39.8	0.337
P. funiculosum	84.4	0.0	51.5	0.0	35.6	37.9	171.5	37.9	459.6	3.890
P. oxalicum	0.0	0.0	36.1	3.7	0.0	0.0	36.1	3.7	39.8	0.337
P. rugulosum	4.4	4.0	0.0	34.4	0.0	7.8	4.4	46.2	50.6	0.428
P. herquei	35.8	0.0	0.0	0.0	0.0	0.0	35.8	0.0	35.8	0.303
P. rubrum	41.0	0.0	88.1	39.0	156.8	3.9	285.9	42.9	328.8	2.783
Total *Fusaria*	288.5	44.2	212.2	46.5	277.5	86.4	778.2	177.1	955.3	8.085
F. moniliforme	119.8	35.8	34.4	4.0	43.3	7.8	167.5	47.6	245.1	2.074
F. oxysporum	142.6	8.4	138.0	35.0	163.0	3.9	443.6	47.3	490.9	4.155
F. solani	13.3	0.0	36.1	7.5	0.0	39.1	49.4	46.6	96.0	0.813
F. chlamydosporum	12.8	0.0	3.7	0.0	71.2	35.6	87.7	35.6	123.3	1.044
Total *Paecilomyces*	178.8	33.0	100.1	62.5	165.0	117.3	443.9	212.8	656.7	5.558
P. divaricata	178.8	24.2	58.2	11.2	114.9	41.8	351.9	77.2	429.1	3.632
P. silvatica	0.0	8.8	41.9	51.3	50.1	75.5	92.0	135.6	227.6	1.926
Total *Trichoderma*	89.3	4.4	34.7	69.4	41.8	12.3	165.8	86.1	251.9	2.132
T. viride	81.3	4.4	34.7	69.4	3.9	3.9	119.9	77.7	197.6	1.672
T. Koningi	8.0	0.0	0.0	0.0	37.9	8.4	45.9	8.4	54.3	0.460
Total *Cladosporium*	93.2	4.4	65.0	46.5	122.7	55.7	280.9	106.6	387.5	3.280
C. herbarum	8.8	4.4	11.6	11.5	45.7	12.7	66.1	28.6	94.7	0.802

Table 3. Contd.

Treatment	Total count of each treatment						Total count of		Total count of R+S	% of total population
	A		B		C					
Species	R	S	R	S	R	S	R	S		
C. epiphyllum	84.4	0.0	53.4	35.0	77.0	43.0	214.8	78.0	292.8	2.478
Total *Alternaria*	66.1	0.0	95.3	42.1	3.9	19.5	165.3	61.6	226.9	1.920
A. humicola	0.0	0.0	23.1	34.4	0.0	11.7	23.1	46.1	69.2	0.586
A. geophila	66.1	0.0	72.2	0.0	3.9	0.0	142.2	0.0	142.2	1.204
A. fasciculata	0.0	0.0	0.0	7.7	0.0	7.8	0.0	15.5	15.5	0.131
Total *Rhizopus*	41.0	71.6	42.3	7.5	113.8	43.0	197.1	122.1	319.2	2.702
R. oryzae	41.0	35.8	42.3	7.5	74.7	43.0	158.0	86.3	244.3	2.068
R. stolonifer	0.0	35.8	0.0	0.0	39.1	0.0	39.1	35.8	74.9	0.634
Total *Mycelia sterilia*	113.4	4.4	35.0	78.8	15.9	3.9	164.3	87.1	251.4	2.128
White	92.1	4.4	0.0	7.7	15.9	0.0	108.0	12.1	120.1	1.016
dark	21.3	0.0	35.0	71.1	0.0	3.9	56.3	75.0	131.3	1.111
Total *Ulocladium*	61.0	0.0	57.7	34.4	7.8	79.6	126.5	114.0	240.5	2.036
U. atrum	49.1	0.0	11.2	0.0	7.8	71.2	68.1	71.2	139.3	1.179
U. chlamydosporum	11.9	0.0	46.5	34.4	0.0	8.4	58.4	42.8	101.2	0.857
Total *Verticillium*	12.4	52.8	4.0	36.1	39.0	0.0	55.4	88.9	144.3	1.221
V. glaucum	8.0	52.8	4.0	36.1	0.0	0.0	12.0	88.9	64.8	0.548
V. sulphurellum	4.0	0.0	0.0	0.0	39.0	0.0	43.4	0.0	43.4	0.367
Stemphylium verruculosum	8.8	0.0	0.0	0.0	75.5	3.9	84.3	3.9	88.2	0.747
Stachybotrys atra	40.2	0.0	19.8	0.0	0.0	0.0	60.0	0.0	60.0	0.508
Humicola grisea	35.8	36.6	34.4	7.5	113.6	37.9	183.8	82.0	265.8	2.250
Cephalosporium curtipes	35.8	8.0	4.0	0.0	0.0	0.0	39.8	8.0	47.8	0.405
Cunninghamella echinulata	0.0	0.0	38.4	0.0	0.0	0.0	38.4	0.0	38.4	0.325
Epicoccum nigrum	11.9	0.0	44.0	0.0	0.0	0.0	55.9	0.0	55.9	0.473

Table 3. Contd.

Treatment	Total count of each treatment						Total count of		Total count of R+S	% of total population
	A		B		C					
Species	R	S	R	S	R	S	R	S		
Helminthosporium sativum	15.9	0.0	7.5	7.5	110.3	42.1	133.7	49.6	183.3	1.551
Total *Curvularia*	4.4	8.0	0.0	36.1	37.9	77.7	42.3	121.8	164.1	1.389
C. tetramera	4.4	0.0	0.0	0.0	37.9	73.5	42.3	73.5	115.8	0.980
C. lunata	0.0	8.0	0.0	36.1	0.0	4.2	0.0	48.3	48.3	0.409
Mucor spp.	108.2	0.0	0.0	0.0	0.0	0.0	108.2	0.0	108.2	0.916
Nigrospora sphaerica	0.0	0.0	0.0	0.0	8.1	4.2	8.1	4.2	12.3	0.104
Myrothecium verrucaria	45.3	0.0	3.7	0.0	3.9	0.0	52.9	0.0	52.9	0.448
Chaetomium magnum	0.0	0.0	0.0	7.7	0.0	0.0	0.0	7.7	7.7	0.065
Gliocladium roseum	36.6	0.0	35.0	0.0	0.0	35.6	71.6	35.6	107.2	0.907
Isaria cretacea	4.4	8.0	0.0	0.0	0.0	4.2	4.4	12.2	16.6	0.140
Phoma humicola	35.8	4.0	35.0	0.0	0.0	0.0	70.8	4.0	74.8	0.633
Acremonium vitis	35.8	0.0	4.0	0.0	35.6	0.0	75.4	0.0	75.4	0.638
Botryosporium sp.	0.0	0.0	3.7	0.0	0.0	3.9	3.7	3.9	7.6	0.064
Botryotrichum piluliferum	36.6	4.4	0.0	0.0	4.2	0.0	40.8	4.4	45.2	0.383
Total count	3418.3	1015.2	2608.9	1051.9	2407.0	1313.8	8434.2	3380.9	11815.1	100.0

Table 4. R/S ratios of the most dominant fungal genera around onion plants

Genera	R/S value in treatments		
	A	B	C
Aspergillus	2.84	2.82	1.99
Penicillium	2.64	3.35	1.62
Fusarium	6.53	4.56	3.21
Paecilomyces	5.42	1.60	1.41
Cladosporium	21.18	1.40	2.20
Rhizopus	0.57	5.64	2.65
Humicola	8.98	4.59	3.00
Helminthosporium	∝	1.00	26.20
Curvularia	0.55	0.00	4.49
Ulocladium	∝	1.68	0.10
Trichoderma	20.30	0.50	3.40
Verticillium	0.23	0.11	∝

Table 5. R/S ratios of the most dominant fungal species around onion plants

Species	R/S values in treatments		
	A	B	C
Aspergillus flavus	4.77	3.22	0.70
A. terreus	3.91	2.66	3.34
A. versicolor	0.83	0.71	0.46
A. ochraceous	10.20	∝	∝
A. sydowi	∝	18.72	∝
A. clavatus	∝	∝	∝
Penicillium coryophilum	30.68	4.83	2.45
P. citrinum	3.16	1.59	0.94
P. notatum	2.21	5.34	5.11
P. chrysogenum	∝	12.55	1.33
Fusarium oxysporum	16.98	3.94	41.79
Paecilomyces divaricata	7.39	5.20	2.75
Trichoderma viride	18.48	0.50	1.00

arranged in the following descending order : *A. clavatus, A. sydowi, A. ochraceous, A. candidus* and *A. niger.*

Three *Aspergillus* species were missed in all rhizosphere and soil isolations of treatment (C) although they were isolated under control conditions (treatments A and B). These were *A. sulphureus, A. okasakii* and *A. wentii* (Table 3).

Penicillium

Penicillia were the second in order of density under control conditions (Table 3). The R/S ratio (Table 4) as affected by treatment (C) was relatively less than its value under control conditions (A and B), a behaviour which indicates a slight inhibitory effect of o-cresol on Penicillia in general; a similar trend to that previously noticed in Aspergilli.

Fifteen *Penicillium* species were isolated from both (R) and (S) of treatments A and B, but only 10 were recovered from both R and S of treatment C (Table 3). *P. coryophilum* ranked first among the isolated species in treatment C. *P. rubrum* and *P. citrinum* completed with *P. coryophilum* for the first position in treatment (C). While *P. citrinum* did not reveal significant response to o-cresol treatment, as nearly the same counts for both rhizosphere and soil were recorded, *P. rubrum* was highly stimulated in the rhizosphere of treatment (C) as compared with its count in the surrounding soil.

P. chrysogenum and *P. nigricans* can be rated second in order of frequency. *P. notatum* occupied a third position. Whereas *P. funiculosum* was not reported in the surrounding soil of treatments (A) and (B), it was represented in both sites of treatment (C) in nearly the same counts. *P. purpurogenum* came fifth in the descending order of frequency in treatment (C) where the main bulk of its count was recorded from the surrounding soil. The other *Penicillium* species were of low frequency.

Five *Penicillium* species were not recorded in both R and S of treatment (C) although they appeared in controls A, B. These were *P. decumbens, P. canescens, P. duclauxi, P. oxalicum* and *P. herquei.*

Fusarium

Fusaria were third in order of density in treatment (C). The R/S ratio showed that the stimulation of *Fusarium* species in onion rhizosphere under treatment C was less than that under treatment B and much more less than that of treatment A.

The genus *Fusarium* was represented in all R isolates of treatment (C) as its frequency of occurrence was high. Also, it was of high occurrence in R of treatments A and B. *Fusarium* was of moderate occurrence in the surrounding soil of onion plants under all treatments.

Four Fusarium species were isolated from all treatments. *F. oxysporum* ranked first followed by *F. chlamydosporum*, *F. moniliforme* and *F. solani* was the last. The frequency of occurrence of the four *Fusarium* species was low in the surrounding soil of all treatments but varied in the rhizosphere.

Paecilomyces

Paecilomyces ranked fourth in order of frequency of total fungal counts in treatment (C) (Table 3). The count of the genus in R of treatment (C) was higher than that estimated in treatment (B) and less than that of treatment (A), while the surrounding soil in treatment (C) gave more fungal counts than those of treatments (A) and (B). The R/S ratio showed the same trend as in the previous three genera.

Paecilomyces was represented by two species only, *P. divaricata* which was more dominant than the other species *P. silvatica*.

Cladosporium

Cladosporium ranked fifth in order of density in treatment (C). It should be noted that the rhizosphere of o-cresol-treated plants was stimulatory to this genus more than the control treatments A & B. The R/S ratio (Table 4), was 2.2 in treatment (C), which was more than the R/S of treatment B (1.4) and very much less than the R/S of treatment A (21.7).

Cladosporium was represented by two species, *C. herbarum* and *C. epiphyllum*. In all treatments the second species dominated the first in the rhizosphere. Both species were generally of low occurrence in both R and S of all treatments.

Discussion

The course of microbial colonization of onion roots varied according to the plant age and type of treatment. The total counts of bacteria or fungi in the rhizosphere of plants pretreated with o-cresol (250 ppm) showed an expected initial inhibition as compared with the surrounding non-rhizosphere soil and/or the untreated plants. This suppression was followed by a clear stimulation. The initial inhibition is most likely attributed to the fungi toxic activity of o-cresol while the further stimulation might be due to the detoxification of the compound through biodegradation and/or its stimulatory effect, in the long run, on root exudation. McNew [14] discussed the degradation of 2, 4 D-phenoxy herbicides in the soil and he noted that the degradation of such chemicals is dependent upon the enzymatic capabilities of the microorganisms.

The results obtained in other following work by Ali et al. [10] indicated that dipping onion transplants in o-cresol solution reduced the percentage infection of onion and the average yield of bulbs increased significantly over the control value under the same condition.

References

[1] Hiltner, L. "Uber neuere Er fahrungn und probleme auf dem gebiet der boden baktgriologie und Unter besonderer Berucksichtigung der Grudungung und Brache." *Arab. Dtsch. Landw, Ges.*, 98 (1904), 59-78.

[2] Hoffman, C. "A Contribution to the Subject of the Factors Concerned in Soil Productivity." *Univ. Kansas Sci. Bull.*, 9 (1914), 81-99.

[3] Rao, A.S. "Fungal Population in the Rhizosphere of Peanut (*Arachis hypogaea* L.)." *Plant and Soil*, 17 (1962), 260-266.

[4] Martiniz, V.R. "Influence of the Maize Rhizosphere or Its Microflora." *Poeyana SERA*, 1 (1964), 1-11.

[5] Tolba, M.K. and Ali, M.I. "Studies on Rhizosphere Microflora of Cotton Plants in Egypt." *Egypt. J. Bot.*, 15 (1972), 23-43.

[6] Moubasher, A.H. and El-Dohlob, S.M. "Studies on Egyptian Soil Fungi. I. Succession of Fungi in Soil Amended with Five Organic Substances." *Egypt. J. Bot.*, 15 (1972), 175-184.

[7] Funck-Jensen, D. and Hockenhull, J. "Root Exudation Rhizosphere Microorganisms and Disease Control." *Växtskyddsnotiser*, 48 (1984), 49-54.

[8] Ali, M.I.A.; Ismail, I.M.K.; Salama, A.M. and Ouf, S.A. "Effect of Prolonged Incubation under Different Concentrations of Phenolic Compounds on Percentage Sclerotial Germination and Germtube Elongation of *Sclerotium cepivorum* Berk." *J. Coll. Sci., King Saud Univ.*, 18 (1987), 17-28.

[9] Salama, A.M.; Ismail, I.M.K.; Ali, M.I.A. and Ouf, S.A. "Soaking *Sclerotium cepivorum* in Phenolic Compounds and Their Effect on Germination, Growth and Sclerotial Formation." *Bull. Fac. Sci., Cairo Univ.*, 53 (1985), 309-319.

[10] Ali, M.I.A.; Ismail, I.M.K.; Salama, A.M. and Ouf, S.A. "Possible Control of Onion White Rot by O-Cresol and its Effect on Pectinolytic and Cellulolytic Activities." *Egypt. J. Phytopathol.* (1989), in press.

[11] Banihashemi, Z, and Dezeeuw, D.J. "Two Improved Methods for Selectively Isolating *Fusarium Oxysporum* from Soil and Plant Roots." *Plant Disease Reporter*, 53 (1969), 589.

[12] Martin, J.P. "Use of Acid Rose Bengal and Streptomycin in the Plate Method for Estimating Soil Fungi." *Soil Sci.* 69 (1950), 215-233.

[13] Skinner, F.A.; Jones, P.G. and Molsion, S. A Comparison of Direct and Plate Counts of Soil Microorganisms" *J. Gen. Microbiol.*, 6 (1952), 261.

[14] McNew, G.L. "Interrelationships between Agricultural Chemicals and Environmental Quality in Perspective." *J. Environ. Qual.*, 1 (1972), 18-22.

[15] Ingham, E.R. "Review of the Effects of 12 Selected Biocides on Target and Non-target Soil Organisms." *Crop Protection*, 4 (1985), 3-32.

[16] Nour, M.A. "A Preliminary Survey of Fungi in some Sudan Soils." *Trans. Br. Mycol. Soc.*, 39 (1956), 357-360.

[17] Ali, M.I.A. "On the Fungal Flora of Saudi Arabia; 1- Wadi Hanifa." *Bull. Fac. Sci. Riyadh Univ.*, 8 (1977), 7-20.

[18] Ali, M.I.A.; Abdel-Rahman, Tahany, M.A.; Salama, A.M. and Abo-Ellil, Amany H. "Effect of Seasonal Variations and Air Pollution by Cement Dust on Soil Fungal Population at Helwan, Egypt." *Bull. Coll. Education, Madinah Munawarah, King Abdulaziz Univ.*, 1 (1988), 59-67.

[19] El-Abyad, M.S. and Ismail, I.M.K. "General Survey of the Numbers of Microorganisms and the Genera of Fungi in Egyptian Soils and its Possible Correlation with the Fungistatic Activities of such Soils." *Egypt. J. Bot.* 21 (1978), 89-103.

[20] Dube, S.; Shukla, H.S. and Tripathi, S.C. "*In vitro* Evaluation of some Natural Products for their Toxicity." *Pesticides*, 22 (1988), 11-12.

تأثير الأورثوكريزول على التركيب الميكروبي في التربة والمنطقة الجذر محيطية لنباتات البصل المزروعة في وجود سكليروشيام سيبيفورام

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ملخص البحث. أظهـر التعداد الفطري والبكتيري في المنطقة الجذر محيطية لنباتات البصل التي سبق معاملتها بأورثوكريزول (٢٥٠ جزء في المليون) إنخفاضًا مبدئيًا عند مقارنته بالتربة المحيطة أو النباتات غير المعاملة ثم تبعه بزيادة واضحة. وكانت التربة المخلوطة باسكليروشيام سيبيفورام ذات تذبذب قليل في التعداد الفطري أو البكتيري في كلا التربة والمنطقة الجذر محيطية طوال الأشهر الخمسة.

تم عزل ٦٩ نوعًا فطريًا ينتمون إلى ٢٨ جنس إلى جانب الفطريات العقيمة. ويمكن ترتيب أجناس الفطريات المعزولة من المنطقة الجذر محيطية لنباتات البصل تبعًا لكثافة تواجدهم في التربة سواء الخالية أو المخلوطـة باسكليروشيام سيبيفورام حيث كلا المعاملتين خاليتين من اورثوكريزول مرتبة تنازليًا كالآتي: اسبرجللس (١٦ نوعًا)، بنيسيليوم (١٥ نوعًا)، فيوزاريوم (٤ أنواع)، باسيلوميسس (نوعان)، الترناريا (٣ أنـواع)، كلاد وسبوريام (نوعان)، ترايكودرما (نوعان)، الوكلاديام (نوعان)، الفطريات العقيمة، ميوكور (نوع واحد)، أجناس أخرى (١٩ نوعًا).

ونتج عن معاملة النباتات بأورثوكريزول قبل زراعتها التغييرات الآتية في فطريات المنطقة الجذر المحيطية: إما زيادة وإما نقص أو حتى غياب بعض الأجناس كلية نتيجة للمعاملة.

وفي كل المعـامـلات تم تسجيل نسبـة الفطريات في المنطقة الجذر المحيطية إلى نسبتها في التربة (R/S).