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Phytoremediation of quizlofop-ethyl contaminated soil using *Sesbania sesabn* L.

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ABSTRACT. In this field experiments, sandy loam soil was treated with different concentration of herbicide (Quizalofop-ethyl) 0.5, 1.0, 1.5 and 2 per cent. *Sesbania sesban* L. seeds were sown in all treated soil. The germination percentage, morphological and enzymes activities were measured after 20, 40 and 120 days. The results indicate that the germination per cent, morphological parameters were increased in control then it was gradually decreased with increasing the herbicide concentration. The enzymes like catalase and peroxidase activity were increased in control then it was decreased with increasing the concentration. Whereas the polyphenoloxidase acticity was lower in control and it was increased with increasing the herbicides concentration. Hence, after 120 days plants were harvested and the plant powder was analyzed for absorption of herbicide by plant with the help of Gas chromatography mass spectrum (GCMS). The obtained data showed that herbicide absorption was concerned in quiazalofop-ethyl treated plant when compared to control. This study expose that herbicide reduced by *Sesbania sesban* L.

1. INTRODUCTION

Herbicides are applied to soil to manage weeds. While it is desirable for the chemicals to control weeds during the season of application, it is not desirable for them to persist and affect subsequent crop growth. For some herbicides, there may be a fine line between controlling weeds for the entire growing season and then planting a sensitive rotation crop. Anything that affects the disappearance soil factors. Soil factors affecting herbicide persistence include soil composition, soil chemistry, and microbial activity. Soil composition is a physical factor determined by the relative amounts of sand, silt, and clay in the soil (the soil texture), as well as by the organic matter content. An important chemical property of soil that can influence herbicide persistence is pH. The microbial aspects of the soil environment include the types and abundance of soil microorganisms present in the soil.

Phytoremediation technologies can be directed to above or below ground contaminants and either remove pollutants from the affected area (phytodecontamination) or stabilize them to prevent off-site movement (phytosequestration or phytostabilization). These later techniques are useful for contaminants having low biodegradation potential or those which rapidly move into the soil profile. Plants can remove organic pollutants, including herbicides, by taking them up from the environment through the roots and leaves. The absorbed pollutants are biochemically converted into non-phytotoxic metabolites that accumulate in plant tissue. Phytoremediation is the process by which plants detoxify soils, sediments, and aquatic sites contaminated with organic and inorganic pollutants (Salt *et al*., 1998),

In comparison with other clean-up technologies, phytoremediation has potentially many advantages, including low installation and maintenance costs, less disruption of the environment and other beneficial side effects such as carbon sequestration and biofuel production (Dietz and Schnoor 2001; Doty S.L *et al*., 2007). In that way the present deals with phytoremediation of herbicide (quizalofop-ethyl).

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2. MATERIALS AND METHODS

The field was prepared randomly like CS (control soil), QS1 (0.5% Quizalofop-ethyl treatment soil), QS2 (1.0% Quizalofop-ethyl treatment soil), QS3 (1.5 % Quizalofop-ethyl treatment soil) and QS4 (2 % Quizalofop-ethyl treatment soil). Soil CS and QS4 herbicide treated soils were used for physic chemical analyses in after 20 day treatment. The herbicide Quizalofop-ethyl [(2-(4-((6-chloro-2-quinoxalinyl) oxy)phenoxy)-ethyl ester] is a brownies liquid haring the chemical formula C19H17ClN2O4. It was obtained from Agro agengies, chidambaram. It is a selective systemic herbicide used for the pre and post-emergence control of annual grasses.

Fifteen uniform seeds of *s.sesban* were placed in a 9cm petri dish lined with filter paper treated of quizalofop-ethyl at 0.5%, 1%, 1.5% and 2% control seeds were treated with distilled water. Each treatment replicated three times. This petri dishes were placed in a growth chamber. After 7 days for *s.sesban* germination was counted and the percentage of germination was calculated. The germination percentage was calculated by using the following formula:

$$\text{Germination percentage} \frac{\text{Number of seeds germinated}}{\text{Total Number of seeds planted}} \times 100$$

Plant Shoot length and root length were measured by using centimeter scale and their Fresh weight was taken by using an electrical single pan balance. The fresh plant materials were kept in a hot air oven at 80o C for 24 hrs and then their dry weight were also determined. Enzyme activities like catalase activity ws measured with minor modifications in the method given by machly and chance, 1987. Peroxidase and polyphenoloxidase activity was determined according to method of kumar and khan, 1982.

The GC-MS analysis was performed on a Shimadzu series GC 17A gas chromatograph equipped with split/splitless injector and interfaced with QP-5050 Shimadzu mass spectrometer. The GC was equipped with capillary column BPX-5 (Phenomenex) (30 m x 0.25 mm I.D. with 0.25 µm film thickness) connected to the split/splitless injector. The optimized oven temperature program was at first 80ºC (5 min.), then from 80°C to 280°C (at 20°C/min). The final temperature was held for 5 min. A column head pressure was 56.7 kPA and an injector temperature was 220°C. Helium was used as the carrier gas at a flow rate of 9.8 ml/min.

The mass spectrophotometer was operated in the electron impact ionization (EI), and the applied energy was 70 eV. Mass spectra were acquired in the mass range from m/z 50 to 650. The detection of Quaizalofop-ethyl was also accomplished in selected ion monitoring (SIM) mode, using the following fragment ions: m/z 25000 [(2-(4-((6-chloro-2-quinoxalinyl) oxy)phenoxy)-ethyl ester]. The instrumentation was controlled by software CLASS 5000 with NIST107 and NIST21 library of mass spectra.

3. RESULT AND DISCUSSION

It can be shows in Fig-1 represents the effect various concentration quizalofop-ethyl on the germination of *Sesbania sesbania* gave maximum 93% germination in control. And it was gradually reduced with increasing the quizalofop-ethyl concentrations. The concentration 2% of quizalofop-ethyl showed the highest inhibitory effect on the germination percentage 60% (Korade and Fulekar, 2009). A decrease in germination rate was observed in all concentrations of α-cypermethrin in tomato plants by Chahid *et al*.,2013. In recent studies (Rai *et al*., 2014).

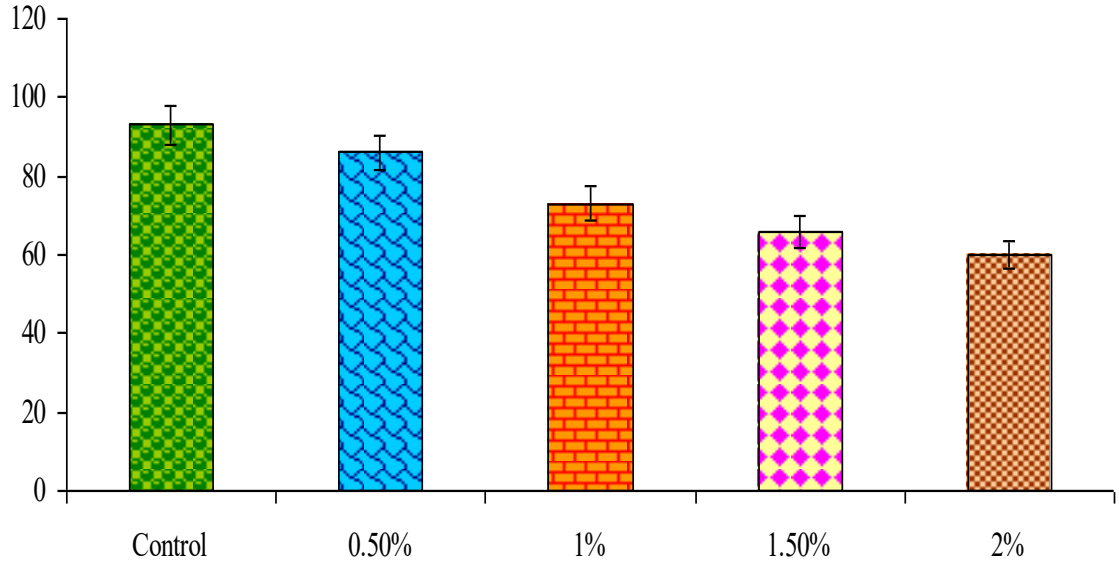
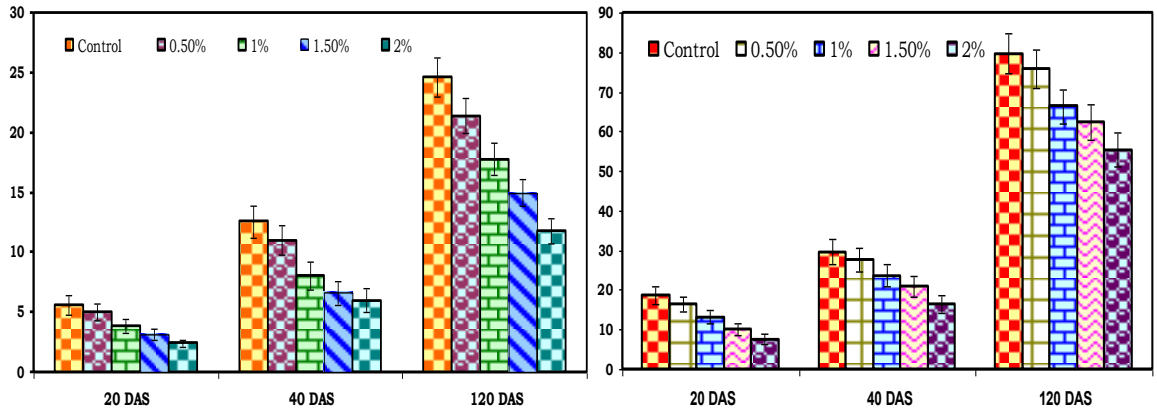


Fig. 1. Effect of different concentrations of herbicide (quizalafop-p-ethyl) on germination percentage of *Sesbania sesban* L.

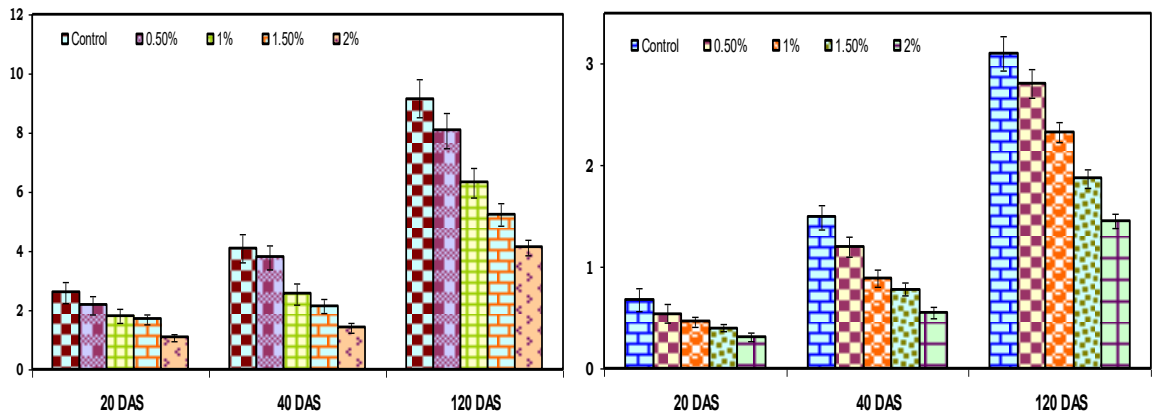
Results in Fig-2 & 3 represents the effect of quizalofop-ethyl on the growth parameters like shoot and root length of *S.sesban* on 20, 40 and 120 DAS. It was observed that 0.5% concentration recorded the growth production having minimum reduction. And it was 2% treatment exhibited the highest inhibitory effect on the production of shoot and root length when compare to control on both 20, 40 and 120 DAS respectively These effects have already been reported by (Sammaiah *et al*., 2011;Mahakavi *et al*., 2014). Similar results reported by (Kengar *et al.,* 2014; Santhoshkumar *et al*., 2015).



Root length **Shoot length**

Fig. 2 & 3. Effect of different concentrations of herbicide (quizalafop-p-ethyl) on shoot and root length of *Sesbania sesban* L.

Fig-4 & 5 indicates the decline in fresh weight and dry weight of *S.sesban* with in various concentration of quizalofop-ethyl exposure in comparison with control on 20, 40 and 120DAS. The plant biomass of fresh weight and dry weight of the *S.sesban* reduced as increasing concentration of all durations of quizalofop-ethyl treatments. However, exceptionally in an individual treatment with quizalofop-ethyl at 2% for both duration showed uttermost reduction in fresh and dry weight when compared to control (Mishra *et al*., 2014). Similar result seen The fresh weight and dry weight decreased in all concentration treatment as per increasing concentration of in Triazophos on spinach and gaur (Kengar *et al.,* 2014).



Fresh weight **Dry weight**

Fig.4 & 5. Effect of different concentrations of herbicide (quizalafop-p-ethyl) on fresh and dry weight of *Sesbania sesban* L.

From fig-6 & 7, it was observed that the enzymes activities of *S.sesban* with in various concentration of quizalofop-ethyl on 20, 40 and 120 DAS. It was observed that the catalase and peroxidase activities of *S.sesban* were higher in control. The catalase and peroxidase activities reduced with increasing quizalofop-ethyl concentration, at the same time polyphenoloxidase was increased with increasing the concentration. (Chauhan *et al*., 2013) Observed that the imidacloprid insecticide treatment increased the polyphenoloxidase.

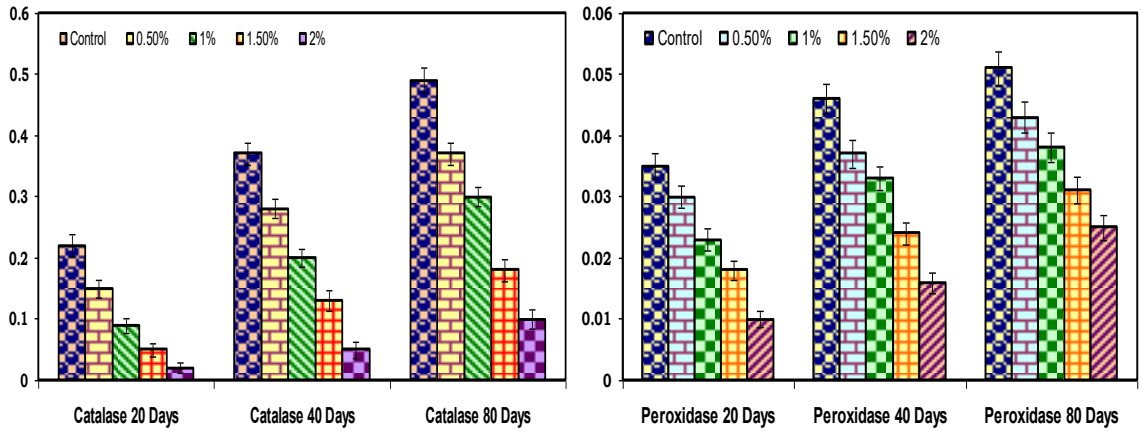


Fig.6 & 7. Effect of different concentrations of herbicide (quizalafop-p-ethyl) on catalase and peroxidase activity of *Sesbania sesban* L.

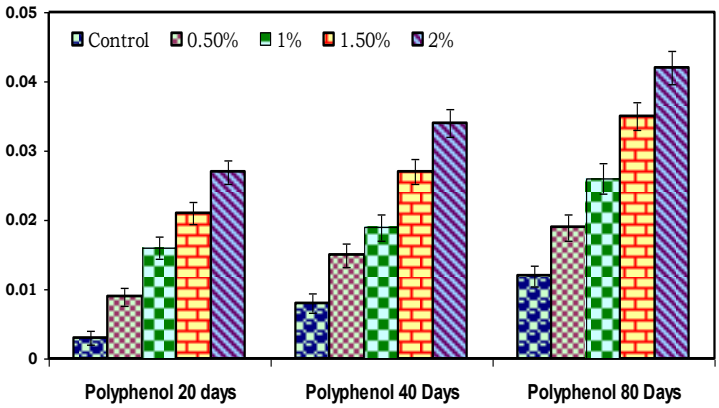


Fig.8. Effect of different concentrations of herbicide (quizalafop-p-ethyl) on polyphenoloxidase activity of Sesbania *sesban* L.

GC-MS analysis was made with 120 days old plants of sesbania grown under various concentration of herbicide toxicity to confirm the phytoremediation interval of uptake of herbicide toxicity by sesbania plants from herbicide treated soil and it showed spectral peaks found to be

14.456 mins that through the uptake of herbicide quizalofop-ethyl by sesbania plants, the toxicity was reduced in the soil, and the same thing was confirme with the graph in which the peak at the molecular weight 372.8 showed the accumulation by the plants.

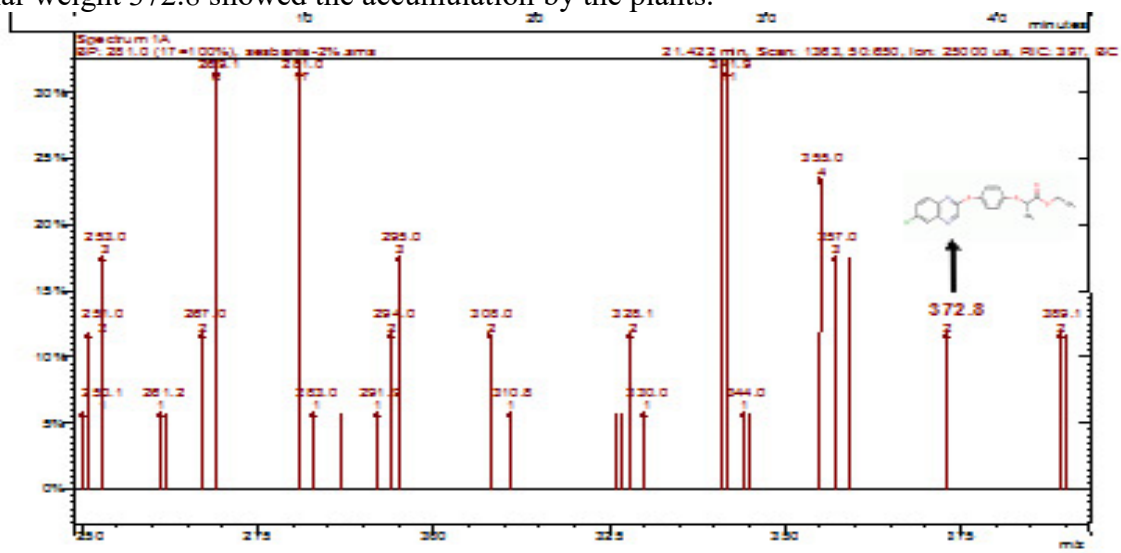


Fig.9. GC-MS analysis of Quizalofop-ethyl accumulation of Sesbania *sesban* L.

4. CONCLUSION

Phytoremediation is the use of plants to remove toxic chlorinated chemicals, including herbicides from the environment. The presence of this herbicide in the soils of *Sesbania sesban* is likely to adversely affect soil flora and fauna and may even cause pollution of surface soil. So this study reveals that residues of herbicide were reduced by *Sesbania sesban* and improve the soil fertility.

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