

Chlorpyrifos Toxicity in Green Gram (*Vigna radiata* L.)

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Abstract

The recent experiment was conducted to assess the effect of insecticide (chlorpyrifos) on seed germination and vegetative growth characteristics of Green gram *vigna radiata* L. This experiment comprised different concentrations of chlorpyrifos treatments compared with control. The seeds were treated with the concentrations of 5 ppm, 25 ppm, 50 ppm, 75 ppm, and 100 ppm of chlorpyrifos. The seedlings were taken out at an interval of eight days for the germination studies. The results show that chlorpyrifos was reduced the green gram seed germination percentage significantly when the increasing of concentration of insecticide. The data suggested that chlorpyrifos affect the seed germination and it was possible to evaluate the toxicity of insecticide in plant.

Key words: Chlorpyrifos, Germination, Green gram, ppm, Insecticide.

1 Introduction

Pesticides were introduced to agriculture to perform the increased food needs of the growing global population. Indiscriminate use of various pesticides in modern age has led to a serious environmental hazard (Mishra *et al.*, 2008). Pesticides are earlier reported to have affected non-target plants but their frequent application to the target plants is also a matter of concern. The application of different pesticides in a long term basis results in persistent ecological damages. The persistent nature of pesticides in the soil enables them to enter into the plants and other primary producers not only affecting the secondary and tertiary consumers that depended upon the producers.

Chlorpyrifos (O, O-diethyl O-(3, 5, 6-trichloro-2-pyridyl)phosphorothioate), is one such organophosphate insecticide effective against a broad spectrum of insect pests of economically important crops. Chlorpyrifos is widely used also for control of Coleoptera, Diptera, Homoptera, and Lepidoptera in soil. It has been suggested that the ability of chlorpyrifos and other organophosphorus pesticides to accumulate in living tissues may create a potential risk to humans and other organisms (Serrano *et al.*, 1997; Wang *et al.*, 2005). Chlorpyrifos produces hazardous effects on the environment when it is applied directly on plants or mixed with soil (Howard 1991). Chlorpyrifos adsorbs strongly to soil particles and it is not readily soluble in water. It is therefore immobile in soils and unlikely to leach or to contaminate groundwater. Chlorpyrifos may be toxic to some plants, such as lettuce. Residues remain on plant surfaces for approximately 10 to 14 days. This insecticide and its soil metabolites can accumulate in certain crops. The half-life of chlorpyrifos in

water is relatively short, from a few days to two weeks. It adsorbs readily to sediments and organic matter.

The effect of chlorpyrifos was assessed based on morphological traits, root and shoot length (Zhi-Yong *et al.*, 2011). Literature is rich in information referring to the phytotoxic and inhibitory effects of herbicides on germination root and shoot growth (Boutin *et al.*, 2004). The effects of pesticides on seed germination, growth, survival, and yield and residue quantification of crop plants have been investigated by Ahmed and Khan (2011). The toxic effect of many fungicides, herbicides and insecticides on germination and seedling growth was carried out (Sengupta *et al.*, 1986). By studying the effect of pesticides on treated seeds on germination and determination of growth indices, it is possible to evaluate the positive or negative influence or toxicity of the chemical compounds. Because germination experiments are easy, cheap, fast and spectacular, the testing of the action of some action of some known and newly synthesized substances on living organisms will be performed using germinating seed. Hence an understanding of hazardous effect of pesticides is also as equally as important to that of their use in the plant protection. This view point has received a great deal of attention by the researches in recent times. In the present study a preliminary attempt was to determine more exactly the impact of these pesticides on seed germination and early seedling growth of *Vigna radiata* L. In that way research work carried out following objective germination percentage, shoot length and root length in responses to chlorpyrifos.

2 Materials and Methods

The green gram seed were purchased from registered seed centre at virudachalam, Tamilnadu, India. Morphologically identical seeds were selected, sterilized with distilled water and soaked in water for 12 hours. The germination was initiated by selecting batches of 20 seeds

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that were germinated in Petri dishes upon two layers of filter paper containing concentration of, 5ppm, 25ppm, 50ppm, 75ppm and 100ppm. The seeds were incubated in Petri plate lined with moist blotter at $28 \pm 2^\circ$ in dark. Germination time was determined as the time of rupture of seed coats, and the emergence of the radical through the seed coat. For seedling growth measurement, seedlings were allowed to grow in above concentrations. Eight-day old seedlings were made on Germination rate. The germination rate of seeds was evaluated by counting the number of germinated seeds in batches of 20 seeds; each value represents the average of three repetitions. Measurements were made of the length of shoots and roots of the germinated seeds, respectively.

3 Results and Discussion

The treatment of Green gram seeds with different concentrations of chlorpyrifos showed a significant decrease ($p < 0.05$) in germination percentage when compared with control. (Fig 1). A seed germination of 96% was seen in case of control while the significant decrease 91%, 86%, 78%, 69% and 64% germination were observed in seeds treated with 5 ppm, 25 ppm, 50 ppm, 75 ppm and 100 ppm respective chlorpyrifos solutions after eight days interval. Similar result also reported by (Mishra *et al.*, 2008) have reported that effect of on the seedling characteristics of *Vigna mungo* L. The exposure of an organophosphorous insecticide, chlorpyrifos proved depressing for nitrogen metabolism and plant growth in *Vigna radiata* L. (Parween *et al.*, 2012). The blocked growth might have resulted from the inhibition of normal cell division or elongation. Margaret and Manuel (2014) reported that pesticide of DDT on seed germination recorded a decrease of 50% (*Vigna sinensis*) and 20% (*Oryza sativa*) in the highest concentration. The combination hexaconazole and triazophos reduced the germination 0.1%, 0.15%, 0.2%, and 0.3% concentrations in spinach and gaur (Kengar *et al.*, 2014).

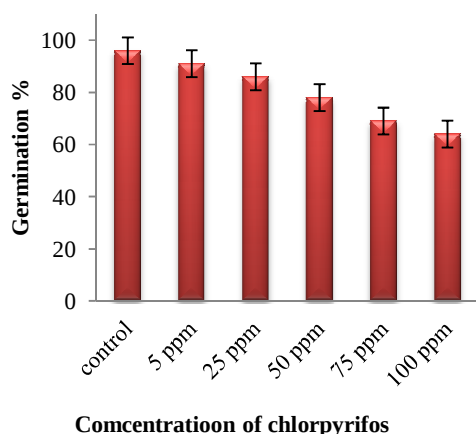


Figure 1: Effect of different concentrations of chlorpyrifos on seed germination of *vigna radiata* L.

Fig-2 and Fig-3 showed that the various concentration of chlorpyrifos on shoot length and root length of *Vigna radiata* L. The maximum shoot length (4.62 cm) and root length (3.14 cm) were observed in control plant at the same

time above said parameter were decreased while increasing the pesticide concentration (3.58, 3.38, 2.70, 2.31, 2.10 and 2.71, 2.51, 2.12, 1.89, 1.11 cm) respectively. Fayez *et al.*, 1994 proposed that chlorsulfuron and metsulfuronmethyl herbicide induced injuries of the root growth in *Pisum sativum* and *Zea mays* and also reported the inhibition of seed germination and seedling growth in *Penesetum americanum* L. due to the application of organophosphate insecticides. Dimethoate insecticide affects the growth, photosynthetic pigments and photosynthetic activity of *Glycine max* L. (Panduranga *et al.*, 2005). Kangetsu Hirase and William T. Molin (2002) revealed that MT-101 decreased germination of hemp sesbania by 57 and 90 % at 0.05 and 0.5mM, respectively. Vidyasagar *et al.*, 2009 suggested that different concentrations (0.2, 0.4 and 0.6%) of endosulfan showed a significant decrease in percent germination, shoot length, root length and biomass decreased in *Sorghum bicolor* (L.) Moench. Tricyclazole fungicides have decreased the germination of (*Oryza sativa* L). at 0.05% and 0.1% concentrations. (Sathees Kannan *et al.*, 2014).

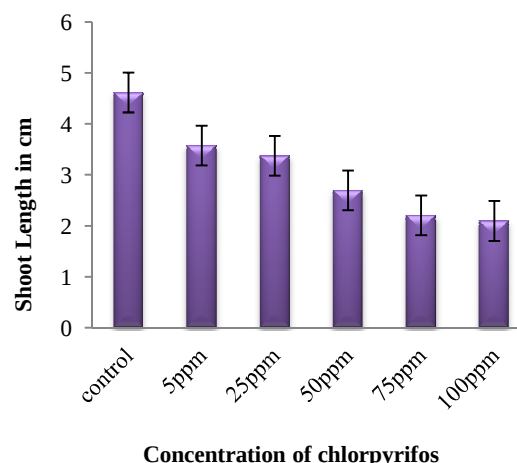


Figure 2: Effect of different concentrations of chlorpyrifos on shoot length of *vigna radiata* L.

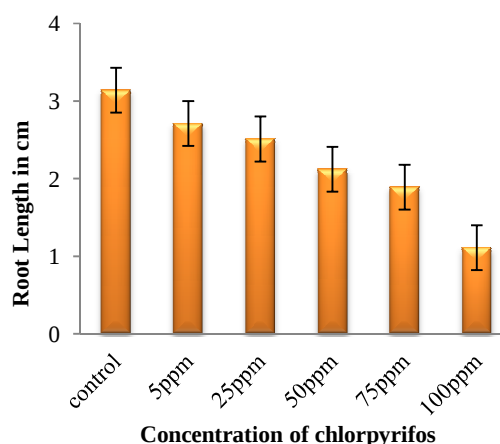


Figure 3: Effect of different concentrations of chlorpyrifos on Root length of *vigna radiata* L.

Chlorpyrifos applied at the MAC rate (0.1 µg a. s. /l) significantly inhibited germination energy and germination (11.25%) of white mustard seeds, as compared to the control (91.3%, 93.5%, respectively) ($t=76.67^{**}$) (Sonja Gvozdenac *et al.*, 2013). Mishra *et al.*, (2014) result showed that the Profenofos has affect the germination at level 0.2% concentration up to 26.5% and also root and shoots length decreased with the increase in profenofos concentration. According to Cavusoglu *et al.*, (2011) 100, 250 and 500 mg l-1 doses of glyphosate caused 24%, 40% and 60%, decrease of seed germination, significantly decreased the root length of *Allium cepa*. A.Sarmamy *et al.*, (2013) reported that Treflan, Cyrin was decreased seed germination of *Triticum aestivum* L. at 8%, and 60% respectively.

4 Conclusion

The obtained data indicates that chlorpyrifos affect of the seed germination of *vigna radiata* L. So the remediation is very important one for chlorpyrifos pollutant then only we make the good environment.

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