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BIOCONTROL POTENTIAL OF *LEPTUS* SPECIES OF MITE- AN ECTOPARASITE OF *LEPTOCORIS AUGUR* FABR. (HETEROPTERA-COROIDEA-RHOPALIDAE), A PEST OF KUSUM TREE, *SCHLEICHERA OLEOSA* LOUR. (SAPINDACEAE)

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ABSTRACT : *Leptus* sp. of mite larvae are ectoparasite of Kusum plant bug, *L.augur*. It parasitizes the adults and nymphs of host bug throughout the year, maximum being during rainy season July to September and minimum during winter months December to February. The parasite brings physical and anatomical changes in host. Percent of parasitization in field varied from 2 to 18% and 50 to 77.7% in laboratory.The parasite is able to check the multiplication of bug population upto some extent and can be used as biocontrol agent.

Key words : Ectoparasite, *Leptus* sp., *L. augur*, biocontrol potential.

INTRODUCTION

Leptocoris augur is a phytosuccivorous bug, which drains out sap from leaves and bark and pierces the testa of the seeds and sucks the oily food content of *Schleichera oleosa* on which lac of best quality is cultivated. Damaged seeds loss viability (Dhiman and Gulati, 1986). It feeds gregariously on the fallen pulpy fruits and blackish seeds and makes unfit for sowing. Insects pests whenever occur in large number, cause havoc inflicting heavy loss in the yield of crops, such as recently entered "Fall army worm or Corn army worm (*Spodoptera frugiperda*)" in India. It has caused 70% loss to corn crop in Africa (Hindustan Times, 10th August, 2018).

Hence, control of insect pests is needed on priority basis. Chemical control poses a great threat to nature and causes pollution hazard. Biological control of insects pests using natural enemies is ecofriendly and cost effective. An ectoparasitic mite *Leptus* sp. has been discovered by Dhiman (1987) parasitizing *L.augur* in good number. In present paper its biocontrol potential is being described after two years field and laboratory investigations.

MATERIALS AND METHODS

Leptus sp. larvae are collected from the infested bugs and brought alive in vials and polythene bags in Entomological Research laboratory in D.A.V. (P.G.) College, Muzaffarnagar. Bugs collected from the field area HRI Training Center, Saharanpur are reared in large numbers in laboratory in hurricane glass lantern chimneys covered at top by fine muslin cloth and wooden wire gauzes for biocontrol efficacy as well as to observe mode of parasitization. Natural enemies have also been reared separately. Permanent slides of the parasites are prepared after dehydration. For rearing of the *Leptus* sp. following materials and methods are used. Various experiments were carried out for bio-control potential.

Rearing of *Leptus* sp.

1. Collection of infested bugs : Infested bugs, *L. augur*, were collected along with fresh leaves and seeds of Kusum plants, *Schleichera oleosa*, by hand picking method from the study site area (Horticultural Experiment and Training Centre, Saharanpur) in polythene bags (20×24 cm). The bugs show gregarious feeding habit on the seeds of aforesaid plant (Dhiman and Gulati, 1986), hence, can be easily captured by hand. They were brought alive in the laboratory at atmospheric temperature and humidity and restored in hurricane glass lantern chimneys.

2. Rearing of bugs in hurricane lamp chimneys : Four glass chimneys of the diameter, 24×36 cm, were taken and these were fitted with fine muslin cloth on the top to allow circulation of air and the bottom of each chimney was placed in a petridish having wet soil collected from the field was first cleaned, sterilized in hot oven and then a thin layer of the same was spread in the petridish. For water supply, a cotton swab was placed in a water filled glass vial. Fresh tender leaves and crushed kusum seeds were also kept in each chimney as a food source. Then, each chimney was placed on a wooden table in laboratory near a window at 28°C and 70% R.H. Now, 25 to 40 mite infested bugs were released in each chimney .The stale food was replaced daily with fresh one .The soil in petridish also kept moist. Laboratory temperature

and relative humidity were recorded at 12.00 noon. Rearing petridishes were examined daily. The larvae of *Leptus* sp. dropped down in the soil from the host body in between four to six days after attaining full engorgement.

3. Separation of dropped larvae : Dropped larvae on the moist soil from the host body were collected with the aid of fine camel hair brush and were kept into separate petridishes, containing clean and sterilized moist soil. Now, these petridishes were covered with fine moist muslin cloth piece and were placed into another big petridishes filled with water, to avoid the escape of the parasites as well as to prevent the entry of ants, etc., (double tray system).

4. Rearing of engorged larvae : Now these petridishes were arranged into a big tray and examined daily at the interval of three hours. The larvae underwent into the soil and for this purpose they used only their legs and palpi and after this they reached their desired position in the soil. Dropped larvae from the host bugs remain active for several hours and when reached under the soil, transformed into an active swollen larval mites and after some hours changes into pupa 1 or nymph chrysalis.

5. Separate rearing of Pupa I or Nymphochrysalis for nymph : The pupae I were transferred into another double tray system. After the emergence of nymph from pupae I, the fresh food was supplied to nymphs which mainly consist of soil micro-arthropods (Collembola and other soil micro-organisms as these are present in soil humus in field). Nymphs avoid to feed on the eggs of *L. augur*. Whenever, the eggs of this bug were supplied, the nymphs showed negative feeding response. Stale food was replaced with fresh food daily.

After feeding for a few days, the nymphs came into engorged condition and went under the soil to become inactive engorged nymphs, which pupated into Pupae II or imagochrysalis.

6. Rearing of Pupae II for adult : The Pupae II were transferred into another double tray system. Adult mites after emergence from Pupae II are capable for walking and running. Like that to nymphs, the same food was supplied to the adults.

During the rearing experiment, fungal growth in the rearing tray was observed, which is one of the most important hazards of laboratory colonization of mites. There is no method for prevention of fungal growth but when grown, is required to be cleaned daily with skill and dexterity which is gradually acquired with practice. Besides, cleansing the fungi daily,observation of different stages of development of mite is also essential in that the different stages need to be transferred to the appropriate tray. During the rearing, it is also necessary to maintain the moisture, regular supply of fresh food and prevention of entry of entry of insects like ants, inside the rearing tray from other important schedule for the maintenance of mite colony.

7. Pairing of male and female mites : After emergence of adult ***Leptus*** sp. mite from pupa II, the sex was identified and a pair of each opposite sex was placed in a small seamless Tin box containing moist sandy loam soil or a damp block of plaster of Paris. Many such boxes were prepared. At this time, same food was given to the adult mites as already mentioned in the rearing of the nymphs.

The process of copulation and egg laying was studied keenly under stereoscopic binocular microscope and with the aid of hand lenses (10 x). After the oviposition, the eggs were transferred with the aid of camel hair brush on the moist soil in petridish. A close vigil was kept and the content of the petridish was examined daily under binocular microscope to note the progress in incubation. Necessary moisture was maintained by adding the water whenever needed.

For biological control and to note the infestation, the quantitative evaluations were made as under-

1. The intensity of infestation/ percentage of infestation was derived by :

$$\frac{\text{Total number of hosts infested}}{\text{Total number of hosts examined}} \times 100$$

2. The mean number of ecto-parasites per observed hosts was derived by :

$$\frac{\text{Total number of ecto-parasites on hosts}}{\text{Total number of hosts observed}} \times 100$$

3. The mean number of ecto-parasites per infested host (an idea about population density) was derived by :

$$\frac{\text{Total number of ecto-parasites}}{\text{Total number of hosts infested}} \times 100$$

4. The population density or concentration index means to the total ecto-parasites burden on a host.

5. The average longevity in days was derived by :

$$\frac{\text{The number of adult mites died}}{\text{Total number of adult mites tested}}$$

The sum of this reading will be the average longevity.

Thus, with the help of the above means further studies were carried out.

RESULTS

Biocontrol potential of *Leptus* sp. (Acarina-Erythraeidae) is evaluated under the following heading separately

Effect of parasitism on the host bug : The adults of *Leptus* sp. are predatory which feed on the eggs of *L.augur* and other small insects found under the litter in crevices and holes of *S. oleosa*. The larvae of this species of mite are ectoparasite of *L. augur* adults and nymphs. These are bright red in colour and feed on the haemolymph of the host bug population in field by piercing and sucking mouthparts. After fully feeding, the larvae become engorged, fall down in soil and pupates into pupa -I which after 8-15 days moults into nympho-chrysalis stage which feeds like a predator and grows in size. After 15-25 days it undergoes to pupa-II stage. This stage lasts for 10-16 days and moults into adult mite. The attachment sites of the ectoparasitic larvae on the host body are observed as –wing axillaries, bases of coxa, joints of legs, antennae and rostrum, pleural joints, cervical region, and tergal and sternite joints. External genitalia and compound eyes ocular membrane, even, are not spared.

The mite load per bug is observed 1-14. Infestation of 1 or 2 *Leptus* larvae does not cause much effect on the host but in heavy infested bugs following effect of parasitization has been observed :

For the study of influence of parasitism, physical changes in the host *L. augur* were studied directly under binocular microscope while anatomical changes were observed by dissecting infested host bugs after dropping off the fully engorged larvae in 70% alcohol under binocular microscope. Besides these, physical behaviour of the infested bug was also taken into consideration.

A. Physical changes

1. The body colour of the host bug changes from bright red to light red.
2. Cervical region comparatively becomes narrower and in heavily infested bugs abdomen shrinks.
3. Wing axillaries are damaged due to gregarious feeding in this region.
4. The host bug is unable to take flight and movement gets slow.
5. Food searching ability decreased.
6. Due to physical weakness, the host turns quite inactive and feeding is adversely affected.
7. Parasitized bug becomes irritated and if mite larvae are attached on head or legs, then the bug tries to remove the mite by moving legs or antennae.
8. Heavily parasitized bugs dies within few days of parasitization or after dropping off the engorged larvae of *Leptus* sp. This occurs due to the seeping out of the body fluid from punctured points which results in the loss of vital haemocoelomic fluid (*i.e.*, bug becomes dehydrated).
9. Decolourised area develops around the feeding point with minute holes.
10. Heavy infested bugs have been observed unable to copulate.

B. Anatomical changes

1. No effect on flight muscles was observed but muscles of wing axillaries were found damaged and poorly developed.
2. Testes and ovaries wereobserved smaller in size.
3. Maturation of ova (vitellogenesis) in ovary is affected.
4. Weight of bug was found decreased in comparison of healthy one.
5. Haemolymph decreased in quantity.
6. Moreover, parasitization in nymphal instars, inhibits the ecdysis and the nymph prolonged its life.

Percent of parasitization in field

For knowing the percentage of parasitization in field, it is difficult to calculate the exact percentage of parasitization due to multiplication of host and parasite population both. Hence, bugs were collected from the field by hand picking method randomly from 5 square meter area and brought alive in polythene bags. These were examined for parasitization. Surveys for collection of bugs for knowing parasitization were conducted monthly during 2016 and 2017. *Leptus* sp. larvae are bright red in colour and externally easily visible on the body of host bug. The healthy bugs were separated from the parasitized ones and the percentage of parasitization or mortality in field was calculated. Data are recorded in Table 1.

Data of Table 1 depicts that parasitization of *Leptus* sp. in field occurs throughout the year, but maximum parasitization 18% occurred in August 2016, 17% also in August 2017. Minimum parasitization percentage (2%) occurred during January 2016 and 4.0% during Jan 2017. In both the years parasitization percentage varied from 2 to 18%.

Percentage of parasitization in laboratory infested bugs

Mass rearing of *Leptus* sp, was carried out in laboratory to gain large number of adults and young stages of the parasite. The technique of rearing has already been described in Material and Method section. Further, in case of *Leptus* sp. huge number of eggs were obtained by gravid

Table 1 : Parasitization percent of the host, L. augur by *Leptus augur*by *Leptus* sp., in field during 2016 and 2017.

Year	Particulars	Months											
		Jan.	Feb.	March	April	May	June	July	Aug	Sep.	Oct.	Nov.	Dec.
2016	Average temp (^{0}C)	12.5	16.2	18.8	26.2	30.2	31.7	29.3	28.1	28.1	28.1	20.2	11.6
	Average R.H. (%)	72.2	70.1	64.5	47.5	45.0	54.4	80.6	86.1	80.2	75.4	70.5	73.7
	Parasitization Percentage												
	of *Leptus augur*	2	4	11	12	16	15	14	18	17	10	11	06
2017	Average temp (^{0}C)	12.6	16.6	21.5	28.0	30.6	31.0	29.0	28.0	28.2	24.9	20.2	15.3
	Average R.H. (%)	75.0	69.2	51.8	34.3	43.6	55.0	80.6	86.3	80.1	73.8	61.1	67.5
	Parasitization Percentage												
	of *Leptus augur*	4	5	5	11	14	15	16	17	14	10.9	8.0	5

Table 2 : Evaluation of parasitization percentage of *L. augur* (in experimental cage) parasitized by *Leptus* sp.

S. No.	Observation Period	No. of bugs released in the cage	No. of bugs found parasitized	Parasitization percent
1	8th July to 24th July 2016	72	36	50
2	1st August to 18 August 2016	100	60	60
3	25th September 15 Sep. 2016	120	80	66.6
4	6th July to 20th July 2017	60	40	66.6
5	9th August to 19th August 2017	90	70	77.7
6	12th September to 21st Sep. 2017	112	66	58.9

Table 3 : Evaluation of mortality percent of *L.augur*in experimental cage by *Leptus* sp. larvae.

S. No.	Observation Period	No. of bugs released in the cage	No. of bugs died due to parasitization	Mortality percent
1	10th July to 25th July 2016	80	4	5
2	6th Aug. to 21st August 2016	100	10	10
3	8th Sept. to 23rd Sep 2016	120	18	15
4	8th July to 20th July 2017	60	3	5
5	9th August to 18th August 2017	90	9	10
6	10th September to21st September to 2017	125	9	7

female adults. Now, newly hatched larvae were collected by keeping the eggs in incubator.

Big wooden wire gauge cages were prepared of the size 1.5×1.0×0.5 meters and used for knowing parasitization percentage in lab. In each cage, a specific number of host population (II to V instar nymphs and male and female adult bu) was released along with crushed kusum seeds. A big wet cotton swab was also placed in the corner of each cage to maintain necessary R.H.

Finally, newly hatched larvae of mite (@ 8 larvae per host), were released in cage. After two days, stale food was replaced by fresh one. Parasitization percentage was observed after 4 days of release and the data are recorded in Table 2.

An examination of Table 2 indicates that the lab. parasitization percent of *Leptus* sp. larvae varies from 50 to 77.7%. Bugs having mite load of 1 to 6 larvae could not cause mortality in the host bugs. However, bugs with a load of 15 to 20 larvae died due to weakness and loss of body fluid.

Biocontrol potential

Biocontrol potential of this natural enemy of *L. augur* is evaluated on the basis ofparasitization percentage in field as well as in lab. Effect of parasitization on the host is also considered.

As said earlier the host bug having mite load 1 to 6 is not much effected but the host bug having mite load of 15 to 20 is affected very much and dies later on due to exhaustion and depletion of haemocoelic fluid. Mortality percentage due to parasitization of this mite species is low (Table 3) and varied from 4 to 15 percent only. Though, it has very good biocontrol potential but it helps in minimizing bug population upto some extent.

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