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Biological Control Agents of *Lepisma saccharina* (common silverfish)

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ABSTRACT

Lepisma saccharina being a popular household pest is often a matter of concern in bookstalls, libraries, archives and residential houses. Though several chemical formulations are available in market but the habit of silverfish of living in crevices and being nocturnal in nature limits their application. Besides their application needs expert knowledge and they are environmentally harmful. The application of natural predators to eliminate silverfish is itself annoying. Thus an experiment, to find out easily available and environmentally friendly substances to get rid of these pests, was carried out. Several commonly occurring plants of Kashmir region were used to observe their effects on silverfish in proximity. A known number of organisms were introduced into separate boxes containing the repellent plants and the number of organisms escaping as well as dying were observed and recorded. The highest repelling effect was observed for pyrethrum and lowest for willow leaves. The concentration of the repellent showed a positive correlation with their repelling effects.

INTRODUCTION

Lepisma saccharina belongs to the basal insect order- Thysanura, a group of primitive insects that are wingless and covered with scales (Smith, 1970). They are usually found in homes, being primarily nuisance pests but they can destroy cereals, books, papers, wallpapers and other starchy items with their excrement (Steven, 2007).

Its common name “Silverfish” derives from the animal's silvery blue colour, combined with the fish like appearance of its movement while the scientific name “L. Saccharina” indicates its preferred diet of carbohydrates such as sugar or starch (Jackman, 1981). While scientific name can be traced back in 1758 (Linnaeus, 1758) but the common name of silverfish is in use since 1855 (Harper, 2001). Silverfish are found commonly as human commensals worldwide. They are thought to be endemic to Paleoarctic and introduced in other bio-geographical regions (Lopez, 2001). This wingless species of primitive insects is estimated to have existed for over 300 million years, originating in Paleozoic era (Barnes, 2005). The adult and immature stage are alike except in size and development of sexual maturity which is attained through moults. There is no metamorphic life cycle (Morita, 1926). The Earwigs, house centipedes and Spiders are known to be the natural predators of silverfish (Day Eric, 1996).

MATERIAL AND METHODS

The sun dried shoots of some prevalent and easily available plants were used to monitor their impacts on silverfish if in proximity. Seven closed boxes labeled from I VII, each of the uniform dimensions of 30 x 45 cm, were used. (Fig. 1) On the basis of known local traditional knowledge only those plants which are common and easily available were selected for the purpose.

Paper material was filled up to first four inches of the box and there were two slit pores, one inch wide, on the opposite vertical sides of the boxes at a distance of six inches from the bottom. The boxes were placed one by one in the centre of a high bordered tin tray of 60 × 75 cm in an open lawn so that the outside of the box be well illuminated.

The animals were caught with an extra care owing to their delicate body. The rotten, thrown out books and papers were shacked gently on an open lid plastic jar and the flour baited trap used and devised by Mallis (1941) was also used. The slippery

glass jars given an outer jacket of adhesive tape so that the insects could get a foothold to climb up in order to reach the white flour kept inside, were placed in unattended areas of a house for few days.

The animals were kept in containers which were maintained at 22±30c temperature and 7080 % relative humidity exactly required for the best growth and reproduction of the animal (Adams, 1937; 1959). Thirty animals were introduced in each box before bringing them to the experimental tray.

The following seven plants were used

Box	Repellent
I	*Juglans regia*
II	*Capsicum annum*
III	*Artemisia absinthium*
IV	*Salix alba*
V	*Cotula anthemoides*
VI	*Pyrethrum hysterophorus*
VII	*Bergennia sp.*

The concentration of the plant (repellant) wrapped in a cotton cloth and introduced in to the box was 150 and 300 grams for two consecutive experiments.

The results of both replications were obtained as;

During first half an hour, the number of organisms escaping from the boxes and thus falling into the tray was recorded after 10, 20 and 30 minutes.

The boxes were kept in a dark room for next three days, after which boxes were opened in the tray and organisms both dead as well as alive were counted and

recorded.

Fig. 1 A box with repellent in the tray

RESULTS AND DISCUSSION

For each repellant used, the number of organisms escaping from the experimental boxes during first 10, 20 and 30 minutes of introduction was recorded. The experiment was repeated to observe the effects of concentration of repellent on the organism. The results obtained are given in Tables 1 and 2 and Fig. 2.

Table 1. The results of repellents used at a dosage concentration of 150 g

Box No.	Time interval (minutes)	Number of organisms escaped	Percentage (%age)	After 3 days (Individuals)	
				Dead	Alive
	10	05	16.6	None	04
Box	20	09	30		
I	30	15	50		
	10	07	23.3	None	None
Box	20	14	46.6		
II	30	20	66.6		
	10	08	26.6	None	None
Box	20	14	46.6		
III	30	22	73.3		
	10	-	-	None	10
Box	20	01	3.3		
IV	30	03	10		
	10	04	13.3	None	03
Box	20	08	26.6		
V	30	17	56.6		
	10	12	40	04	None
Box	20	18	60		
VI	30	25	83.3		
	10	-	-	None	13
Box	20	02	6.6		
VII	30	05	16.6		

Highest repellency was observed in case of box VII containing *Pyrethrum* (83.3%) followed by box III containing *Artemisia* (73.3%). The box IV containing *Salix* and box VII containing *Bergennia* exhibited poor repellency. The immediate deaths of the organisms were observed only for *Pyrethrum*.

Table 2. The results of repellents used at a dosage concentration of 300 g

Box No.	Time interval (minutes)	No. of organisms escaped	Percentage (%age)	After 3 days (Individuals)	
				Dead	Alive
Box i	10	05	16.6	None	None
	20	11	36.6		
	30	18	**60**		
Box ii	10	09	30	None	None
	20	17	56.6		
	30	26	**86.6**		
Box iii	10	08	26.6	None	None
	20	19	63.3		
	30	25	**83.3**		
Box iv	10	02	6.6	None	05
	20	05	16.6		
	30	09	**30**		
Box v	10	06	20	None	None
	20	10	33.3		
	30	20	**66.6**		
Box vi	10	14	46.6	08	None
	20	20	66.6		
	30	22	**73.3**		
Box vii	10	02	6.6	None	08
	20	04	13.3		
	30	07	**23.3**		

In first experiment the boxes IV and VII containing *Salix* and *Bergennia* exhibited poor repellency but in experiment II they enhanced their effect which indicates that concentration of repellent has a bearing on its efficiency

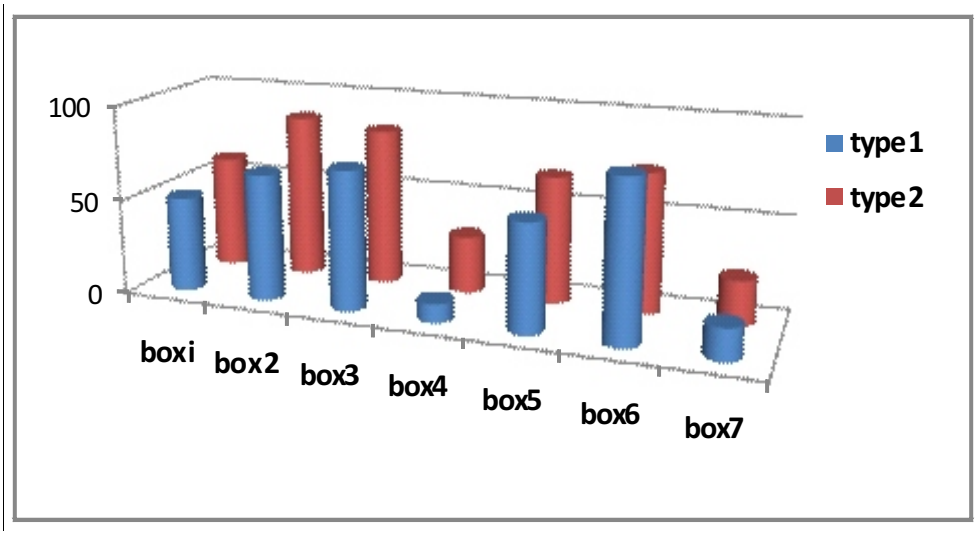

Fig. 2. The comparison of organisms escaped on doubling the concentration of the repellents.

The type 1(green) represents the exp. I (conc.150g) and

The type 2 (red) represents the exp. II (conc. 300g).

The results of the study suggests following: That the common household practices of keeping red pepper or some other repellents in clothes and books / papers holds good, as these materials have anti-silverfish properties.

The most powerful repellent was the pyrethrum as the highest percentage (83.33%) of silverfish left the box within first half an hour and the four animals were found dead after three days indicating that only could leave the box after half an hour (Table.1)

The lowest repellent activity was exhibited by box (VI) containing dried willow leaves. It

Cotula couldn't show better result during first 10 minutes but as the time goes up, a good number of organisms left the box indicating its higher concentration can do well.

The concentration of the repellent has a marked effect on its activity as studied by Wang *et al.* (2006) for leaves of *Cryptomeria japonica*. It is clearly evident from the fig. 1, the comparison of repellent activity and the number of alive organisms in box IV and V in two successive experiments and the immediate death of eight organism in box (VI) in IInd experiment.

L. saccharina is able to distinguish a more noxious stimulus. It is depicted by the movement of silverfish (being negatively phototaxic) outwards from dark interior to illuminated outside under the repellent stimulus.

Since the silverfish lives in narrow crevices and is nocturnal in habit, it is rarely noticed. The application of insecticides is not much effective as it doesn't often reach the interior of crevices. Thus the application of these natural repellents can help in preventing the valuable documents and clothing.

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