The Biology, Medical Significance and Control of Processionary Caterpillars

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Introduction

Processionary caterpillars, the larvae of a number of species of moth, are equipped with barbed poison hairs which may cause severe dermal irritation when they come into contact with human skin. These caterpillars are common in many parts of the world where Service personnel are stationed, and have caused particular problems in Cyprus, Hong Kong and parts of BAOR. This defensive mechanism and the processionary behaviour of the larva, is characteristic of the four species involved, *Thaumtopoea pityocampa*, *T. wilkinsoni*, *T. processionea* and *T. pinivora*.

Distribution

The geographical distribution of the moths covers continental Europe, southward to the Mediterranean and eastwards to Bulgaria and Greece. One species *T. wilkinsoni* is found in Cyprus (where it is a particular pest), parts of North Africa and the Middle East, including Israel.

Description

The adult moths of the genus *Thaumtopoea* have a wing span of about 25 mm. The eyes are bare and ocelli are absent. The antennae of both sexes are combed as far as the tip. The proboscis projects backwards towards the thorax, which is thickset and covered in woolly hairs. The abdomen has a posterior bush, though in the male the hairs are of a stouter composition. Arising from the end of the abdomen is a single spur. *T. pityocampa* and *T. wilkinsoni* are closely related and of a similar appearance, the head possessing a chitinized cockscomb of four serrations (Fig. 1). The forewings are grey-white with darker transverse stripes and the hindwings are white. The ovum is 1-1.5 mm in diameter, white and spherical. The larva has a blue-black dorsal surface and whitish underside. The head is black, and the mirrors, areas of cuticle containing the poison hairs, are slightly raised. Abdominal segments are coloured yellow-brown and the long lateral hairs, are grey-

Fig. 1 Head of adult *T. pityocampa* showing chitinized cockscomb of four serrations¹.

white. The pupa is russet in colour and possesses two hooks at the cremaster.

T. pityocampa, *T. wilkinsoni* and *T. pinivora* prefer to feed on trees of the genus *Pinus* with *Cedrus* species as a second choice.

In comparison to *T. pityocampa* and *T. wilkinsoni* the adult of *T. processionea* has a flatter head and the serrated chitinized cockscomb is absent. The forewings are yellow-grey with the darker bars being indistinct or absent. Hindwings are grey-white in colour. The egg is white with flattened ends. The head of the larva is brown-black and the body blue-grey with a yellow-grey underside. In general appearance the larva is not as hirsute as those of the other species. Members of this species are often found on oak trees.

Life Cycle

The adult moth emerges from the pupal case with the aid of the chitinized process on the head, the male emerging before the female. The preferred

flying period is two hours before and two hours after sunset and the distance travelled during this time may be in excess of 4 km. During her first flight the female moth becomes sexually mature and starts to produce a sex attractant. Males attracted to the scent generally copulate with the female within one hour of their own emergence. Between thirty minutes and several hours after the copulation the female begins egg laying, moving in a spiral around a pine needle stem (Fig. 2). Each egg batch contains 7-300 eggs and ovi-position may take up to four hours.

Fig. 2 Eggs, laid around a pine needle¹.

First instar larvae emerge 30-45 days after ovi-position and spin a nest in the immediate vicinity of the egg cluster, within which they consume all available food. Larvae emerging later in the year, when temperatures are cooler, tend to construct their nests in parts of the tree which attract the most sunlight and therefore warmth. The insulating nature of the closely woven fibres can control the interior temperature of the nest to within 1.5°C, and larvae have been reported to survive for ten hours at 10°C¹.

It is prior to pupation that the presence of the 4th instar larvae is most apparent. Their migration procession in search of a suitable site for pupation brings them more into contact with people and animals. A procession first forms when larvae gather into a tight ball, which later flattens to a disc of larvae rotating around a single caterpillar. This central figure is often the leader of the procession when it becomes linear. Each larva in the procession maintains fore-and-aft contact with the others as they migrate to a suitable area in which to pupate. Pupation occurs in sunny situations in wooded areas, for example clearings and paths. The soil must be of a consistency which the larvae can penetrate, and the optimum soil temperature is 20-22°C. Should the temperature drop sharply after the larvae have entered the soil, they may well re-emerge and, again in procession, move to a more suitable area, provided they have not yet begun to spin cocoons. The duration of the pupal stage is 4-5 months in optimum conditions; this may be delayed by four

months if the temperature above ground is unsuitable for larval viability. Temperatures in excess of 32°C are lethal to both eggs and larvae.

Medical Significance

The defensive mechanism by which the larvae of all stages may cause urtication consists of cuticular projections containing a poisonous fluid. The exact nature of the haemolytic poison is not known. These projections or spines are readily detachable and can easily penetrate tender skin, when the tip of the spine breaks off releasing the poison. The poison spines are situated on 'buttons' or 'mirrors' positioned laterally in pairs on each segment of the larva. Normally covered by folds of skin, the mirrors become exposed if the caterpillar is alarmed. Poison spines found on lepidopterous larvae are of two types, primitive and modified. Those found on the larvae of *T. pityocampa* are of the modified type (Fig. 3). Detached spines are sometimes present on pupal cases and newly emerged adults, where they may still cause dermal irritation to those who come into contact with them. Indeed in one case 600 out of 3000 Israeli soldiers encamped in a pine grove demonstrated urticaria and skin irritation although no living larvae were discovered in the area².

The degree of injury depends on the species of caterpillar, the amount of poison injected and the

Fig. 3 Poisonous spines of lepidopterous larvae³. A primitive. B modified.

sensitivity of the patient. Faust³ states at the time the poison is introduced "... there is a local burning, stinging sensation, the affected area becomes erythematous, then elevated and whitish, with a redder border extending radially as much as 2.5 cm, and a peripheral reddish macular zone 2 cm beyond." Occasionally urticarial wheals may develop over the entire body, accompanied by systemic manifestations suggesting a neurotoxic syndrome. Further complications of poisoning in severe cases may cause muscle cramps, intense headaches, nervousness and tachycardia⁴. Should the hairs come into contact with the conjunctiva, cornea or iris, local lesions may be produced with pseudotubercles around the hairs. Even superficial gangrene has been reported from the upper and lower eyelids, resulting in scarring, corneal ulceration and chronic conjunctivitis from a boy who came into contact with larvae of *T. pinivora*⁵.

The only satisfactory treatment appears to be the application of palliative lotions⁶. The use of tetracaine ointment is suggested, Benadryl, and occasionally codeine sulphate to relieve the pain. According to Wigglesworth⁷ the poison appears to liberate histamine in the tissues but not to produce it.

Predators and Parasites

The gregarious behaviour of the larva, involving the migratory habit and therefore a change of habitat, exposes it to a wide variety of predators and parasites. Several birds including the Great Tit (*Parus major*) appear to be unaffected by the poisonous hairs and may consume larvae in large quantities. Similarly predatory insects, for example the earwig *Forficula auricularia*, will consume the eggs. The largest group of parasitic insects which may seriously affect processionary caterpillars is the parasitic wasps (Order Hymenoptera). Ten or more species are involved, including *Ooencyrtus pitocampae*, *Tetrastichus servadei*, *Trichogramma* sp, *T. evanescens*, *T. semblidis*, *Anastatus bifasciatus*, *Charitophorus* sp, *Meteorus versicolor*, *Coelichneumon rudis* and *Conomorium eremita*.

Adult wasps lay eggs inside the caterpillar or in some cases the pupa. The eggs within the parasitized larva develop and emerge once the moth has pupated. In Cyprus where the larva of *T. wilkinsoni* is a common pest, *O. pitocampae*, *A. bifasciatus* and *Conomorium eremita* are reported as effective parasites⁸. Other insects known to parasitize the larva of *Thaumtopoea* sp belong to the Order Diptera and include *Villa brunnea* (Bombyliidae), *Compsilura concinnata* and *Tricholyga segregata* (Tachinidae). Georgiou⁸ reports the two tachinids from Cyprus.

The larva is also known to be susceptible to at least two viruses *Borrelinavirus pitocampae* and

Smithiavirus pitocampae, isolates of which have been found in large numbers in the fat body and tracheal systems of dead larvae. The susceptibility of the larva and pupa to fungal disease is also reported¹, but it is difficult to quantify the degree of pathogenicity. Fungi isolated include: *Beuveria bassiana*, *Paecilomyces fumoso-roseus*, *P. farinosus*, *Cordyceps* sp and *Metarrhizum anisopliae*.

Control

Control measures used against processionary caterpillars may be physical, chemical or biological.

Physical control can only be used successfully against the larva while it is still in the nest. The nests, and the branches to which they are attached, are carefully cut from the tree and burnt. This method was used successfully in Spain in 1969-70 to control processionary caterpillars infesting 52,000 hectares of land.

Chemical control is reported to be a long and expensive process involving the use of residual insecticides in infested areas. It is possible that penetration of the nest by insecticides is poor and climatic factors, rainfall in particular, may lower the amount of available insecticide, thus reducing the efficiency of the control programme. Ultra-low volume (ULV) application and thermal fogging using non-residual insecticides have been used in Cyprus against *T. wilkinsoni* but no figures are available to indicate the effectiveness of this method.

Biological control involves the use of *Bacillus thuringiensis*, a selective insect pathogen. This method was used successfully in France in 1958-9 with an average mortality rate of 81% in treated areas, as opposed to 10% in untreated areas¹.

In Italy *B. thuringiensis* was used against *T. wilkinsoni*. The bacteria were formulated as a suspension of 30 x 10⁶ spores/g. and applied at a rate of 6 kg/ha. by helicopter. The mortality rate varied between 62.5% and 99.8%. Other countries which have successfully used *B. thuringiensis* include Bulgaria, Yugoslavia and Greece¹.

Discussion

The urticarial lesions produced by some species of *Thaumtopoea* are sometimes sufficiently severe to make this insect a serious nuisance.

Further observations into the biology of the insect may result in more efficient methods of control. Chemical control is undoubtedly the most economical and labour saving method used, but may also result in the destruction of the indigenous predators and parasites. The treatment of individuals affected by the poisonous hairs of processionary caterpillars, the biochemistry of the poison involved, and the way in which it affects tissues requires further investigation.

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