ISSN: 0976-3031

Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 8, Issue, 4, pp. 16415-16418, April, 2017

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Research Article

IMPACT OF SELECTED INSECTICIDES AND FUNGICIDES ON PHOSPHATASE ACTIVITY IN GROUNDNUT (*ARACHIS HYPOGAEA L.*) SOILS

Madhavi, A and Rangaswamy, V*

Department of Microbiology, Sri Krishnadevaraya University, Anantapuramu, Andhra Pradesh, India

DOI: http://dx.doi.org/10.24327/ijrsr.2017.0804.0143

ARTICLE INFO

Article History:

Received 05th January, 2017
Received in revised form 08th February, 2017
Accepted 10th March, 2017
Published online 28st April, 2017

Key Words:

Xenobiotics, Oxydemeton Methyl, Emamectin Benzoate, Dithane-Z-78, Benlate and Groundnut (*Arachis hypogaea* L.) soils.

ABSTRACT

Many xenobiotic compounds have long-term stability in soil, and their persistence results in significant impact on the soil ecosystem. A laboratory study was done to determine the impact of two selected insecticides, Oxydemeton Methyl (Organophosphorus), Emamectin Benzoate (Evermectin) and two selected fungicides Dithane-Z-78 (Dithiocarbamate), Benlate (Benzimidazole) on phosphatase enzyme activity in two different soil samples (Black clay soil and Red sandy loam soil) of Groundnut (*Arachis Hypogaea* L.) cultivated fields in Anantapuramu district of Andhra Pradesh, India. The soil samples were treated with insecticides and fungicides at five different concentrations i.e., 10, 25, 50, 75,100 ppm, which are equivalent to field application rates (1.0, 2.5, 5.0, 7.5, 10.0 kg ha^{-1}). We observed that phosphatase enzyme activity significantly enhanced at 2.5 kg ha^{-1} in both the soil samples after 10 days of incubation. After the prolonged incubation upto 30 and 40 days, there was a decline in phosphatase enzyme activity, However stimulation was observed with four pesticides incubated for 20 days at 2.0 $kgha^{-1}$.

INTRODUCTION

Pesticides have become an integral part of our modern life as a part of pest control strategies. Groundnut (*Arachis hypogaea L.*) is an important oil seed crop out of nine oil seeds crops grown in our county. The increased use of pesticides in agricultural soils cause soil contamination. Enzymes are the vital activators in life processes, like wise in the soil they are known to play a substantial role in maintaining soil health. These enzymes play key biochemical functions in the overall process of organic matter decomposition in the soil system. Many of the pesticides used are persistent soil contaminants, whose impact may endure for decades and adversely affect soil conservation (Quazi *et al*, 2011; Defo *et al*, 2011; Ahemad and khan, 2011a,b). Study of soil enzymes gives information about the release of nutrients in soil. Soil enzymes analysis helps to establish correlation with soil fertilization, microbial activity and biochemical cycling of various elements in soil.

The pesticides selected for the present study are Oxydemeton Methyl, Emamectin Benzoate, Dithane- Z-78 and Benlate. They influence soil phosphatase enzyme activity in Black and Red groundnut soils. The phosphatase enzyme activity by influence of these four chemicals was recommended by Agriculture Department for control of pests on crops (Anonymous, 2016)

MATERIALS AND METHODS

Soils and pesticides

Black and Red soils are collected from Groundnut fields of Anantapuramu district to a depth of 12 cms, air dried and brought to the laboratory in sterile polythyene bags for soil experiments. Details of soil properties and pesticides used are mentioned in Table 1 and 2.

Soil incubation studies

The soil ecosystem stimulating non-flooding conditions consisting of 2g portions of soil samples were added to test tubes (10 ×150mm) and moisture to a water potential of 0.090 Mpa, in order to maintain 60% water holding capacity. The same model was used previously to elucidate the effect of pesticides on microbial activity (Jayamadhuri and Rangaswamy 2003 and Madakka *et.al* 2011)

Phosphatase activity

Two gram portions of each soil, in triplicates were treated with selected pesticides at five different concentrations i.e., 1.0, 2.5, 5.0, 7.5 and 10 kg ha^{-1}. Soil samples without pesticide

*Corresponding author: **Rangaswamy, V***
Department of Microbiology, Sri Krishnadevaraya University, Anantapuramu, Andhra Pradesh, India

treatment served as control. Soil samples in test tubes with and without pesticide treatment were incubated at room temperature in the lab (28 ± 4 ºC). After 10 days of incubation, soil extract was prepared in distilled water for assay of phosphatase as per Rangaswamy and Venkateshwarulu, 1996.

Assay of Phosphatase

Soil samples were transferred to 100 ml Erlenmeyer flask and 0.2 ml of toluene, 6 ml of 0.1M maleate buffer (pH 6.5), and 2 ml of *p*-nitrophenyl phosphate disodium salt were added. The flask were swirled for a few seconds to mix the contents, stoppered and incubated at 37 ºC for 30 min. The reaction was stopped by adding 1ml of 0.05 M $CaCl_2$ and 4 ml of 0.05M NaOH followed by swirling of the flask, for a few seconds and the soil suspension was filtered through a Whatmann No.1 filter paper. The liberated *P*-nitrophenol in the filtrate was determined at 410 nm in Thermo Scientific-Evolution 201 u.v/visible Spectrophotometer.

Statistical Analysis

The concentration of phosphatase was calculated on soil weight (oven dried basis). The pesticide treatments were contrasted with untreated controls and the significant level $P \leq 0.05$ between values of each sampling and each pesticide were assessed using SYSTAT statistical software package to find the results of one-way analysis of variance (ANOVA) followed by Duncan's multiple range test (DMRT) (Jaffer *et al*, 2010).

RESULTS AND DISCUSSION

Phosphatases are a group of enzymes that catalyse the hydrolysis of both esters and anhydrides of phosphoric acid. The mineralization of organic phosphorous by the activity of phosphatase in soils makes one of the essential elements, phosphorous in soil for plant growth (Li *et al*, 2004).

Table 1 Physico-chemical properties of soils used in the present study

Properties	Black clay soil	Red sandy loam soil
Sand(%)	76.5	72.0
Silt (%)	18.0	25.0
Clay(%)	5.5	3.0
pH a	8.4	6.3
Water holding capacity (ml g^{-1} soil)	0.48	0.34
Electrical conductivity (m.mhos)	266	246
Organic matter b(%)	0.94	0.801
Total nitrogen c (%)	0.05	0.034
NH_4^+ - N(µ g^{-1} soil)[d]	8.95	7.80
NO_2^- - N (µ g^{-1} soil)[e]	0.51	0.35
NO_3^- -N(µ g^{-1} soil)[f]	1.04	0.99

[a]1:1.25 (soil:water)
[b]Walkley-Black method (Jackson, 1971)
[c]Micro-Kjeldhal method (Jackson, 1971)
[d]Nesslerization method (Jackson, 1971)
[e]Diazotization method (Barnes and Folkard, 1951)
[f] Brucine method (Ranney and Bartler, 1972)

Hence, phosphatase enzyme activity was measured under the influence of two insecticides Oxydemeton Methyl and Emamectin Benzoate, and two fungicides Dithane- Z-78 and Benlate. So the data obtained from these experiments are presented in the tables 2-5. Phosphatase activity increased in all individual tested pesticide- treated soils throughout the experiment. The stimulation in the activity of phosphatase increased up to 2.5 kg ha^{-1} and then turned down in both black and red soils after 10 days of incubation (tables 3 and 4).

Table 2 Details of the pesticides used in the present study

Technical name	Commercial name	Chemical class	Commercial formulation	Sources
Oxydemeton Methyl	Metasystox	Organo phosphorous	25% EC*	UPL Ltd, Gujarat.
Emamectin Benzoate	EM-1	Evermectin	5% SG**	Dhanuka |Agritech Ltd, Gurgoan.
Benlate	Benofit	Benzimidazole	50% WP***	Coromandal International Ltd, Secunderabad.
Dithane –Z-78	Zineb	Dithio carbamate	75%WP***	Indofil chemicals company, Maharastra.

*Emulsifying concentration ** Soluble Granules *** Wettable powder

Table 3 Effect of different concentrations of selected pesticides on activity of phosphatase * in Black soil after 10 days

Concentration of pesticides (Kg ha^{-1})	Oxydemeton Methyl	Emamectin Benzoate	Dithane-Z-78	Benlate
0.0	97 ± 1.632 d	98 ± 2.209 d	97 ± 1.622 d	98 ± 1.13 d
1.0	110 ± 2.661 c	111 ± 1.421 b	112 ± 442 c	120 ± 3.333 b
2.5	140 ± 2.731 a	144 ± 1.123 a	155 ± 332 a	145 ± 2.886 a
5.0	120 ± 2.361 b	110 ± 4.343 b	125 ± 2.776 b	102 ± 1.154 c
7.5	99 ± 1.531 d	95 ± 2.123 d	99 ± 1.732 d	95 ± 2.866 d
10.0	88 ± 2.842 e	89 ± 2.886 c	90 ± 1.632 e	91 ± 1.732 d

*µ g P – nitrophenol (PNP)g^{-1} soil formed after 3 hours incubation with P- nitrophenyl phosphate (PNPP)
Each column is mean ± S.E. for 6 concentrations in each group;
Means, in each column, followed by the same letter are not significantly different ($P \leq 0.05$) from each other according to DMR test.

Table 4 Effect of different concentrations of selected pesticides on activity of Phosphatase* in red soil after 10 days

Concentration of insecticides (Kg ha^{-1})	Oxydemeton Methyl	Emamectin Benzoate	Dithane-Z-78	Benlate
0.0	60 ± 1.32 d	60 ± 1.32 e	60 ± 1.32 c	60 ± 1.32 d
1.0	76 ± 2.742 c	80 ± 4.322 c	77 ± 1.122 b	83 ± 1.521 c
2.5	105 ± 5.723 a	102 ± 5.321 a	99 ± 0.577 a	110 ± 0.521 a
5.0	82 ± 1.134 b	88 ± 1.154 b	80 ± 5.732 b	90 ± 8.214 b
7.5	70 ± 5.773 d	70 ± 3.881 b	70 ± 5.776 c	69 ± 0.532 d
10.0	55 ± 2.88 a	66 ± 3.841d	60 ± 5.341 c	66 ± 0.222 c

*µ g P – nitrophenol (PNP)g^{-1} soil formed after 3 hours incubation with P- nitrophenyl phosphate (PNPP)
Each column is mean ± S.E. for 6 concentrations in each group;
Means, in each column, followed by the same letter are not significantly different ($P \leq 0.05$) from each other according to DMR test.

As increase in the concentration of the pesticides, the stimulation of the enzyme activity was decreased after 2.5 kg ha^{-1}. This enzyme activity continues up to 20 days of incubation and no declines afterwards (Table 5). Enhancement in phosphatase activity over control was recorded in Black and Red soils treated with Oxydemeton Methyl, Emamectin Benzoate, Dithane- Z-78 and Benlate at concentrations of 1.0 and 2.5 kg ha^{-1} by the end of 10 days incubation, respectively (Table 3 and 4). The phosphatase activity was enhanced in both soils with and without pesticides upon further incubation for another 10 days (20- day interval). At 20-days interval, slight increment in the phosphatase activity in both soils with or without pesticides occurred in comparison to the activity of the respective increment at 10-day interval (Table 5).

Table 5 Influence of selected Pesticides on phosphatase activity* in black and red soils.

	Soil incubation, in days			
	10 days	**20 days**	**30 days**	**40 days**
	Black soil			
Control	97 ± 1.632 a	120 ± 4.773 a	110 ± 4.341 a	80 ± 4.342 a
Oxydemeton Methyl (2.5 kg ha^{-1})	140 ± 2.73 b	170 ± 4.783 b	155 ± 2.781 b	130 ± 5.721 b
Emamectin Benzoate (2.5 kg ha^{-1})	144 ± 1.123 b	177 ± 1.321 c	140 ± 4.832 b	125 ± 5.771 b
Zineb (2.5 kg ha^{-1})	155 ± 3.32 f	175 ± 2.886 c	155 ± 2.866 c	110 ± 4.732 c
Dithane-Z-78 (2.5 kg ha^{-1})	145 ± 2.886 b	165 ± 2.834 d	152 ± 1.154 b	121 ± 3.421 b
	Red soil			
Control	60 ± 1.32 a	89 ± 0.577 c	50 ± 5.773 d	42 ± 1.542 d
Oxydemeton Methyl (2.5 kg ha^{-1})	76 ± 2.72 b	120 ± 5.773 b	90 ± 5.772 c	70 ± 5.773 c
Emamectin Benzoate (2.5 kg ha^{-1})	105 ± 5.723 c	135 ± 2.866 a	120 ± 8.547 a	98 ± 7.154 a
Zineb (2.5 kg ha^{-1})	82 ± 1.134 d	125 ± 2.886 b	105 ± 2886 b	72 ± 1.154 c
Dithane-Z-78 (2.5 kg ha^{-1})	70 ± 1.342 b	131 ± 0.577 a	100 ± 5.773 b	81 ± 0.577 b

*µg P – nitrophenol (PNP)g^{-1} soil formed after 3 hours incubation with P- nitrophenyl phosphate (PNPP)
Each column is mean ± S.E. for 6 concentrations in each group;
Means, in each column, followed by the same letter are not significantly different ($P \leq 0.05$) from each other according to DMR test.

The present results indicating stimulation in phosphtase activity at 2.5 kg ha^{-1} in both Black and Red soils (Table 3 and 4). After this concentration, increase in concentration of pesticides decreases the stimulation of enzyme activity. Phosphatase acitivity was improved in both the soils upon further incubation for another 10 days (20-day interval). Phosphatase activity declined in both pesticides- amended and control soils for further incubation for another 10 days (30- day interval). The release of *p*-nitrophenol from paranitrophenyl disodium ortho phosphate was significantly higher in Black clay soil when compared to Red soil (Table 5). Similarly, Mancozeb N_{10} {10 times the normal application (60 kg ha^{-1})} brought about a 41% stimulation in activity after 14 days of incubation compared to control. But, after 28 days of incubation a 30% decrease in enzyme activity was recorded (Rasool and Zafar, 2010). In the pot study alkaline phosphatase activity was inhibited by swing at high doses and stimulated by unix (Jastrzebska and Kucharski, 2007). (*Gopal et al*, 2007) showed that 10 % of Azadirachtin granules at all doses exerted suppressive effect on phosphatase activity. Interestingly, (Quian *et al*, 2007) reported that the Validamycin stimulated its activity higher than that of control, only highest dose stimulated acid phophatase activity by 29.7%. The Cadmium reduced the activity of phosphatase at early incubation time (1-7 days), while the reduction almost disappeared at the end of the incubation (Wang *et al*, 2007). When Cd (10 mg kg^{-1}) was combined with butachlor (50 and 100 mg kg^{-1}), the acitivity of phosphatase became lower than without combination at early incubation time, which indicated that the toxicity of Cd significantly increased ($P < 0.05$ or 0.001). However, when Cd (10 mg kg-1) was combined with butachlor (10 mg kg^{-1}), the activity of phosphatase became higher than those without combination at the end of the incubation, which indicated that the toxicity of Cd decreased. (Piotrowska-Seget *et al*, 2008) noticed that the acid and alkaline phosphatase activities were significantly reduced by soil treatment with captan. Obviously, phosphatase activity is instability in the beginning of 2 to 4 weeks incubation along with decomposing of mixed pesticides of deltramethrin and probineb in soil, and decline to last part of 12 weeks incubation (Rahmansyah *et al*, 2009). (Wang *et al*, 2009) showed that the phosphatase activity in copper concentrations of orchard soils significantly increased with increasing orchard ages ranging from 21.8 to 141 mg kg^{-1}, and the $CaCl_2$- extractable soil Cu concentrations varied from 0.00 to 4.26 mg kg^{-1}. The soil mean C_{mic} values varied from 43.6 to 116 mg kg^{-1} in the orchard soils, and were lower than the value of the reference soil (144 mg kg^{-1}). The ratio of soil C_{mic} to total organic C (Corg) increased from 8.1- to 18.3 mg C_{mic} g^{-1} corg with decreasing orchard ages, and was 26.1 mg C_{mic} g^{-1} Corg for the reference soil. A significant correlation was observed between total or $CaCl_2$- extractable soil Cu and soil C_{mic} or C_{mic}/Corg, suggesting that the soil Cu was responsible for the significant reductions in C_{mic} and C_{mic}/Corg. On the other hand (Cycon *et al*, 2010) reported that the acid and alkaline phosphatase was more sensitive to mancozeb + dimethomorph at 1500mg kg^{-1} and its activity declined in both loamy soils and sandy loam soils. However, mancozeb, endosulfan and chloripyrifos at 100 mg/ kg inhibited 50% activity of phosphatase (Sharma *et al*, 2010.) Similarly, (Suryakalyani *et al*, 2010) observed that acid phosphatase activity enhanced 1.8 times, respectively by the 14th day of incubation with 1ppm endosulfan.

CONCLUSION

The application of the selected pesticides Oxydemeton Methyl, Emamectin Benzoate, Dithane- Z-78 and Benlate to soils increased the phosphatase enzyme activity upto 2.5 kg ha^{-1} and decreased the enzyme activity when increased the pesticide concentration in both soils. Stimulation and pronounced activity of phosphatase by selective pesticides was noticed at 20 day period of incubation. Prolonged incubation upto 40 days of pesticide treated soils on the enzyme activity showed no effect. These results of the present study clearly indicate that these pesticides widely used in the cultivation of groundnut, at field application rates, enhance the activity of phosphatase enzyme in black and red soils of Anantapuramu District, Andhra Pradesh, India.

Acknowledgements

We are thankful to University Grants Commission (UGC), New Delhi for financial assistance by sanctioning UGC-MRP (43-470/2014(SR)), dated October, 2015. The authors were also thankful to Department of Microbiology, Sri Krishnadevaraya University, Anantapuramu, Andhra Pradesh, India for providing all necessary facilities to carryout my research work.

References

Anonymous 2016. Agricultural production plan for Anantapuramu district for Kharif season, Department of Agriculture, Anantapur, A.P, India.

Ahemad, M., and Khan, M.S. 2011a. Assessment of plant growth promoting activities of *Rhizobacterium Pseudomonas putida* under insecticide-stress. *Microbiology Journal* 1, 54-56.

Ahemad, M., and Khan M.S. 2011b. Effects of insecticides on plant-growth-promoting activities of phosphate-solubilizing rhizobacterium *Klebsiella sp*. Strain PS19. *Pesticide Biochemistry and Physiology* 100, 51-56.

Defo, M.A., Njine, T., Nola, M., and Beboua, F.S. 2011. Microcosm study of the long term effect of endosulfan on enzyme and microbial activities on two agricultural soils of Yaounde-Cameroon. *African Journal of Agricultural Research* 6, 2039-2050.

Gopal, M., Gupta, A., Arunachalam, V., and Magu, S.P. 2007. Impact of azadirachtin, an insecticidal allelochemical from neem on soil microflora, enzyme and respiratory activities. *Bioresource Technology* 98, 3154-3158.

Jaffer Mohiddin, G., Srinivasulu, M., Madakka, M., and Rangaswamy, V. 2010. Influence of insecticides on the activity of amylase and cellulase in groundnut (*Arachis hypogaea L.)* soil. *Ecology Environment and Conservation* 16, 383-388.

Jastrzebska, E., and Kucharski, J. 2007. Dehydrogenases, urease and phosphatases activities of soil contaminated with fungicides. *Plant soil Environment 53*, 51-57.

Jaya Madhuri, R., and Rangaswamy, V. 2003. Influence of selected fungicides on microbial population in groundnut (*Arachis hyopogeae L.)* soils. *Pollution Research* 22, 205-212.

Li, Y., Guohua, M., Fanjun, C., Jianhua, Z., and Fusuo, Z. 2004. Rhizosphere effect and root growth of two maize (*Zea mays* L.) genotypes with contrasting P efficiency at low P availability. Plant Sci. 167: 217-223.

Madakka, M., Jaffer Mohiddin, G., Srinivasulu, M., and Rangaswamy, V. 2011. Influence of Pesticides, Alone and in Combination, on Phosphatase Activity in Soils Groundnut (*Arachis hypogaea L.)* Fields. Dynamic Soil Dynamic Plant, (IN PRESS).

Piotrowska, S.Z., Engel, R., Nowak, E., and Jacek, K.J. 2008. Successive soil treatment with captan or oxytetracycline affects non target microorganisms. *World Journal of Microbiology and Biotechnology* 24:2843-2848.

Qian, H., Hu, B., Wang, Z., Xu, X., and Hong, T. 2007. Effects of validamycin on some enzymatic activities in soil. *Environmental Monitoring and Assessment* 125, 1-8.

Quazi, S., Datta, R., and Sarkar, D. 2011. Effects of soil types and forms of arsenical pesticide on rice growth and development. *International journal of Environmental Science and Technology* 8, 445-460.

Rahmansyah, M., Antonius, S., and Sulistinah, N. 2009. Phosphatase and Urease instability caused by pesticides present in soil improved by grounded rice straw. *ARPN Journal of Agricultural and Biological Science* 4, 56-62.

Rangaswamy, V., and Venkateswarlu, K. 1996. Phosphatase activity in groundnut soils as influenced by selected insecticides. *Journal of Environmental Biology* 17, 115-119.

Rasool, N., and Zafar Reshi, A. 2010. Effect of the fungicide mancozeb at different application rates on enzyme activities in a silt loam soil of the Kashmir Himalaya, India. *Tropical Ecology 51*, 199-205.

Sharma, ID., Chadel, R.S., Kaushal, R., Patyal, S.K., and Sharma, P.L., 2010. Effect of pesticides on biochemical properties of tomato (*Solanum lycopersicon*) cropped soil. *The Indian Journal of Agricultural Sciences* 80, (7) 640-4.

Surya Kalyani, S., Sharma, J., Dureja, P., Singh, S., Lata, Y.X.Z. 2010. Influence of endosulfan on microbial biomass and soil enzymatic activities of a tropical alfisol. *Bulletin of Environmental Contamination and Toxicology* 84,351-6.

Wang, J., Lu, Y., Ding, H., and Shen, G. 2007. Effect of cadmium alone and in combination with butachlor on soil enzymes. *Environmental Geochemistry and Health* 29, 395-403.

Wang Q-L., Zhou D-M., and Cang, L. 2009. Microbial and enzyme properties of apple orchard soil as affected by long-term application of copper fungicide. *Soil biology and Biochemistry* 41, 1504-1509.

How to cite this article:

Madhavi, A and Rangaswamy, V.2017, Impact of Selected Insecticides and Fungicides on Phosphatase Activity In Groundnut (Arachis Hypogaea l.) Soils. *Int J Recent Sci Res.* 8(4), pp. 16415-16418.
DOI: http://dx.doi.org/10.24327/ijrsr.2017.0804.0143

****