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Research Article

PHYTOTOXICITY OF PROFENOFOS 50% EC (CURACRON 50 EC) TO *VIGNA RADIATA*, L. SEEDLINGS: II. STUDIES ON BIOCHEMICAL PARAMETERS

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Abstract

Profenofos 50% EC (curacron 50 EC) is a hazardous pesticide commonly used in agriculture is also an important contaminant of environment. Its presence in biological system has gained importance due to bioaccumulation in food chain. The phyto-toxic effect of profenofos was assessed based on the biochemical parameters (Shoot and Root) of seedlings (Amino acids, Protein, Sugar, DNA and RNA) of the test species, Vigna radiata,L. The concentrations of pesticide chosen were based on EC50 and are in the range of 0.02, 0.05, 0.08, 0.1 and 0.2 % of profenofos. The biochemical parameters like Amino acid, Sugar, DNA and RNA were significantly reduced with increase in pesticide concentration whereas Protein concentration increased with the profenophos treatment. The increase in amino acid was more pronounced in Shoot of the seedlings than root.

Key words: Profenofos; organophosphate; seedlings; biomolecules

Introduction

Pesticides of various categories are frequently used against a number of pests, in the field to increase the crop production, though these chemicals are highly toxic and represent a risk for the non-target organisms and finally finding their way to the food chain .Profenofos (O-4-bromo-2-chlorophenyl-O-ethyl S-propyl phosphorothioate), is a broad-spectrum organophosphate pesticide used widely for agricultural and household purposes in India and other countries. Profenofos (PFF) had been investigated to be highly toxic to different organisms including mammals insects and fish. It also has been classified as moderately hazardous(toxicity class II) pesticide by WHO and it has a moderate order of acute toxicity following oral and dermal administration.(WHO, 1990 & 2001) Organophosphates, including chlorpyrifos, are the most hazardous water pollutants, which have already led to biotope pollution in some regions. Since 1965, chlorpyrifos has been in use throughout the world (Anonymous 1, 2012). According to Pascoe (1993), those methods have been improved regarding their sensitivity, precision and accuracy but they are not sufficient to assess the effects on living organisms and bioavailability. Therefore, it is necessary to involve biological tests, namely bio-indicators, in risk assessment and water contamination detection.

Literature is rich in information referring to the phytotoxic and inhibitory effects of herbicides on germination, root and shoot growth (Boutin *et al*., 2004, White and Boutin, 2007), as well as the effects of seed-coating fungicides on germination (Klokocar-Smit, 1991, Stevanovic *et al*., 2009a, 2009b)**.**However, very few reports can be found on the effects of insecticides, especially organophosphates, on these seed and plant traits.

Keeping a view on the above literature available on the phytotoxocity of organophosphates. Here an attempt has been made to find out the effects of an organophosphate, Profenofos on the seedlings of *Vigna radiata*, L. (mung)

Materials and Methods

Experimental Protocol

Selection of profenofos concentration

The concentrations of pesticide, Profenofos chosen were, 0.02, 0.05, 0.08.=, 0.1 and 0.2%. A control set was maintained with distilled water only for comparison purpose.

Selection of test seed

The prime pulse seed *Vigna radiata*, var.PDM 139 Samart commonly used in eastern state of India, particularly Odisha State has been chosen for study. Healthy seeds of Vigna radiata, were obtained from OUAT Extension Ratnapur, Ganjam for the experimentation.

A standard filter paper method was used. Mung seeds (20 per replication) were placed in Petridishes (6″) on filter paper moistened with 10 ml of test solution. The mung seeds surface sterilized with sodium hypo chloride for 10 minutes and were incubated in the dark at 25±2 °C for 7 days in Seed Germinator (REMI-6C).

After seven days the following assessments were made on Biochemical parameters like Protein (Lowary et al., 1957), Amino Acids (Moore and Stein, 1948), DNA and RNA (Schmeider, 1957) and Sugar (Yoshida *et al.*,1972) following standard procedures. The experiment was set in three replicates.

Statistical Analysis

The data are expressed as mean values of (n=5) and were analyzed employing Correlation Analysis to determine whether the values were significantly different from control at 0.05P with 4 d.f. (XLSTAT 2015 software)

Results

The observations made in relation to morphological traits and phyto-pigments are given in Fig. 1-5, showing the correlation analysis of profenofos concentration (%) and parameters studied. Fig. No.-1 shows the effect of profenofos on Protein content of Shoot and Root of 7days old Mung seedlings recorded after 96h of treatment under laboratory conditions. It was found that , there is a gradual increase in protein content in both shoot and root with the increase in profenofos concentration and response of Root was less than shoot with the increase in profenofos treatment.

Fig. 2-5 showed the declining trend in DNA, RNA, Amino Acids and Sugar content in root and shoot of 7days old seedlings after profenofos exposure. All the parameters decreased with the increase in profenofos concentration. The decline in DNA and RNA content in Shoot of the seedling with the profenofos exposure was more pronounced in comparison to Root. However, an exception was found in case of 0.02% profenofos treatment where it elevated the parameters studied.

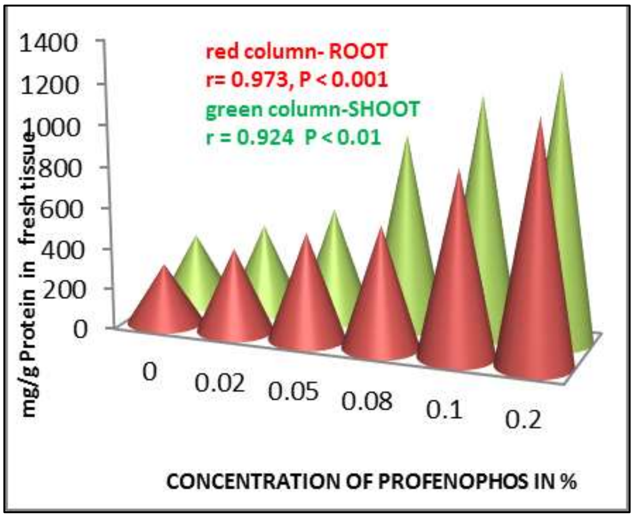

Fig. 1: Changes in protein content in 10d old seedlings of *V. radiata* after profenophofos treatment

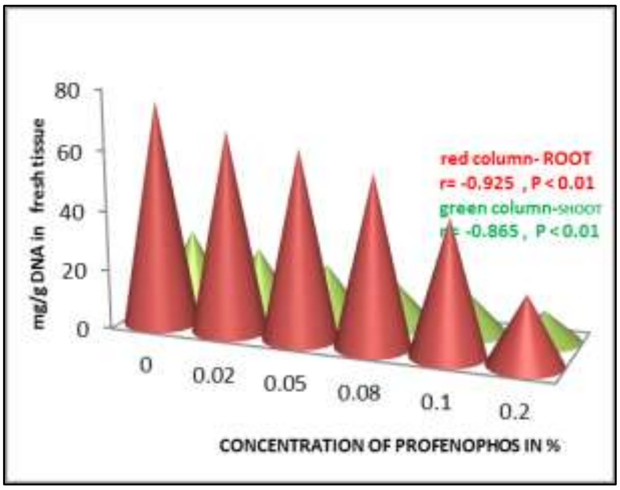

Fig. 2: Changes in DNA content in 10d old seedlings of *V. radiata* after profenophofos treatment

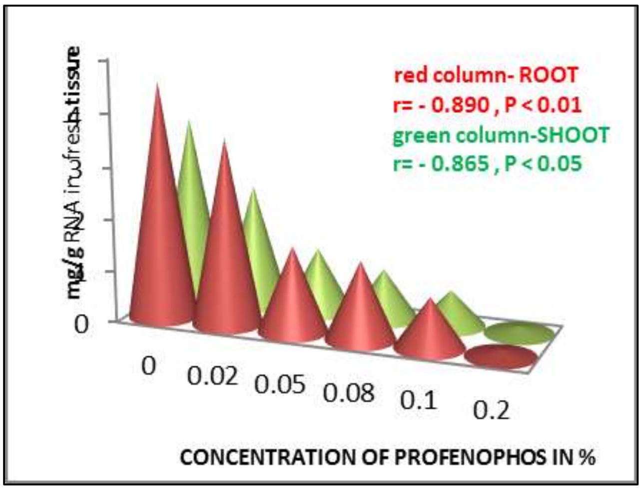

Fig. 3: Changes in RNA Content in 10d Old Seedlings of *V. radiata* after profenophofos treatment

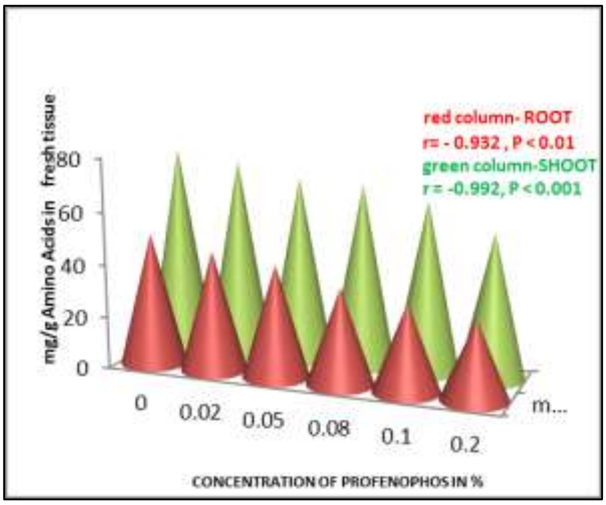

Fig. 4: Changes in amino acid content in 10d old seedlings of *V. radiata* after profenophofos treatment

The correlation analysis (r values) was carried out between each parameter observed with the Concentration of Profenofos (%) are given in Fig No.1-5..The biochemical traits like DNA, RNA, Amino Acids and Sugar showed a statistically significant result.

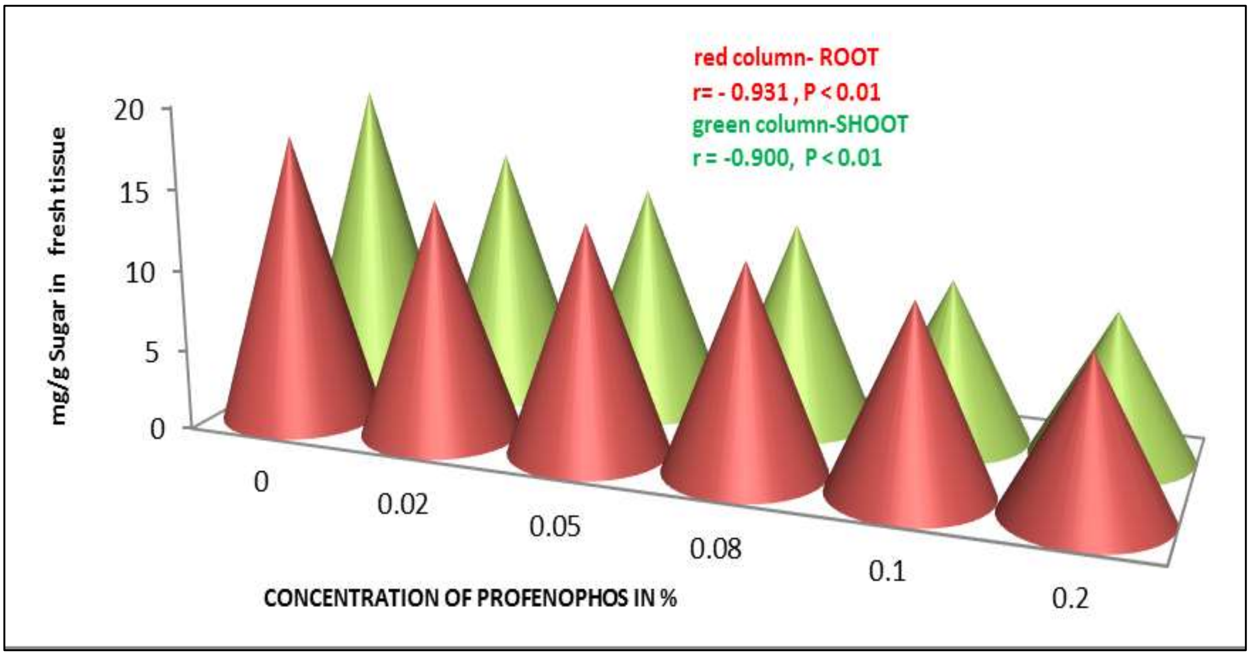

Fig. 5: Changes in Sugar Content in 10d Old Seedlings of *V. radiata* after profenophofos treatment

Discussion

Extensive use of organophosphorus insecticide profenofos (PFF) for agricultural and house-hold purposes has led to serious environmental pollution, with potential risk to organisms in the ecosystem. This study examined the toxicity of PFF to the soil springtail Folsomia *candida* and ammonia-oxidizers through a series of toxicity tests conducted on two agricultural soils. The results of the acute toxicity tests suggested that the survival of *F. candida* could be considered as the most suitable bio indicator for fast screening of PFF toxicity because of its fast and easy test procedure.

The growth and fruiting pattern of cotton plants were noticeably altered in association with the use of two systemic organophosphorus insecticides. Phorate was applied as a seed treatment, and phorate and Di-Syston®(*O*,*O*-diethyl *S*-[2-(ethylthio)- ethyl] phosphorodithioate) were applied as granular formulations in the soil either at planting time or in June. Phorate treatments at planting time delayed seedling emergence and reduced the /lumber of plants per acre at one or more locations, and resulted in greater plant height and leaf size in all tests. Insect and spider mite control obtained with these materials apparently was not a contributing cause for growth and fruiting differences**.**(Leigh,1963)

Insecticide mixtures viz., Roket, colphos, Nimbicidine + Biolep, eucalyptus + lemon grass oil + neem oil and profenofos (organophosphate insecticide) generally used against *Helicoverpa armigera* significantly increased chlorophyll content 'a' in chickpea leaves while application of endosulfan + Biolep showed sharp decline in chlorophyll content 'a'. Endosulfan at 0.07% concentration with 0.5% Biolep proved more toxic to chlorophyll content 'a' than endosulfan at 0.05%.(Srivastava *et al*., 2006).

The organ phosphorus compounds are taking the major share of insecticide consumption in India **(**Aditya *et al.,* 1997). Chlorpyrifos is abroad-spectrum organophosphate insecticide being used for more than a decade to control foliar insects that affect agricultural crops, to reduce pod damage (Khan *et al.*, 2009; Wu and Laird 2003; Rusyniak and Nanagas 2004), and subterranean termites (Venkateswara *et al.*, 2005). Chlorpyrifos produces hazardous effects on the environment when it is applied directly on plants or mixed with soil (Howard 1991). The absorption and translocation of chlorpyrifos residue by wheat and oil seed rape root has been studied by Wang *et al.*(2007) and it concluded that, the uptake rate of chlorpyrifos residue by these two plants increased with an increase in the amount of chlorpyrifos residue in soil**.** Parween *et al.* (2011) revealed that the exposure of an organophosphorous insecticide chlorpyrifos proved depressing for nitrogen metabolism and plant growth in Vigna radiata L. Previous studies have demonstrated that dimethoate causes a reduction in plant growth, photosynthetic pigments and photosynthetic activity of Glycine max L. (Panduranga *et al.*,2005) and Vigna unguiculata L**.** (Mishra *et al.*,2008).Continuous exposure to imadacloprid at higher doses significantlyimpaired the germination and growth of riceseeds and seedlings (Stevens *et al.*,2008) whereas adverse effects of mancozeb on morphological and anatomical traits of Lens culinaris L. at different developmental stageshas been investigated by Bashir *et al.*(2007a, b).The blocked growth might have resulted from the inhibition ofnormal cell division or elongation.

Disturbance of seed germination and mitosis could produce severe consequences for root growth and development. This was clearly demonstrated for the roots of *Pisum sativum* and *Zeamays* with different concentrations of the sulfonylurea herbicides chlorsulfuron and metsulfuronmethyl which caused severe injuries of the root growth (Fayez *et al.* 1994).After the treatment with different concentrations of pesticides, we observed that the percentages of seed germination decreased while the concentrations increased for each concentration of profenofos.

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