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RESEARCH ARTICLE

EFFECT OF INSECTICIDES ON THE GROWTH AND DISTRIBUTION OF SOIL MYCOFLORA IN AGRICULTURE FIELDS AT NARASANNAPETA

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ABSTRACT

The pri Pesticides have become integrated into transport and degradation processes that characterize soil ecosystems. Although, pesticides are anticipated to protect crops, they may affect non-target organisms and pollute soil environment which might result in alteration in the equilibrium of soil processes for shorter or longer periods. Eleven fungal species like *Aspergillus flavus, A.niger, A.oryzae, Curvularia lunata, Fusarium oxysporum, F.solani, Penicillium aurentiogriseum, P.chrysogenum, P.frequentans, Rhizopus stolonifer* and *Trichoderma harzianum* were selected for the study. Three commercial insecticides i.e; Dimethoate, Profenofos and Chlorpyriphos were used to study their effects on soil fungi. The study was conducted to determine the effects of insecticides application on soil fungal populations, at different application rates ranging from ½litre, 1litre and with the control soil samples having no insecticide injection. A total of 282 colonies of 11 species were isolated from the control plates examined in 3 different crops (Rice, Black-Gram and Ground-Nut) of Narasannapeta Mandal, in Srikakulam District. 230 and 158 colonies were isolated from the soils treated with ½ and 1 Lt Dimethoate. From the use of Dimethoate none of the species were extinct. 215 and 144 colonies were isolated from soils treated with ½ and 1 Lt Profenofos, and finally a total of 194 and 125 colonies were obtained from soils treated with ½ and 1 Lt of Chlorpyriphos, thus confirming Chlorpyriphos as the more destructive among the insecticides used. Application of Profenofos and Chlorpyriphos yielded similar results leading to the extinction of *F.oxysporum, F.solani* and *T.harzianum.* The results revealed that insecticide applications caused reduction in microbial population present in the soils when compared with the control.

INTRODUCTION

Soil microbial communities are affected by several conditions, one of which is usage of insecticides. Their effect varies according to the types, doses and field conditions. The application of agricultural chemicals over the last 2 decades has presented problems pertaining to the interaction of enduring pesticides of long persistence with biological systems in the environment. The water solubility and vapour pressure of an insecticide were the major factors responsible for the degree of toxicity to fungi as determined by the diameter of mycelia produced. Among the organophosphate insecticides, Selecron (Profenofos) is commonly used in Egypt for controlling the cotton leaf worm which showed a significant decrease in nitrogen fractions of *A.niger*. Nitrogen fractions of *P. chrysogenum* were significantly increased whereas protein-N was decreased. Abdel-Basset *et al.,* (1992) found that Selecron was inhibitory to the extra-cellular protein production by three cellulose decomposing fungi (*A. niger, Nectriahaematococca* and *T.harzianum*). The application of insecticides to soil to control plant diseases has become a common practice in crop production in many parts of the world. The number of reports on the effects of pesticides on non-target soil organisms is enormous (Edwards, 1988, 1989, 1992).

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MATERIALS AND METHODS

Insecticides used

Insecticides are used against the eggs and larvae of insects in all developmental forms. They fall under variety of classes like Organophosphates, Pyrethroids, Neonicotinoids, Biological insecticides and many more which are used against insects, pests etc.

Dimethoate

It is an organophosphate insecticide widely used to kill insects. Its chemical name is O,O-dimethyl S-[2-(methylamino)-2-

oxoethyl] dithiophosphate and chemical formula is $C_5H_{12}NO_3PS_2$.. The required dosage used 500ml and 1000ml diluted in 420Lt and 840Lt of water for ½Lt and 1Lt of pesticide treatment. Dimethoate is effective in disabling cholinesterase, an enzyme essential for functioning of central nervous system of insects. It is manufactured by Rallis India Limited, Akola, Maharashtra.

Profenofos

Profenofos is chemically known as O-(4-bromo-2-chlorophenyl)-Oethyl S-propyl phosphorothioate. Its chemical formula is $C_{11}H_{15}BrClO_3PS$. The required dosage used is 500ml and 1000ml of chemical diluted in 250Lt and 500Lt of water for ½Lt and 1Lt of pesticide treatment. It is effective against a wide range of chewing & sucking insects and mites on Cotton, Rice, Maize, Sugar beet, Soybeans, Vegetables, Tobacco, Oil seeds and other crops. Manufactured by Nagarjuna Agrichem Limited, Nagarjuna Hills, Punjagutta, Hyderabad, Telangana.

Chlorpyriphos

Chlorpyriphos is an organophosphate insecticide. It is chemically called as O, O-diethyl-O-3,5,6-trichloro-2-pyridl phosphorothioate. Its chemical formula is $C_9H_{11}Cl_3NO_3PS$. The required dosage as recommended and used is 500ml and 1000ml of chemical diluted in 200Lt and 400Lt of water for ½Lt and 1Lt of pesticide treatment. Manufactured by Excel Crop Care Limited, Bhavnagar, Gujarat. The study was conducted in the agricultural fields of Narasannapeta. Initially soil samples were collected for microbial analysis 20days after emergence of the plants, from 0 – 20cm depth, using an auger. The samples collected without pesticide application were used as control, after which insecticides were sprayed. Three insecticides were selected for the study. The samples were collected from these agricultural sites under rice, black-gram and groundnut cultivation, 10 days after application of insecticides. The collected samples were taken to the laboratory and stored at of 4°C until the analysis was conducted. For the enumeration of micro-fungal population dilution plate count technique (DPCT) (Waksman, 1922) was followed. Eleven fungal species were identified on account of their high frequency in these soils. Out of them 3 sp.belonged to genus *Aspergillus,* 3 belonged to *Penicillium,* 2 sp. belonged to *Fusarium,* 1 sp. belonged to *Curvularia,* and *Rhizopus. Trichoderma harzinum* though not on the list of high frequency, was selected on account for bio-control. Therefore the insecticide effect was experimented on all eleven species. Three commercial insecticides Dimethoate, Profenofos and Chlorpyriphos were used for the study.

RESULTS

The effect of pesticide application on soil fungal populations was conducted at application rates ½Lt, 1Lt and with control soil samples having no pesticide injection. Pesticide applications caused drastic reduction in microbial population Fig 9. The untreated soils had higher fungal populations than the treated soils. Hence, this indiscriminate use of pesticides leads to no beneficial soil micro-organisms to hold on to nutrient. During the study the untreated soils were collected and 11 fungal species were identified based on the number of colonies produced. The fungal diversity was examined in 3 different crops (Rice, Black Gram and Ground-Nut) of Narasannapeta. Table 1 shows the number of fungal isolates in the soil samples not treated with pesticides (insecticides), and therefore was referred to as control. A total of 282 colonies of 11 species were isolated from the control plates. The fungal population varied from one crop to another with soil samples from rice crop having the total value of 101 colony counts with a mean value of 9.18 that constitutes 35.80% and black gram crop soil having total value of 85 colony counts with a mean value of 7.72 which constitutes to 30.14% and ground nut soils with a total of 96 colony counts and mean value of 8.72 which constitutes 34.04% variations. However, there was no appreciable difference in the mean values of the fungal isolations between rice and ground nut sampled soils that are not treated with pesticides, where as little difference was seen with black gram soil samples. All the fungal species listed were present abundantly in the non-treated soils except *Fusarium oxysporum, F.solani* and *Trichoderma harzianum* which tend to be smaller in quantity. The highest percentage was that of *Aspergillus niger* (19.5%) followed by *Penicillium chrysogenum* (16.31%), *A.flavus* (15.24%), *P.aurentiogriseum* (10.63%), *P.frequentans* (10.28%), *Rhizopus stolonifer* (7.09%), *A.oryzae, Curvularia lunata* both equally with (6.02%), *Fusarium oxysporum* (3.54%), *F.solani* (2.83%) and *Trichoderma harzianum* (2.48%).

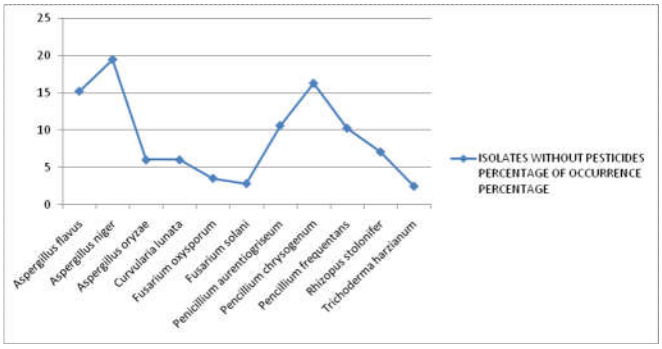

Fig. 1. Percentage of Occurrence of Fungal Colonies from Soils that were not treated with Pesticides

Fig. 2. Insecticides: (G)Dimethoate (H)Profenofos (I) Chlorpyriphos

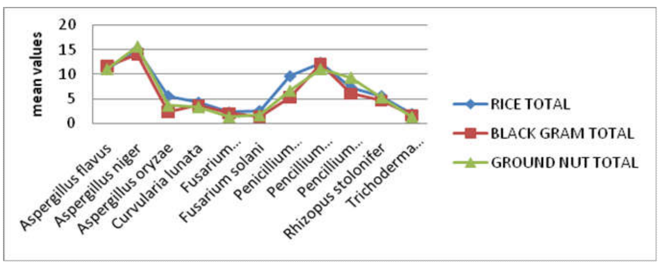

Fig. 3. Variation of Mean Values of Fungal Isolates of 3 Crop Fields according to Soil Treated with ½ LT Insecticides

Table 1. Fungi Isolated From Soil Samples Not Treated With Pesticides

S.No	Name of the Organism	Rice	Black gram	Ground nut	Mean ± SE	TOTAL	%	VSD	PSD	VPSD
1	Aspergillus flavus	14	15	14	14.33±0.33	43	15.24	0.33	0.47	0.22
2	Aspergillus niger	19	17	19	18.33±0.66	55	19.5	1.33	0.94	0.88
3	Aspergillus oryzae	7	4	6	5.66±0.88	17	6.02	2.33	1.24	1.55
4	Curvularia lunata	6	5	6	5.66±0.33	17	6.02	0.33	0.47	0.22
5	Fusarium oxysporum	4	3	3	3.33±0.33	10	3.54	0.33	0.47	0.22
6	Fusarium solani	3	2	3	2.66±0.33	8	2.83	0.33	0.47	0.22
7	Penicillium aurentiogriseum	12	8	10	10±1.15	30	10.63	4.00	1.63	2.66
8	Pencillium chrysogenum	16	16	14	15.33±0.66	46	16.31	1.33	0.94	0.88
9	Penicillium frequentans	10	7	12	9.66±1.45	29	10.28	6.33	2.05	4.22
10	Rhizopus stolonifer	7	6	7	6.66±0.33	20	7.09	0.33	0.47	0.22
11	Trichoderma harzianum	3	2	2	2.33±0.33	7	2.48	0.33	0.47	0.22
		101	85	96		282				
		9.18	7.72	8.72						

SE : Standard Error; VSD: Variance Standard Deviation; PSD: Population Standard Deviation; VPSD: Variance Population Standard Deviation

Table 2. ANNOVA for Fungi isolated from soil not treated with pesticides

Source of Variation	Sum of Square Values (SS)	Degree of Freedom (d.f)	Mean Sum of Squares (MS)	*F*	*P-value*	*F crit*
SSB	12.1818	2	6.090909	0.19861	0.820934[@]	3.31583
SSW	920	30	30.66667			
SST	932.1818	32				

Table 3. Biodiversity Indices of Fungal Species in Narasannapeta in 3 different crop soils not treated with pesticides

Index	Rice	Black Gram	Ground Nut
Simpson Index	0.1113	0.1249	0.1145
Dominance Index	0.8887	0.8751	0.8855
Shannon Index	3.227	3.12	3.192
Menhinick Index	1.095	1.193	1.123
Berger-Parker Dominance Index	0.1881	0.2	0.1979
Equitability Index	0.9327	0.9018	0.9227
Margalef Richness Index	2.167	2.251	2.191

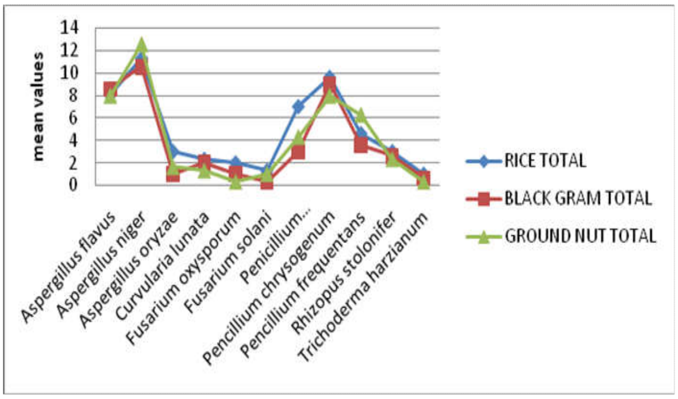

Fig. 4. Variation of Mean Values of Fungal Isolates of 3 Crop Fields according to Soil Treated with 1 LT Insecticides

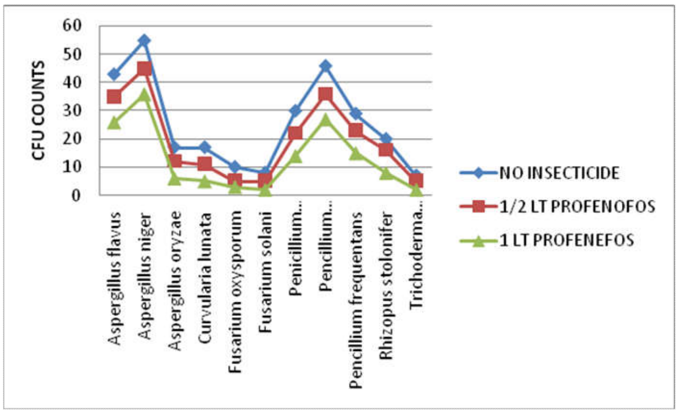

Fig. 6. Frequencies of Fungal Colonies isolated from Soil Samples Treated Without and With ½ & 1 LT Profenofos

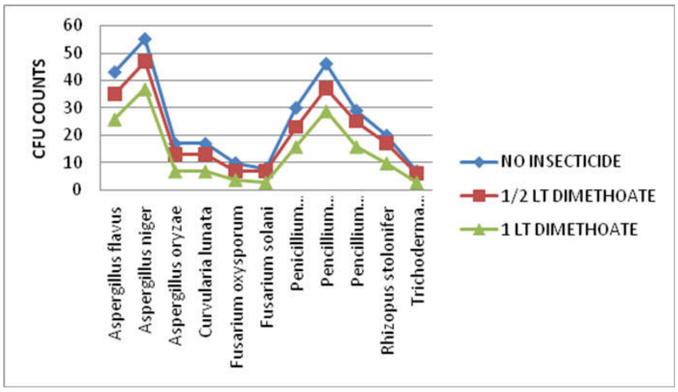

Fig. 5. Frequencies of Fungal Colonies isolated from Soil Samples Treated Without and With ½ & 1 LT Dimethoate

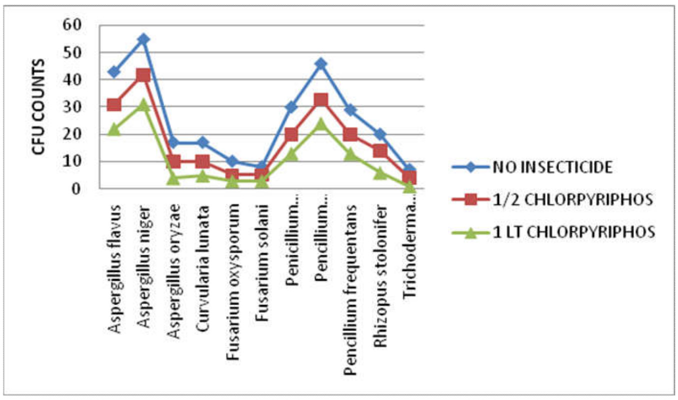

Fig. 7. Frequencies of Fungal Colonies isolated from Soil Samples Treated Without and With ½ & 1 LT Chlorpyriphos

Table 4. Fungi Isolates From The Soil Samples Treated With 1/2 Lt Insecticides

S.No	Name of the Organizm	DIMETHOATE				PROFENOFOS				CHLORPYRIPHOS			
		Rice	Black gram	Ground nut	Mean ± SE	Rice	Black gram	Ground nut	Mean ± SE	Rice	Black gram	Ground nut	Mean ± SE
1	Aspergillus flavus	12	12	11	11.66±0.33	11	12	12	11.66±0.33	10	11	10	10.33±0.33
2	Aspergillus niger	16	15	16	15.66±0.33	15	14	16	15±0.57	14	13	15	14±0.57
3	Aspergillus oryzae	6	3	4	4.33±0.88	6	2	4	4±1.15	5	2	3	3.33±0.88
4	Curvularia lunata	5	4	4	4.33±0.33	4	4	3	3.66±0.33	4	3	3	3.33±0.33
5	Fusarium oxysporum	3	2	2	2.33±0.33	2	2	1	1.66±0.33	2	2	1	1.66±0.33
6	Fusarium solani	3	2	2	2.33±0.33	2	1	2	1.66±0.33	3	1	1	1.66±0.66
7	Penicillium aurentiogriseum	10	6	7	7.66±1.20	10	5	7	7.33±1.45	9	5	6	6.66±1.20
8	Pencillium chrysogenum	12	13	12	12.33±0.33	13	12	11	12±0.57	12	11	10	11±0.57
9	Pencillium frequentans	8	7	10	8.33±0.88	8	6	9	7.66±0.88	6	5	9	6.66±1.20
10	Rhizopus stolonifer	6	5	6	5.66±0.33	6	5	5	5.33±0.33	5	4	5	4.66±0.33
11	Trichoderma harzianum	2	2	2	2±0	2	2	1	1.66±0.33	2	1	1	1.33±0.33
		83	71	76		79	65	71		72	58	64	
		7.54	6.45	6.9		7.18	5.9	6.45		6.54	5.27	5.81	

SE: Standard Error

Table 5. ANNOVA for Fungi isolated from soil of 3 crops treated with ½ LT Dimethoate

Source of Variation	Sum of Square Values (SS)	Degree of Freedom (d.f)	Mean Sum of Squares (MS)	*F*	*P-value*	*F crit*
SSB	6.60606	2	3.30303	0.15189	0.859735@	3.31583
SSW	652.3636	30	21.74545			
SST	658.9697	32				

@= probability level is not significant.

Table 6: ANNOVA for Fungi isolated from soil of 3 crops treated with ½ LT Profenofos

Source of Variation	Sum of Square Values (SS)	Degree of Freedom (d.f)	Mean Sum of Squares (MS)	*F*	*P-value*	*F crit*
SSB	8.969697	2	4.484848	0.19924	0.820424@	3.31583
SSW	675.2727	30	22.50909			
SST	684.2424	32				

@= probability level is not significant.

Table 7. ANNOVA for Fungi isolated from soil of 3 crops treated with ½ LT Chlorpyriphos

Source of Variation	Sum of Square Values (SS)	Degree of Freedom (d.f)	Mean Sum of Squares (MS)	*F*	*P-value*	*F crit*
SSB	8.969697	2	4.484848	0.23417	0.792654@	3.31583
SSW	574.5455	30	19.15152			
SST	583.5152	32				

@= probability level is not significant.

The statistical analysis of the data with p value 0.820934 indicated the frequency and percentage contribution of the selected 11 fungal species from rice, blackgram and ground-nut field soils not treated with pesticides Table 2. The Simpson's Diversity Index was lowest in the rice fields (0.1113) followed by ground nut (0.1145) and finally black-gram (0.1249). The Shannon's Index is highest in rice (3.227) followed by ground nut (3.192) and black-gram (3.12). This shows rice has the highest species diversity. The Donimance Index shows not much difference among the 3 crops studied. Menhinick's Index is high in black gram followed by ground nut and then rice similarly Berger-Parker Dominance Index is also high in black gram (0.2) followed by ground nut (0.1979) and rice (0.1881). Margalef's Richness Index is high in blackgram (2.251) followed by ground nut (2.191) and rice (2.167) which shows low species abundance in black gram and high species abundance in rice. The Equitability Index is lowest in black gram showing less species abundance in black gram Table 3.

Effect of insecticides

The insecticides Dimethoate, Profenofos and Chlorpyriphos Fig 2 were used to study the affect of insecticides on the soil mycoflora. Table 4 shows the number of fungi isolated in soil samples treated with ½Lt of Insecticides.

The insecticides have a lesser impact on fungi. Each type of insecticide has its own specific effect. The number of fungal colonies reduced, compared to control, but the effect was not so significant. From the chosen 11 spp. no spp. was extinct when ½ Lt Insecticides were used. The difference in mean values of fungi isolated from sampled soils were 7.54, 6.45 and 6.9 which constitutes percentage 36.08%, 30.86% and 33.04% for Dimethoate; and 7.18, 5.9 and 6.45 constituting a percentage 36.74%, 30.23% and 33.02% for Profenofos; and 6.54, 5.27 and 5.81 constituting percentage 37.11%, 29.98% and 32.98% for Chlorpyrifos respectively. The statistical analysis of the data with p values 0.859735, 0.820424 and 0.792654 non-significantly indicates the frequency of fungal colonies isolated from soil treated with ½LT insecticides Dimethoate, Profenofos and Chlorpyriphos depicted in Table 5, 6 & 7 respectively. Table 8 shows the number of fungi isolated in soil samples treated with 1 Lt of the three insecticides. It was observed that application of Profenofos lead to the extinction of *F.oxysporum* and *T.harzianum* in groundnut soil samples, and *F.solani* from black gram soils. During the test with Chlorpyriphos it was observed that the result of extinction was similar to that of Profenofos, along which *T.harzianum,* was also extinct from black gram soils. When compared to the control, soils of insecticides treated plants harboured lesser number of fungal colonies.

Table 8. Fungi Isolates From The Soil Samples Treated With 1 Lt Insecticides

S.No	Name of the Organizm	DIMETHOATE				PROFENOFOS				CHLORPYRIPHOS			
		Rice	Black gram	Ground nut	Mean ± SE	Rice	Black gram	Ground nut	Mean ± SE	Rice	Black gram	Ground nut	Mean ± SE
1	Aspergillus flavus	9	9	8	8.66±0.33	8	9	9	8.66±0.33	7	8	7	7.33±0.33
2	Aspergillus niger	12	12	13	12.33±0.33	12	11	13	12±0.57	10	9	12	10.33±0.88
3	Aspergillus oryzae	4	1	2	2.33±0.88	3	1	2	2±0.57	2	1	1	1.33±0.33
4	Curvularia lunata	3	2	2	2.33±0.33	2	2	1	1.66±0.33	2	2	1	1.66±0.33
5	Fusarium oxysporum	2	1	1	1.33±0.33	2	1	0	1±0.57	2	1	0	1±0.57
6	Fusarium solani	1	1	1	1±0	1	0	1	0.66±0.33	2	0	1	1±0.57
7	Penicillium aurentiogriseum	7	4	5	5.33±0.88	7	3	4	4.66±1.20	7	2	4	4.33±1.45
8	Pencillium chrysogenum	10	10	9	9.66±0.33	10	9	8	9±0.57	9	8	7	8±0.57
9	Pencillium frequentans	5	4	7	5.33±0.88	5	4	6	5±0.57	4	3	6	4.33±0.88
10	Rhizopus stolonifer	4	3	3	3.33±0.33	3	3	2	2.66±0.33	2	2	2	2±0
11	Trichoderma harzianum	1	1	1	1±0	1	1	0	0.66±0.33	1	0	0	0.33±0.33
		58	48	52		54	44	46		48	36	41	
		5.27	4.36	4.72		4.9	4	4.18		4.36	3.27	3.72	

SE: Standard Error

Table 9. ANNOVA for Fungi isolated from soil of 3 crops treated with 1 LT Dimethoate

Source of Variation	Sum of Square Values (SS)	Degree of Freedom (d.f)	Mean Sum of Squares (MS)	*F*	*P-value*	*F crit*
SSB	4.606061	2	2.30303	0.147975	0.863078@	3.31583
SSW	466.9091	30	15.56364			
SST	471.5152	32				

@= probability level is not significant.

Table 10. ANNOVA for Fungi isolated from soil of 3 crops treated with 1 LT Profenofos

Source of Variation	Sum of Square Values (SS)	Degree of Freedom (d.f)	Mean Sum of Squares (MS)	*F*	*P-value*	*F crit*
SSB	5.090909	2	2.545455	0.160244	0.85266@	3.31583
SSW	476.5455	30	15.88485			
SST	481.6364	32				

@= probability level is not significant.

Table 11. ANNOVA for Fungi isolated from soil of 3 crops treated with 1 LT Chlorpyriphos

Source of Variation	Sum of Square Values (SS)	Degree of Freedom (d.f)	Mean Sum of Squares (MS)	*F*	*P-value*	*F crit*
SSB	6.606061	2	3.30303	0.268605	0.766264@	3.31583
SSW	368.9091	30	12.29697			
SST	375.5152	32				

@= probability level is not significant.

Table 12. Biodiversity Indices of Fungal Species in Narasannapeta in 3 different crop soils treated with different types of pesticides

Index				Simpson Index	Dominance Index	Shannon Index	Menhinick Index	Berger-Parker Dominance Index	Equita-bility Index	Margalef Richness Index
Rice	Insecticides	Dimethoate	½ LT	0.1093	0.8907	3.226	1.207	0.1928	0.9324	2.263
			1 LT	0.1174	0.8826	3.12	1.444	0.2069	0.902	2.463
		Profenofos	½ LT	0.1136	0.8864	3.177	1.238	0.1899	0.9184	2.289
			1 LT	0.1244	0.8756	3.07	1.497	0.2222	0.8873	2.507
		Chlorpyriphos	½ LT	0.1111	0.8889	3.204	1.296	0.1944	0.9261	2.338
			1 LT	0.1188	0.8812	3.105	1.588	0.2083	0.8975	2.583
Black Gram	Insecticides	Dimethoate	½ LT	0.1235	0.8765	3.118	1.305	0.2113	0.9013	2.346
			1 LT	0.1445	0.8555	2.928	1.588	0.25	0.8464	2.583
		Profenofos	½ LT	0.1284	0.8716	3.067	1.364	0.2154	0.8867	2.396
			1 LT	0.148	0.852	2.854	1.508	0.25	0.8593	2.378
		Chlorpyriphos	½ LT	0.1325	0.8675	3.027	1.444	0.2241	0.875	2.463
			1 LT	0.163	0.837	2.693	1.521	0.2571	0.8494	2.25
Ground Nut	Insecticides	Dimethoate	½ LT	0.1182	0.8818	3.15	1.262	0.2105	0.9105	2.309
			1 LT	0.1342	0.8658	2.996	1.525	0.25	0.8659	2.531
		Profenofos	½ LT	0.128	0.872	3.057	1.305	0.2254	0.8835	2.346
			1 LT	0.1657	0.8343	2.689	1.342	0.2889	0.8482	2.102
		Chlorpyriphos	½ LT	0.13	0.87	3.028	1.375	0.2344	0.8753	2.404
			1 LT	0.1654	0.8346	2.676	1.423	0.3	0.8442	2.169

Among the three insecticides used, Chlorpyriphos was observed to be most effective thereby contributing to the loss of fungal spp. Table 8 shows the fungal variations with mean values 5.27, 4.36 and 4.72 constituting percentage of 36.7%, 30.37% and 32.91% in case of Dimethoate, and 4.9, 4.0 and 4.18 constituting percentage 37.5%, 30.55% and 31.94 from Profenofos and 4.36, 3.27 and 3.72 which constitute a percentage as 38.4%, 28.8% and 32.8 from Chlorpyriphos when 1 Lt were used respectively in all three crop soil samples. The statistical analysis of the data with p values 0.863078, 0.85266 and 0.766264 non-significant indicates the frequency of fungal colonies isolated from soil treated with 1

LT insecticides Dimethoate, Profenofos and Chlorpyriphos depicted in Table 9, 10 & 11 respectively. On the whole when ½LT insecticides were used the percentage in rice, black gram and ground nut soil samples were 36.61%, 30.35% and 33.02% respectively Fig 3 and when 1Lt were used 37.47%, 29.97% and 32.55% Fig 4. While 282 colonies were obtained from control soils, 230 and 158 colonies were isolated from the soils treated with ½ and 1 Lt Dimethoate. From the use of Dimethoate none of the species were extinct. 215 and 144 colonies were isolated from soils treated with ½ and 1 Lt Profenofos. And finally a total of 194 and 125 colonies were obtained from soils treated with ½ and 1 Lt of Chlorpyriphos. The individual frequencies of the 11 species were depicted in the Fig 5, 6 & 7. The affect of insecticides on fungal populations on the three agricultural soils were significantly decreased and is shown in Fig 8.

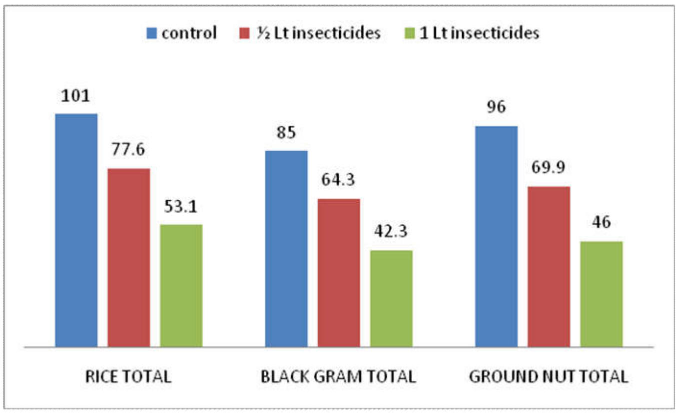

Fig. 8. Effect of insecticides

Fig. 9. Fungal colonies on PDA from soils treated with insecticides Dimethoate, Profenofos and Chlorpyriphos

The Simpson's Diversity Index was highest in 1Lt Profenofos (0.1657) followed by 1Lt Chlorpyriphos (0.1654) in ground nut indicating the less species diversity. The Simpson's Index was lowest in ½Lt Dimethoate (0.1093) in rice field. The Shannon's Index is highest in ½Lt Dimethoate (3.226) followed by ½Lt Chlorpyriphos (3.204) in rice field soils, showing the highest species diversity. The Donimance Index is highest in ½Lt Dimethoate (0.8907) followed by ½Lt Chlorpyriphos (0.8889) in rice field indicating high species dominance and high diversity and lowest in 1Lt Profenofos (0.8343) followed by 1 Lt Chlorpyriphos (0.8346) in ground nut fields indicating less diversity. Menhinick's Index is high in 1Lt Chlorpyriphos (1.588) in rice field soil and lowest in case of ½Lt Dimethoate (1.207) followed by ½Lt Profenofos (1.238) both in rice field soils, followed by ½Lt Dimethoate (1.262) in ground nut field and finally in ½Lt Chlorpyriphos (1.296) in rice field soils shows high species richness and thus diversity. Similarly Berger-Parker Dominance Index is also high in 1Lt Chlorpyriphos (0.3) and is lowest in ½Lt Profenofos (0.1899) in rice field soils. Margalef's Richness Index is high 1Lt Chlorpyriphos (2.583) in rice and 1Lt Dimethoate (2.583) in blackgram and the Index is low in case of 1Lt Profenofos (2.102) in ground nut. This shows the low species abundance and high species abundance respectively. The Equitability Index is lowest in 1Lt chlorpyriphos (0.8442) in ground nut field soils showing low species abundance and highest in ½Lt Dimethoate (0.9324) in rice field soils indicating lowest and highest species evenness respectively Table 12.

DISCUSSION

Agriculture is the backbone of Indian economy as 70% of the country's population earns its livelihood from it. India's population has increased drastically from 102.8crore to 121.1crore, according to the 2011 Primary Census Abstract. Due to this drastic increase in population there is higher demand of food leading to increase in sustainability of food production through intensive agriculture. Cowley & Lichtenstein, 1970 reported that Carbaryl or aldrin at 20pg./ml. inhibited growth of *F. oxysporum* by *37* to 44%. The initial rise in microbial counts was followed by a general decline in microbial counts. According to Sreenivasulu and Rangaswamy, 1973, there are reports of initial depression followed by recovery of microbial population in soil under insecticide treatment. They suggested that the initial recovery of the initial depression may be due to degradation and disappearance of the insecticides. A.M. Moharram *et al* 1994 reported that Selecron (Profenofos) insecticide was found to be inhibitory to cellulose production, extra-cellular protein as well as mycelial protein of *A. niger, Nectria haematococca* and *T. harzianum*. Amirkhanov*et al.,* 1994 observed that field doses of many insecticides like gamma-HCH, phoxim, cypermethrin and chlorfluazuron had inhibitory effect on soil microorganisms. Several studies (Wingfield *et al*., 1977; Lal, 1982; Pozo *et al.,* 1995) on soil microflora showed that soil characteristics may modify the effect of pesticides on microbial numbers and their biological activity. Shu-Kang Chen *et al.,* 2001 found that benomyl, captan and chlorothalonil had some inhibitory effects on soil microbial activity and biomass. Pandey and Singh, 2004 observed that insecticides also affect the population and activity of beneficial microbial communities in soil. Sohail Ahmed and Shakeel Ahmad, 2006 studied the effect of Chlorpyrifos 40EC, at 4 different concentrations and observed that addition of chlorpyrifos in plates brought a reduction in microbial population at different concentrations, which were significantly different from control. Among all the three insecticides used Chlorpyrifos proved to be the most destructive on soil microorganisms. The spore forming ability of fungi enable them to resist hard conditions like high temperature, alkalinity, and acidity etc. (Azhar M. Haleem, *et al.,* 2013). No definite conclusion can be made on the effect of insecticides on microorganisms and their associated transformations of nutrients in soil, since different groups of insecticides exhibit manifold variations in toxicity (Dr. Sonia Sethi *et al.*, 2015).

Conclusion

The soil microbial community plays a crucial role in numerous ecosystems, hence the changes in the community affects the ecosystem. Continues use of pesticides in agriculture and remnants of persistent pesticides used in the past, form a diffused low level contamination. Man is damaging his environment by this injudicious use of pesticides to overcome problem of controlling insects, diseases etc. From the study it was evident that few of the species like *F.oxysporum, F.solani* and *T.harzianum* have become extinct. Among the three insecticides used Chlorpyriphos was observed to be more effective. Thus Application of these insecticides to agricultural soils may affect the composition of the microbial communities and thus disturb the fertility of the soil.

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