Biology and control of *Liposcelis bostrychophila* (Badonnel) (Insecta: Psocoptera) a newly recorded insect pest on herbal materials prepared for the export market.

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Abstract
Biology of a newly recorded insect pest on dried Aerua lanata *(Polpala,) a herbal tea prepared for the export market was investigated as this pest affected the quality of the product adversely. The pest was identified as* Liposcelis bostrychophila *(Badonnel, 1931) a Psocopteran species belonging to family* Liposcelidae. *The adult is about 1 mm long had four nymphal instars and life cycle was completed within 30-40 days at mean temperature of 27°C and 90% RH. They reproduce parthenogenetically resulting in a rapid increase of pest population. The present study revealed that this infestation was originated in the warehouse. Maintenance of strict hygienic conditions in the warehouse, further solar drying of the final product for 30 minutes before the preparation of dipping bags were recommended as suitable non chemical methods to control the build up of pest population within the warehouse and the development of the pest in the final product.*
Key words: *Liposcelis bostrychophila*, stored product pest, *Aerua lanata* herbal tea,

Introduction

Herbal materials prepared from dried medicinal plants in Sri Lanka are popular in many countries of the world and there are small-scale rural industries which produce such herbal materials for the export market. The quality of the dried food materials depend on various factors such as retention of natural flavors, natural colour and absence of pesticide residues, pests and diseases etc.Herbal teas such as Polpala (*Aerua lanata*), Iramusu (*Hemidesmus indicas)* and Ranawara (*Cassia auriculata*), have a very high demand in Eastern European countries due to their high medicinal value and the healing properties for a number of disorders e.g. urinary disorders, stomach ache etc. (Anonymous, 1997). Many rural farmers in Chilaw district grow these plants as intercropping or mixed crops. They harvest, wash and dry these crops in solar drying units at about 105°C for 3 days. Field officers from small scale industries collect these samples, process them further and bring them to warehouses. These herbal products are prepared according to customer requirements such as dipping bags packed in cardboard containers that are covered by cellophane and stored in the warehouse until the products are exported to relevant destinations. During this process, the herbal products may be infested by stored product pests such as insects and mites. A product in storage infested with insect pest quickly loses its quality and in turn, the customer demand. In the natural habitat these pests are usually controlled by their natural enemies, but in the stores where there are no such controlling agents, the pest population increases rapidly.

An incidence of heavy insect infestation on a herbal product prepared from dried Polpala (*A. lanata*) was recorded from a small scale industry in Colombo in 2005. Since pest population was building up very rapidly, production of Polpala herbal tea was temporarily halted. The pest was identified as an insect species belonging to the order Pscoptera, which could rapidly multiply under favourable environmental conditions (Broadhead, 1954; Shires, 1982).

The present study was conducted to identify the pest up to species level and study its biology and origin of infestation and finally to find a suitable cost-effective non chemical method to control the pest.

Materials and methods

Infested samples were brought to the laboratory. Collected insects were preserved in 70% alcohol. Insects were identified using taxonomic keys available at HORDI, Gannoruwa. To study the biology pests were reared in dried and crushed Polpala plants in the laboratory under normal temperature. Body length, body width, head length and head width of 106 insects were measured using a calibrated eye piece graticule. Percentage of insects which had similar length ranges was calculated and these values were plotted against the categories to find out the different life stages of the pest. To measure the duration of the life cycle, 10 pairs of adults were separately introduced to the uninfested culture medium (Polpala) in small glass vials. Vials were observed every other day using a binocular microscope.

To find out the source of introduction of the pest to food materials, 10 samples of herbal materials (10 g weight) were collected from each field site in Anamaduwa where herbs were collected, from sites that store collected samples, from solar drying units and from the final processing unit in Colombo that stores herbs after drying for the production of dipping bags. Samples were taken to the laboratory and observed under the binocular microscope for the presence of pests.

The incipient lethal high temperature for the pest was investigated. Survival of pests at five temperatures, 30 ^{o}C, 32 ^{o}C, 34 ^{o}C, 38 ^{o}C and 40 ^{o}C was investigated. Five insects with food in glass vials were kept at each temperature in an oven for overnight and examined. Five replicates were conducted for each temperature. Ten insects were kept in the vial at room temperature as the control.

The impact of solar drying of final product with insects was investigated. Ten (10) insects each were introduced to three samples and dried in a solar drying unit for 10 minutes, 20 minutes and 30 minutes. After drying, samples were checked and the number of insects remaining in each sample was recorded. Ten insects were kept in a vial at room temperature as the control. Three (3) replicates were done.

Plate 1. Adult *Liposcelis bostrychophila* (10x10)

Results

According to taxonomic characters, the pest was identified as *Liposcelis bostrychophila* (Badonnel, 1931) a Psocopteran species generally known as book lice, belonged to the family Liposcelidae. Enlarged hind femora are the characteristic feature of this species (Plate 1).

The percentages of insects were plotted against the respective body length (Figure 1), body width (Figure 2), head length (Figure 3) and head width (Figure 4). According to Dyer's rule 5, peaks in graphs 3 and 4 indicated that the insect has five different growth stages. Adult females were identified by the presence of enlarged abdomen. This study further revealed that these females can reproduce parthenogenetically.

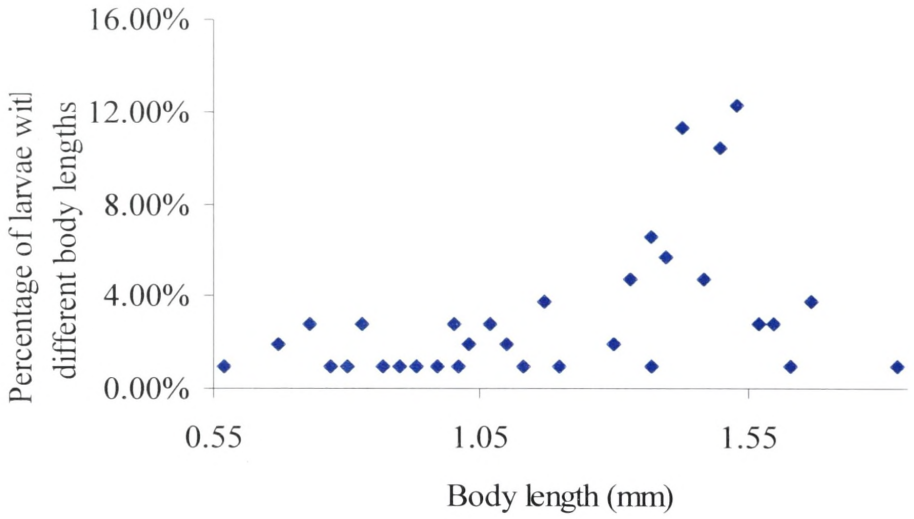

Figure 1. Percentage of *Liposcelis bostrychophila* larvae with different body lengths

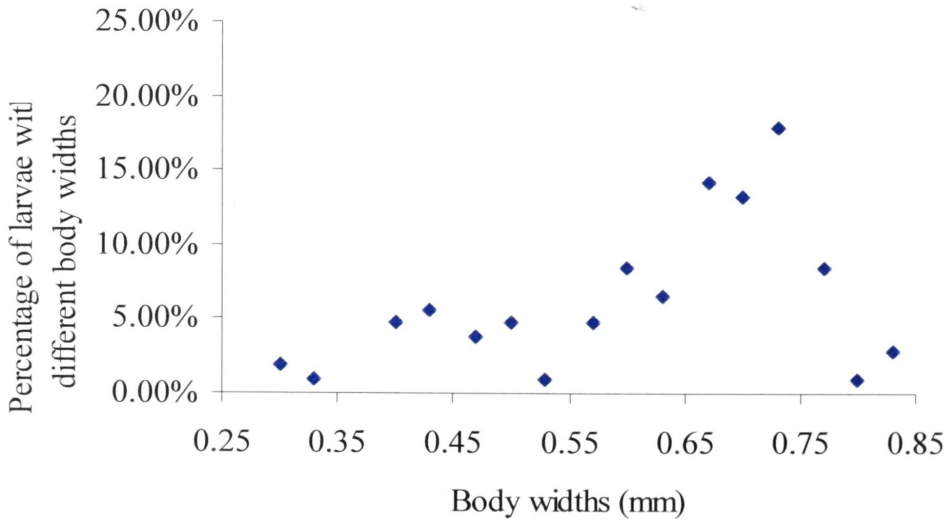

Figure 2. Percentage of *Liposcelis bostrychophila* larvae with different body widths.

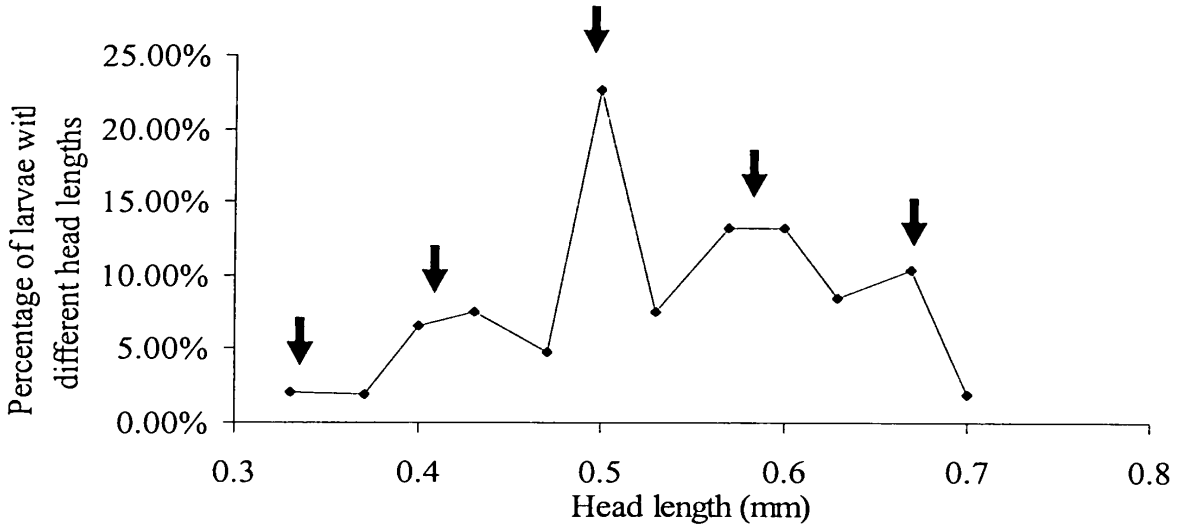

Figure 3. Percentage of *Liposcelis bostrychophila* larvae with different head lengths.

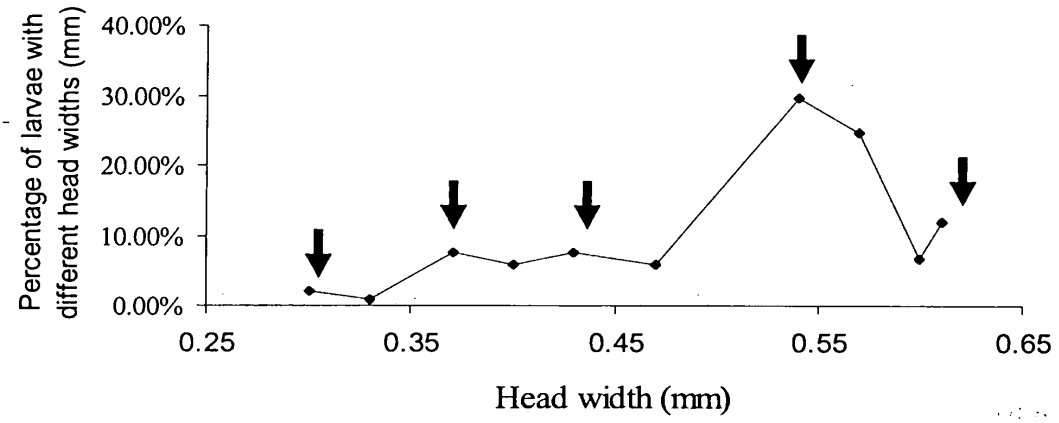

Figure 4. Percentage of *Liposcelis bostrychophila* larvae with different head widths.

Table 1 shows that *L. bostrychophila* was recorded only in the end product sample. They were not recorded in the field sites, stores, and driers. Therefore samples were infested in the packing section at Colombo.

Table 1. Source of introduction of pest to the product at various sites of herbal production

Sites	Presence of insects	Temperature °C
Collection sites	0	28
Storage sites	0	29
Drier	0	65
Storages in Colombo.	+	28

Lethal temperature for *L. bostrychophila* was 40 °C. When the samples were heated to temperature ranges from 30 °C to 40 °C all the tested insects died at 40 °C (Figure 5). *L. bostrychophila* pest density decreased with increased solar drying periods. A sample dried for 30 minutes can reduce the population density by 80% (Figure 6). Therefore further solar drying of the samples before final processing could be recommended as an efficient and easy non chemical method to control the pest. It is practical and does not affect the quality of the final product.

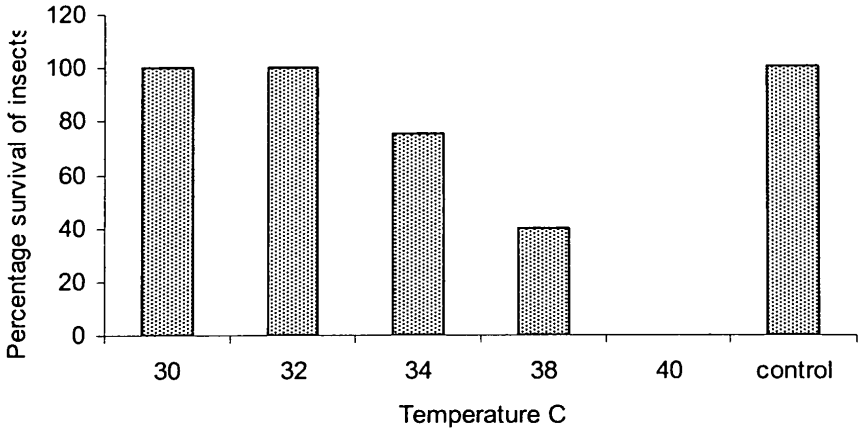

Figure 5. Survival of *Liposcelis bostrychophila* at different temperatures

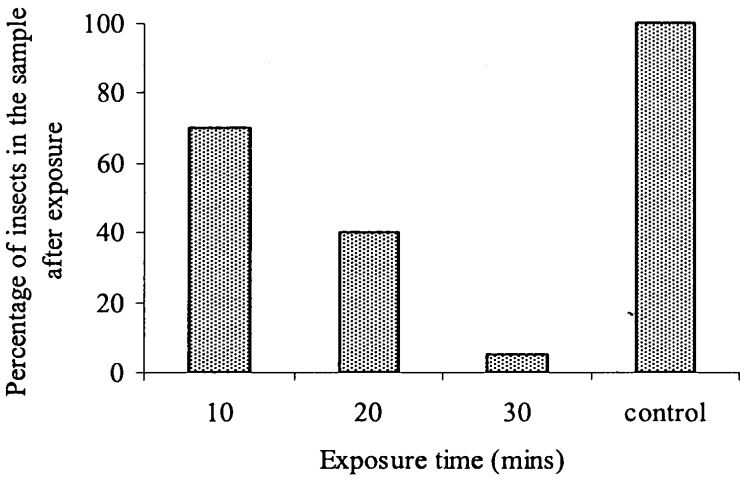

Figure 6. Presence of *Liposcelis bostrychophila* in samples further solar dried for different time periods

Discussion

Most booklice species are found in natural habitats such as nests of animals, tree trunks, crevices under bark (hence the alternative name of barklice) and on leaves. However those species that have achieved pest status are widely distributed and often found in warehouses, food manufacturing units, granaries and museums as well as domestic and retail premises (Broadhead, 1954). *L. bostrychophila* is such a species recorded throughout the world and the present study indicates that polpala is a suitable food material for the development of this pest.

L. bostrychophila has simple metamorphosis accompanied by nymphs. The females of *L. bostrychophila* reproduce without fertilization, the males being suppressed, or dwarfed entirely. During her life each female produces about 200 eggs. The emerging nymphs closely resemble the adult and pass through 4 moults to reach maturity in about 40 days (Shires, 1982). The present study also revealed that *L. bostrychophila* populations collected in Sri Lanka have similar life cycles with four nymphal stages.

L. bostrychophila has a number of effective pest qualities that cause them to become serious pests in the stores *i.e.* a wide range of foods (Srivastava and Sinha, 1997), very wide habitat distribution (Turner and Bishop, 1998), small size which enables it to hide in crevices, avoiding contact with many standard types of treatment and the ability to survive without food for considerable periods of time (Shires, 1982, Turner, 1988, Turner *et al,*. 1996). The present study also revealed that these pests originated from the surviving populations in warehouses used to store the final product for processing. These pests started to feed on dried polpala and became serious pests within a very short time. They may contribute to a gradual heating of grain stored in bulk with an eventual impairment of its properties and reduction in its value (Turner and Maude – Roxby, 1987, 1991).

The control of *L. bostrychophila* could be done in two ways. Being small with flattened bodies, the pests are very inconspicuous, and able to hide in cracks and crevices at low population densities. We suggest that maintenance of strict hygienic conditions in the warehouses or final storage units as the most important controlling measure for this pest. Solar drying is the other method of control, which can be applied easily. Since this small pest possesses a relatively thin cuticle coupled with a large surface/volume ratio, they are not well adapted to survive adverse conditions, particularly low relative humilities or high temperatures (Shires, 1982). However, over drying of the herbal material must be avoided as it could destroy the medicinal value of the final product.

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