COMPARATIVE PHYTOTOXICITY OF SYNTHETIC PESTICIDES - CYPERMETHRIN AND TRIAZOPHOS, ON THE GERMINATION OF SOYBEAN (*GLYCINE MAX* LINN. VAR. JS-9560) AND WHEAT (*TRITICUM AESTIVUM* VAR. LOK-1) SEEDS

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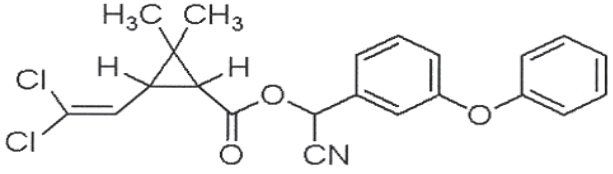
Abstract: The trend of increasing chemical pesticide usage in agricultural sector to increase production is a major concern in scientific community as it poses threat to the ecological integrity and sustainability. The present study takes into account the effect of broad host range pyrethroid pesticide - Cypermethrin, and organophosphorous pesticide - Triazophos, on the germination of two major crops of the state of M.P. Three different concentrations of the pesticide (0.1, 0.5 and 1.0 ppm) were used against a set of control in order to evaluate the effect of residues in the field after its application on the previous crop. Seed germination, root and shoot elongations have already been used to test the short term phytotoxicity in plants. The results confirmed significant toxicity of these pesticides on both germination and early root growth in the respective crops.

Keywords Cypermethrin, Pesticide, Germination, Phytotoxicity, Residues.

Introduction: The escalating demand of food with the alarming population growth rate led to intensification of agriculture resulting in diminishing yields due to both nutrient scarcity and increase in toxic chemicals in the soil. The main aim of this study is to investigate the effect of the chemical pesticides Cypermethrin and Triazophos on seed germination and early root growth of two crop plants of major importance in the study area. Germination and root-shoot enlargement have previously been used to evaluate the short term phytotoxicity in plants (Wang et al., 2002).

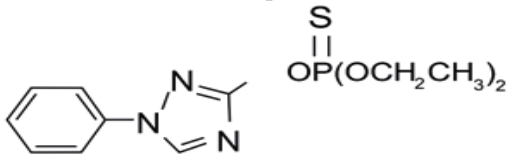
Soybean with its countless and varied uses is an important crop at global level. It's seeds are rich in oil (Approx. 21%) and protein (Approx. 40%). Currently Madhya Pradesh accounts for nearly 87% of the area under the crop in the country and contributes about 83% of its total national production. Wheat is the most important cereal crop and a staple food of the vast majority of human population. At present, India is second largest producer of Wheat in the world after China with about 12% share in total world Wheat production. Among the different states of India, Madhya Pradesh contributes 8.78% to the total national p roductivity of this crop.



Cypermethrin, a synthetic pyrethroid, is one of the extensively used insecticides in M.P. more often used to control the pests in Soybean and other vegetable crops. Pyrethroids are neurotoxic agents which principally affect the sodium channels of the neuronal cell membranes [Soder-lund et al, 2002] because they have a very high affinity for sodium channels [Ray, 1991].

The structural formula of cypermethrin,
pyrethroid insecticide
Chemical formula $C_{22}H_{19}Cl_2No_3$
Molecular Mass 416.3

Triazophos is a non-systemic organophosphorous insecticide and acaricide chiefly used for controlling insects (Lepidoptera) that damage agricultural, horticultural and forest crops.



The structural formula of Triazophos,
Organiphosphorous insecticide and acricide,
Chemical formula $C_{12}H_{16}N_3O_3PS$
Molecular Mass 313.31

Objective:

- To evaluate the effect of different concentrations of two pesticides, Cypermethrin and Triazophos, on the germination and early root growth of Wheat and Soybean.

Hypothesis:

H_0: There is no significant impact of Triazophos and Cypermethrin (Concentration - 0.1, 0.5 and 1.0 ppm) on the germination and root growth of Soybean and Wheat.

Materials and methods:

Selection of species: Two major crop species – *Triticum aestivum*, and *Glycine max* were evaluated in terms of their potential of germination in different concentrations of Cypermethrin and Triazophos. The seeds of ***Triticum aestivum* var. Lok-1**and ***Glycine***

***max* Var. JS-9560** were procured from Vasundra Seeds, Ujjain, India.

Seed germination test: The seeds procured were graded according to size and equal sized healthy seeds selected for the experiment. They were cleaned using double distilled water. Ten seeds of both the crop varieties were placed equidistant on triply folded whatman filter paper No. 1 in autoclaved Petri dishes and 15ml of 0.1, 0.5 and 1ppm concentration of both the pesticide solutions were applied. For each concentration experiments were laid in triplicates, and for both the crops control (without pesticide) was also run. After incubation daily reading were taken for 14 days. Appearance of radical in a seeds was treated as germinated.

Germination rate (%)

$$= \frac{\text{Number of germinated seeds}}{\text{Total number of sowed seeds}} \times 100$$

Root lengths were measured after 7 and 14 days of incubation according to pant et al., 2008.

Statistical analysis:

Germination assessment: The data presented in this study is represented as mean of samples. In order to examine the significant effects, if any, of the pesticides, Chi square test was performed at 0.05 level of significance by the following formula.

$$\chi^2 = \frac{(Observed - Expected)^2}{Expected}$$

Table 1. Germination of Soybean and Wheat under application of Triazophos

Crop /Conc.	Observed (O)	Expected(Control) (E)	O-E	$(O-E)^2$
Wheat 1.0ppm	49.44	83.33	-33.89	1148.53
Wheat 0.5ppm	63.88	83.33	-19.45	378.3025
Wheat 0.1ppm	65.55	83.33	-17.78	316.1284
Soybean 1.0ppm	48.33	82.91	-34.61	1197.85
Soybean 0.5ppm	62.77	82.91	-20.14	405.6196
Soybean 0.1ppm	64.16	82.91	-18.75	351.5625
Total		498.72		3795.92

$$\chi^2 = \frac{3795.92}{498.72}$$

$$\chi^2 = 7.611$$

$\chi^2_{cal} > \chi^2_{tab}$ at 5% level of significance, so we reject the null hypothesis and conclude that there is a significant relationship between the concentration of Triazophos used and the germination of crops.

Table 2. Germination of Soybean and Wheat under application of Cypermethrin

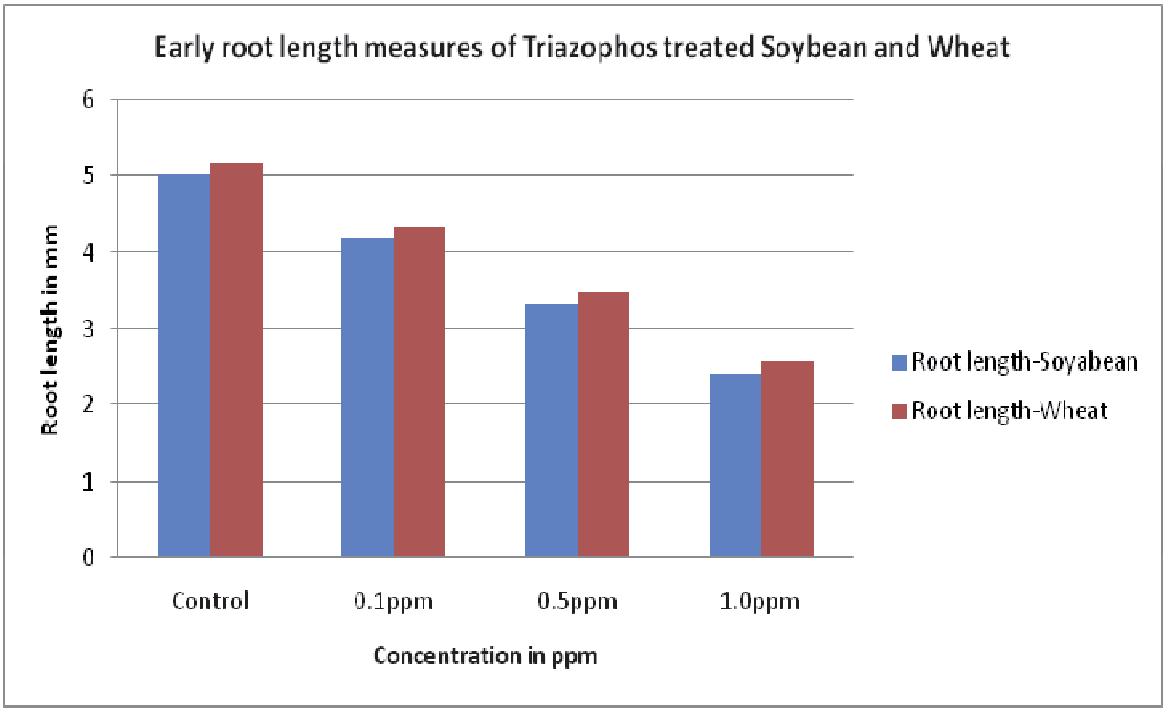
Crop /Conc.	Observed(O)	Expected(Control) (E)	O-E	$(O-E)^2$
Wheat 1.0ppm	44.16	71.25	-27.09	733.86
Wheat 0.5ppm	40.416	71.25	-30.834	950.73
Wheat 0.1ppm	46.25	71.25	-25.00	625
Soybean 1.0ppm	40.00	66.87	-26.87	721.99
Soybean 0.5ppm	25.83	66.87	-41.04	1684.28
Soybean 0.1ppm	42.5	66.87	-24.37	593.8969
Total		414.36		5309.779

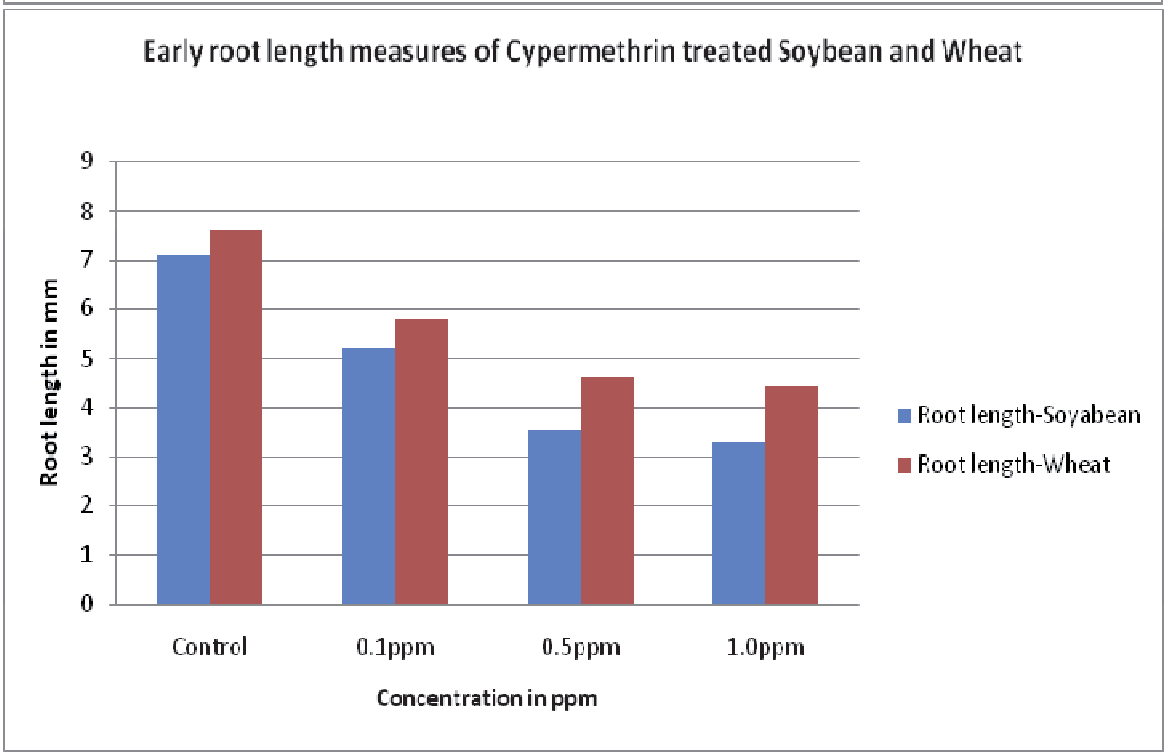
$$\chi^2 = \frac{5309.779}{414.36}$$

$$\chi^2 = 12.814$$

$\chi^2_{cal} > \chi^2_{tab}$ both at 1% and 5% level of significance, so we reject the null hypothesis and conclude that there is a significant relationship between the concentration of Cypermethrin used and the germination of crops.

Root length evaluation:





Result and Discussion: The results showed a significant decrease in the germination and early root growth of both the plant species with the increase in concentration of the pesticides which is in accordance with Sharma et al., 2010 and Dubey et al., 2011. Since the excess use of Cypermethrin not only

leaves its residue in soil but also leads to potential pollution of soil, air and ground water (Liu et al., 2009), recommendations of dilution for these chemicals should be strictly followed.

Root length assessment also showed a significant and negative effect on the growth under the effects of pesticides. The decreasing trends of seed germination due to Cypermethrin and Triazophos may be ascribed to increased numbers of free radicals.

The above results for early root growth confirm the toxicity of these chemical pesticides. Both Soybean and Wheat shows increasing toxicity with increasing concentrations of Triazophos. Compared to control, Soybean showed 51.79, 33.73 and 16.46% while Wheat showed 50.32, 33.07 and 16.08% decrease in root length in the respective concentrations of 1ppm, 0.5ppm and 0.1ppm. Under the effect of same concentrations of Cypermethrin, Soybean showed 54.07, 50.42 and 26.75% and Wheat showed 41.99, 39.37 and 24.39% decrease in root length with increasing concentrations. From the study we also conclude that both the pesticides suppress Soybean germination as well as root growth more than they affect the same parameters in wheat. Even very low concentration i.e. 0.1ppm is also toxic for germination. Hence the use of pesticides should be in a proper dose and as far as possible their use should be avoided as they posses residual toxicity too.

Conclusion: The relevance of percentage seed germination and the concentration of two different pesticides have been proved. It stands proved that with increasing concentration of both Triazophos and Cypermethrin from 0.1ppm to 1ppm, there is gradual decrease in percentage of seed germination in the tested crops, Soybean and Wheat. Root growth also shows the same decreasing trend with increase in concentration of pesticides in both the crops. Since these pesticides are applied in indoor conditions, there is possibility of variation in actual soil conditions where different microbial population can degrade these chemicals to either more harmful or useful byproducts. Also the soil chemistry in one way or the other influences the outcome of all the biological and physical interactions in rhizosphere. There is scope of more research in the field which keeps the paper open ended.

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