Progressive Research – An International Journal
Print ISSN : 0973-6417, Online ISSN : 2454-6003
Volume 11 (Special-IV) : 2615-2617 (2016)

Society for Scientific Development in Agriculture and Technology
Meerut (U.P.) INDIA

ECO-FRIENDLY MANAGEMENT OF *Parthenium hysterophorus* BY THE APPLICATION OF LEAF RESIDUE OF *Xanthium strumarium*

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ABSTRACT

A pot experiment at the research farm of Rajendra Agricultural University, Pusa during 2003 and 2004 revealed that the growth of *Parthenium hysterophorus* may be restricted by the application of grinded leaf residue of *Xanthium strumarium* at the rhizosphere. Among different treatments, maximum growth inhibition of *Parthenium* was observed with the treatment of 3.0% (w/w) *Xanthium strumarium* residue for all observation periods starting from 30 days after sowing (DAS) to 90 DAS. The inhibition was observed in all plant parts of *Parthenium hysterophorus* i.e. root, shoot, and leaf. The inhibition in emergence of seedlings of *Parthenium* was also recorded at 30 DAS. Significant inhibition in the growth of *Parthenium hysterophorus* was started to observe with treatment of 1.5% *Xanthium strumarium* residue. Therefore, the present study clearly indicates the potential eco-friendly management of the obnoxious weed, *Parthenium hysterophorus*. Such eco-friendly control of weeds will also indirectly help in biodiversity conservation of the local region.

Key words : *Allelopathy, Parthenium hysterophorus, Xanthium strumarium, leaf residue.*

Parthenium hysterophorus is alien and invasive weed introduced from American subcontinents. *Parthenium hysterophorus* was first reported from India in 1956 (Rao, 1956). Presently, it became a menace throughout the nation and is badly infesting millions of hectare lands, which comprises of fallow land along highways and railways, pasture land, waste land etc (Paradkar *et. al.,1*997) It spreads quickly due to its prolific seed production capacity and its wider physiological adaptability. The successful survival and spread of this weed in India may be attributed to its allelopathic properties (Marsie and Singh, 1987). It is a menace of local biodiversity by removing major portion of nutrients from soil and destroying natural vegetation. It is also known to cause allergic hazards to human beings and animals (Pahwa, *et. al.,* 2000). It has also become a menace for fallow lands in urban and suburban areas and therefore posing a serious threat to people and cattle (Mahadevappa, 1997; Sushilkumar and Varshney, 2007). Presently, it is considered as one of the seven most dangerous weeds of the world (Singla, 1992). This weed even started to infest crop plants at cultivated areas (Sushilkumar and Varshney, 2007). Invasiveness of this weed is more pronounced in short shuttered and slow growing crops like vegetables, onion, groundnut, soybean etc (Dixit *et. al*., 2001; Tiwari and Bisen, 1984).

In north east India, *Parthenium hysterophorus* germinates mainly in the month of February-March and attains its peak growth during June-July and produces seeds during September-October and thus completing the life cycle in 200-240 days. Phyto-sociologically the plant is a rapid colonizer and competes out other vegetation in its vicinity within two growing seasons. Although it is possible to control this weed through chemical herbicide, but needs monetary investment without any profit from fallow lands and hence is neglected (Arya and Singh, 1996). It was also reported that growth of any plant can be affected by neighboring plants due to competitive ability and inherent vigor of the plant species. In some cases, release of certain bio-chemicals from a plant may alter the physiological behavior of the neighboring plant species (Batish?et. al., 2005; Rice, 1984). Hence, the detailed study on the allelopathic effect of plant has gained tremendous importance and the same concept may be applied for biological controls of weeds. The allelopathic effect of *Xanthium strumarium* was clearly visible in fallow lands of calcareous soils, where no other plants can grow in its association. The allelopathic effects of *Xanthium strumarium* on *Parthenium hysterophorus* has been also shown under laboratory conditions (Sinha and Singh, 2004). To utilize this allelopathic effect for weed management, the effect of the grinded leaf residue of *Xanthium strumarium* was studied to assess the inhibition level for possible control of *Parthenium hysterophorus* in fallow lands.

MATERIALS AND METHODS

A pot culture experiments was carried out to evaluate the extent of allelopathic effect of *Xanthium strumarium* on *Parthenium hysterophorus.* The study was conducted under All India Coordinated Research Project on Weed Control during 2003 and 2004 in the net house at Rajendra Agricultural University, Bihar, Pusa, Samastipur. Seventy two earthen pots were used with keeping view of six treatments, three sampling times (30, 60, and 90 DAS) and four replications. Each pot was filled with 10 kg of soil, sand, and farmyard manure in the ratio of 2:1:1.

Application of leaf residue of *Xanthium strumarium* : The leaves of *Xanthium strumarium* was collected from naturally occurring healthy plants from the local area. Subsequently the leaves were dried in oven at 100 C for eight hours (Narwal, 1996) and ground in a mechanical

Table-1 : Effect of *Xanthium strumarium* leaf residue on growth of *Parthenium hysterophorus.*

Treatments	Root dry weight (g/plant)			Shoot dry weight (g/plant)			Leaves dry weight (g/plant)		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
T_1	0.33	5.0	5.3	1.4	8.2	11.6	0.28	13.9	16.8
T_2	0.11	3.7	4.4	1.2	7.3	10.4	0.25	12.2	14.6
T_3	0.10	3.4	3.8	0.08	6.3	8.1	0.20	9.9	11.5
T_4	0.08	2.4	3.3	0.06	4.9	5.6	0.16	7.6	8.5
T_5	0.05	2.0	2.5	0.05	3.6	4.5	0.12	6.2	7.8
T_6	0.04	1.3	1.9	0.03	2.2	3.0	0.10	3.9	5.4
CD (p = 0.05)	0.22	1.41	0.92	0.33	0.94	1.53	0.04	1.82	2.52

T_1-Control; T_2-1.0% leaves residue Xanthium strumarium; T_3-1.5% leaves residue Xanthium strumarium; T_4-2.0% leaves residue Xanthium strumarium; T_5-2.5% leaves residue Xanthium strumarium; T_6-3.0% leaves residue Xanthium strumarium.
DAS indicates days after sowing.

grinder. Leaves residue of *Xanthium* at 1.0, 1.5, 2.0, 2.5 and 3.0% (w/w) was prepared by thorough mixing with soils. Accordingly, six treatments comprising five levels of *Xanthium strumarium* leaf residue (1.0, 1.5, 2.0, 2.5, and 3.0 %), were applied along with one control. The pots were left in shade for 15 days before sowing so that the residue in the soil became fully decomposed and then twenty healthy and uniform seeds of *Parthenium hysterophorus* were sown in each pot during first week of March to study the residual effects of *Xanthium strumarium* on the seedling emergence and changes in biomass status in root, shoot and leaf of *Parthenium hysterophorus.* Pots of the experiments were kept inside the net house and ambient conditions were maintained for natural growth of plants. Each pot was supplied with water up to soil saturation on every alternate day. The total experiment was designed by following randomized block design (RBD) with four replications.

Measurements : Seedling emergence (%) was calculated at 30 days after sowing (DAS) by dividing total emerged germinated seeds by total seeds in each set multiplying with hundred. The dry biomass of root, shoot, and leaves were recorded after 30, 60, and 90 DAS by uprooting of the plants from randomly selected pot in each replication. Lateral root of the plants were washed gently with tap water from the pots. Root, shoot and leaves were separated gently. To obtain the dry biomass weight, fresh biomass of root, shoot and leaves were collected from treated pots and then dried in oven at 70 1 C for 48 hours. The data were subjected to analysis of variance by adopting standard statistical procedure.

RESULTS AND DISCUSSION

Effect of *Xanthium* residue on the emergence of *Parthenium* : The data on emergence of *Parthenium* was recorded at 30 DAS as it was considered as the end of germination. The mean data revealed that the leaf residue of the *Xanthium strumarium* caused significant reduction in emergence of *Parthenium hysterophorus.* (Fig.1). Data showed that the emergence percentage of plants, grown in treated soil with leaf residue of *Xanthium* ranged from 16.8 to 98.5%. The highest level of emergence percentage was observed in control pot, *i.e.* in the pot without residue. The emergence percentage was lowest corresponding to 3.0% of *Xanthium* leaf residue treated pots. The inhibitory effect on emergence of *Parthenium* may be due to the presence of some allelochemicals in the leaves of *Xanthium.* Earlier, it was also reported that the leaf extract of *Xanthium* suppresses the germination percent of *Parthenium* (Sinha and Singh, 2004).

Effect of *Xanthium* residue on the growth of *Parthenium* : The data on root, shoot, and leaf dry weight revealed that the growth of *Parthenium hysterophorus* was adversely affected by the application of *Xanthium strumarium* leaf residue (Table 1). Minimum root dry weight was observed with the treatment T_6 (3.0% leaves residue *Xanthium strumarium*) at all observation periods (30, 60 and 90 DAS) and the corresponding values were 0.04, 1.30 and 1.90 g, respectively. Similar to the trend of root, dry weight of shoot and leaves were also lowest with the treatment T_6. Dry weight of shoots was 0.03, 2.20 and 3.00 g, respectively at 30, 60, and 90 DAS for T_6 treatment. Similarly, the dry weight of leaves was 0.10, 3.90, and 5.40 g, respectively at 30, 60, and 90 DAS for T_6 treatment. Although, the control and the treatment T_2 (1.0% leaves residue *Xanthium strumarium*) recorded statistically comparable results but the successive increase in quantity of leaf residue had a significant effect on reduction in root, shoot, and leaf dry weight (Table 1). The decrease in root, shoot, and leaves dry weight may be due to the presence of allelochemical in *Xanthium* and thus hinders the growth of *Parthenium.* Similar to this finding, inhibition in radicle and plumule length of *Parthenium* by leaf leachates of *Xanthium* in different concentrations was also reported earlier (Sinha and Singh, 2004). A few previous literatures also reported that the *Xanthium strumarium* may adversely affect the growth of maize (Saayman et. al., 1996) and Soybean (Ellis et. al., 1998). Therefore, it may be concluded that the efficacy to control *Parthenium* was higher with *Xanthium* leaf residue at higher content. Further, being a plant residue it may have no residual impact on rhizosphere and hence is preferable for eco-friendly management of weed.

CONCLUSION

The present study clearly showed that the vigorous growth

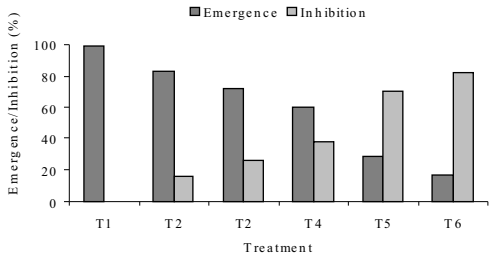

Fig.-1 : Effect of *Xanthium leaves* residue on the emergence of *Parthenium.* T_1-Control; T_2-1.0% leaves residue *Xanthium strumarium*; T_3-1.5% leaves residue *Xanthium sstrumarium*; T_4-2.0% leaves residue *Xanthium strumarium*; T_5-2.5% leaves residue *Xanthium strumarium*; T_6-3.0% leaves residue *Xanthium strumarium.*

of *Parthenium* may be checked through eco-friendly approach by applying dried plant parts of *Xanthium strumarium* in grinded form in the rhizosphere of *Parthenium.* The result of the present study also indicated that the degradation potential of *Xanthium* was higher and thus has less chance of leaving residual impact in treated soils. The present study may be very useful for control of *Parthenium hysterophorus* in fallow lands and thus indirectly will also help to conserve the local biodiversity.

ACKNOWLEDGEMENTS

The authors of this paper expressed his sincere thank to the Director Research, Rajendra Agricultural University, Pusa, Samastipur, Bihar, India for providing facilities. Technical help rendered by Mr. Ram Dayal Pandit and Mr. Rajesh Kumar is duly acknowledged.

REFERENCES

1. Arya, M.P.S. and Singh, R.V. (1996). Effect of varying levels of herbicides against *Parthenium hysterophorus* L. and other associated weeds. *Indian Journal of Weed Science 28 :* 36-39.
2. Batish D.R., Singh, H.P., Pandher J.K., Kohli R.K. (2005). Allelopathic interference of *Parthenium hysterophorus* residues in soil. *Allelopathy Journal 15 :* 267-273.
3. Dixit, Anil, Raghuwansi, M.S. and Bhan, V.M. (2001). *Parthenium hysterophorus* and its control. *Pesticides Information 27 :* 9-11.
4. Ellis J.M., Shaw, D.R, and Barrentine, W.L. (1998). Soybean (*Glycine max*) seed quality and harvesting efficiency as affected by low weed densities. *Weed Technology 12:* 166-173.
5. Mahadevappa, M. (1997). Ecology, distribution, menace and management of *Parthenium*. In: *Proc. First International Conference on Parthenium Management*, Dharwad (Karnataka), India, pp. 1-12.
6. Marsie, W., and Singh, M. (1987). Allelopathic effects of *Parthenium* extract and residue on some agronomic crops and weeds. *Journal of Chemical Ecology 13 :* 1739-1747.
7. Narwal, S.S. (1996). Suggested methodology for allelopathy laboratory bioassays. In: Allelopathy: Field Observations and Methodology (*Eds*. S.S. Narwal and P. Tauro) Scientific Publishers, Jodhpur, India pp. 255-266.
8. Pahwa, S.K., Yadav, A., Malik, R.K., Balyan, R.S., and Punia, S.S. (2000). Allelopathic effects of *Parthenium hysterophorus* on weeds. *Indian Journal of Weed Science 32 :* 177-180.
9. Paradkar, N.R., Kurchania, S.P., and Tiwari, J.P. (1997). Chemical control of *Parthenium hysterophorus* L. and other associated weeds in upland Drilled Rice. *Indian Journal of Weed Science 29 :* 151-154.
10. Rao, R.S. (1956). *Parthenium*: a new weed record for India. *Journal of Bombay Natural History Society 54:* 218-220.
11. Rice, E.L. (1984). Allelopathy, Second Edition, Academic Press, Inc., Orlando, New York.
12. Saayman, A.E.J., Venter, H.A., and Van De (1996). Influence of weed competition on the germination and seed vigour of the produced caryopses of *Zea mays*. In: *Proc. Second International Weed Control Congress*. Copenhagen, Denmark, pp. 101-106.
13. Singla, R.K. (1992). Can *Parthenium* be put to use. *The Tribune. 112 :* 6.
14. Sinha, N.K., and Singh, S.J. (2004). Allelopathic effects of *Xanthium strumarium* on *Parthenium hysterophorus*. *Indian Journal of Plant Physiology. 9 :* 313-315.
15. Sushilkumar and Varshney Jay G. (2007). Biological Control of *Parthenium*; Present status and Prospects (in Hindi), *Published by National Research Centre for Weed Science,* Jabalpur, India.
16. Tiwari, J.P., and Bisen, C.R. (1984). Ecology of *Parthenium hysterophorus*. *Indian Journal of Weed Science 16 :* 203-206.
17. Wakjira, M. (2009). Allelopathic effects of *Parthenium hysterophorus* L. on germination and growth of onion. *Allelopathy Journal 24 :* 351-362.