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Biological Control of *Lantana camara* through *Spilosoma oblique and Rhizopus* Species

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Abstract : This research was aimed at evaluation of bio-control effectiveness of *Rhizopus spp*. against *Lantana camara* initially Lantana Plants were treated by releasing insects *Spilosoma oblique*. Reported insect was able to develop, survive and reproduce vigorously on lantana plant parts under laboratory conditions continuously. Evidence of conspicuous and damaging effect of *Rhizopus spp* on lantana indicates that the pathogen is able to infect a wider range of weedy clusters and is significantly more damaging to target plant. Successful invasion has been obtained with the pathogen on already stunted weed infested with insect biocontrol agent which caused complete decay of the weed hence proved this fungi is highly host specific pathogen to lantana.

Keywords Biocontrol, *Lantana camara, Spilosoma oblique, Rhizopus spp,.*

Introduction

L. camara is generally harmful to biodiversity and has been considered as an agricultural weed leading to large economic losses in many countries. In addition to this, it increases the risk of fire, is toxic to livestock and is a host for several pests and diseases. *Lantana camara* L. (Verbenaceae) and other species of lantana has been declared a noxious perennial weeds in all over India under the *Noxious Weeds* Act, 1993 and Northern Territory Weeds Management Act 2001 of India, assuming serious proportions in Madhya Pradesh, Uttar Pradesh, Andhra Pradesh and Mysore where jungles of this woody shrub grow, making clearing operations difficult and expensive (Sharma and Raghubanshi, 2007). In a recent study Ghosal *et al.* (2016) identified the most dominant pollen responsible for IgE sensitivity in most patients emerged from *Lantana camara* (LC) an obnoxious weed growing in and around suburban areas of West Bengal. Therfore, it must be carefully managed through combined preventive strategies. Its mechanical control is reported to be effective in clear land but requires continual follow-up treatment to remove roots and seedlings of *L. camara*. Cutting and burning stimulate suckering. Similarly chemical method of its control by application of glyphosate, fluroxypyr with aminopyralid, imazapyr and many more herbicides is quite successful but it create pollution problems in the environment. Continuous chemical control of Lantana species using different herbicides made it resistant towards herbicide like triclopy (Goodall and Naude, 1998).

In addition, both chemical and mechanical control methods are costly and labor intensive and are only useful in the short term. Dohn *et al.* (2013) recommend hand pulling for creating firebreaks or where minimizing damage to native species is paramount. A number of biological control organisms have been studied for controlling *Lantana camara* spread. It has been demonstrated that many organisms like *Ophiomyia lantanae* (fruit-mining fly), *Calycomyza lantanae* (agromyzid seedfly), *Teleonemia elata* (leaf-sucking bug), *Teleonemia scrupulosa* (leaf-sucking bug) were used for controlling *Lantana camara* but most failed as it has several varieties or forms resulting in complicating the introduction and establishment of exotic insects.

Despite some limitations of biological control of Lantana, is still considered to be the only viable, lasting control option, since it offers a safe, cost-effective and environment friendly method of suppressing the weed (Anon, 2015).

Use of bio-control agents are proved useful as it has decreased the volume of individual plants making its control methods considerably easier. Although the *L. camara* management through indigenous insect pests was experimented very early at Central Plant Protection Training Institute, Hyderabad, Andhra Pradesh, India (Verma and Sadatulla, 1969) but had not been remained successful for the want of more insect - plant relationship investigations for better management of this weed.

Among the insect pests Spilosoma obliqua (Lepidoptera: Arctiidae) larvae is a polyphagous and sporadic pest and has been reported to cause extensive damage to many crops and nearly 126 plants species (Singh and Varatharajan, 1999). The larvae are voracious feeder and its population often reaches epidemic level when they defoliate plants.

Spilosoma oblique has been identified as new record on *Lantana camara* was able to develop, survive and reproduce vigorously on lantana plants under laboratory conditions (Mishra *et al*., 2014). This research was aimed at evaluation of biocontrol effectiveness of *Rhizopus spp* against *Lantana camara*. Pathogens cause important

disease in any plant object which plays a direct role in the destruction of the natural resource. The distribution of *Rhizopus* introduced in the lantana plant spreads in few days due to detrimental effects on weed. The fungus is attracted to the lantana by chemical stimulants released by actively growing weed plant cells or decomposing weed residues and continues to grow on the external surface of the weed. It causes a specialized infection that penetrates the weed cells and releases nutrients for constant fungal growth and development. Paper also includes a brief description on life cycle of *Spilosoma obliqua* on lantana and its prospects on biological control of this weed in the field naturally.

Materials and methods

Larvae of *Spilosoma obliqua* were collected from the lantana fields (Fig.1a), brought to the laboratory and were fed on fresh leaves daily *ad libitum* and the life stages were recorded for three generations. All the experiments were carried out at Mata Gujri Mahila Mahavidylaya (Auto), Jabalpur under the laboratory conditions. Individual larvae were reared in separate boxes and data were recorded on size, number, molting and duration of stages. Fifteen replications were prepared for the study of life cycle experiment. As reported after releasing and its intensive feeding behavior on lantana indicates its, round the year contribution in damaging lantana weed.

Lantana twigs affected with fungus were collected from the field (fig. 1b) and inoculated in PDA plates treated with antibacterial drugs. Fungus isolated from the leaves of affected lantana weed was identified as *Rhizopus* spp. Plates were Incubated for 72 hrs at 30^0C (Fig. 2). Culture was purified by selecting the individual colonies and re-inoculating them. Finally 500 ml broth culture was prepared in Potato dextrose in conical flasks (Fig. 3). After about 72 hours Broth culture of fungus was sprayed on treated plant using vacuum sprayer. Control pot was sprayed with broth only. Plants were watered every day up to 4 to 6 weeks. Subsequently later within one month, all plants in the pots were found dry and dead except control set. No regeneration or revival was seen even after 2 months of observation.

Fig. 1- Lantana plant infested with
(a) *Spilosoma oblique* (b) *Rhizopus* spp.

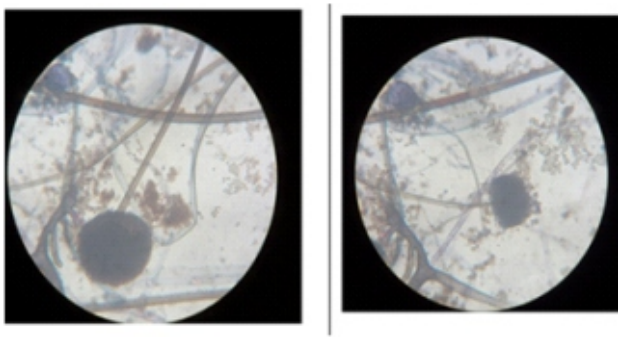

Fig. 2: *Rhizopus* spp under microscope (40X).

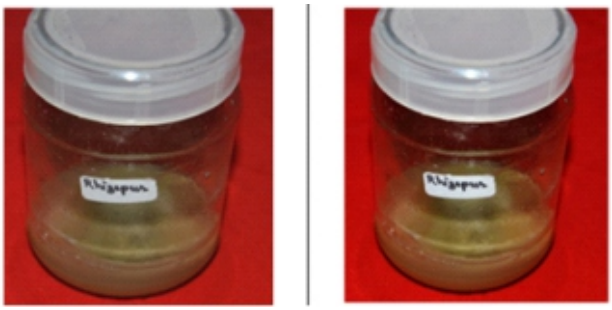

Fig. 3: Broth culture of *Rhizppus* spp.

Results and Discussion

It was reported that ***Spilosoma obliqua*** are damaging *Lantana* weed significantly in the field (Fig.1a). Single first instar could feed 7.14% of the average leaf area of the single lantana leaf in 24 hrs. Whereas larvae above fourth instar could consume 100% of average leaf area of the single lantana leaf within 24 hrs. First and second first instars did not damage the shoot. Seventh instar caused maximum 28.25% damage in average length of the twigs exposed for 72 hrs. Except first instar, almost all the instars make considerable damage in lantana fruits within 24 hrs. First instar showed only 3.21% damage in fruits within 72

hrs whereas seventh instar larvae caused 79.73, 98.89 and 100% damage in lantana fruits within 24, 48 and 72 hrs respectively.

To observe the devastating effect of *Rhizopus spp* along with the insect as biological control agents on lantana, the weed plants were planted in pots and reared up to one month before releasing insects (Fig.4). When plants got sufficient no of leaves, *Spilosoma oblique* larvae were released for 72 hrs (Fig.5).

Fig. 4: Lantana pots 4 -5 weeks before treatment.

Fig. 5: Lantana pots after 2-3 days feeding by *Spilosoma oblique* larvae

Fig. 6: Pots one month after spraying *Rhizopus* spp. Culture.

After that *Rhizopus spp.* has been assessed and screened for spray. Once the pathogen is successfully established, significant damage to the weed *L. camara* has been noticed by infecting leaf petiole and stem tissues, resulting in cankering, and stem die- back as well as premature leaf drop decompose and destroy the plant completely within the specified period (Fig.6). The pathogen along with insect biocontrol agents would definitely append the eradication process of this weed clusters. A new insight being generated as the specific pathogen spp amalgamated with the other biocontrol agent trigger a threshold to get rid of an obnoxious weed *Lantana camara*.

For almost a century, attempts have been made to control *L. camara* using insects (Swarbrick *et al.,* 1995). Sonya Broughton (2000) excellently reviewed the success of biological control agents in the field and evaluated the progress on biological control of lantana world wide. Despite the efforts and time expended on lantana biocontrol, results were variable. From the results it is very clear that the *S. obliqua* larvae are efficiently feeding on leaves, shoot and fruits during their life cycle. This specific species was found naturally infecting *Lantana* spp. around Jabalpur region as surveyed so and when reared in the laboratory was able to continue its life cycle in varying temperature without decreasing in feeding on green mass of weed which indicates its round the year contribution in damaging lantana weed (Mishra *et al.,* 2014). From the evidence presented by Sarah *et al.,* (2000), in their paper, fungal pathogens clearly have the potential to play a significant role in the classical biological control of *L. camara.* The interaction of insects and pathogens has not been investigated in any detail on this weed. Manenji *et al.* (2017) concluded that amines were detected only in *L. camara*, extract may utterly be responsible to attract a few specific fungal pathogens.

Conclusion

So far, many control actions have been employed to curb *Lantana camara* infestations in India, but none have been able to completely restrict its incursion. There is lot of scope for screening of various biological agents for safe and efficient control of weeds including Lantana spp. Application of *Rhizobium* spp. on already stunted weed infested with insect agents caused the complete decease of the weed plant and prove a positive way for entire eradication of weed from the environment. Further studies are required on the strategic and sustainable approach incorporating holistic process of control and management of this invasive species.

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