

INVESTIGATIONS ON PARASITES AND PREDATORS OF SOME MAJOR FOREST INSECT PESTS IN INDIA

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(Received 31 March 1976)

Natural enemies of *Adelges* spp., *Pineus laevis* MASKELL, *Lymantria obfuscata* Wlk., *Hypsipyla robusta* MOORE, *Petrova Cristata*¹ (Walshingham), *Dioryctria* spp. and *Sirex* spp. have been investigated in India with a view to possible biological control of the same or related forest insect pests in various parts of the world. About 50 predatory species attack *Adelges* and some of these have been introduced into Canada and the U.S.A., but without success. Predators of *P. laevis* occurring in India are worth trying against *Pineus pini* (L.) in East Africa and Hawaii. *L. obfuscata* has a large complex of hymenopterous and dipterous parasites, some of which are common to *L. dispar* and occur also in Europe and other areas. A number of *Lymantria* parasites from India are now being bred in the U.S.A. for release against *L. dispar*. *H. robusta* is attacked by over 50 species of parasites and several of these have been shipped to Trinidad and from there to the Windward Islands, British Honduras, Brazil and Mexico, for trial against *Hypsipyla grandella* Zeller. *Trichogrammatoidea robusta* Nagaraja has become established in Trinidad. The pine shoot-borers *P. cristata*¹, *Dioryctria sylvestrella* complex, *D. assamensis* Mutuura, *D. castanea* Bradley and *D. raoi* Mutuura have a large complex of hymenopterous parasites. Many of these have only been identified generically and warrant more detailed studies to evaluate them. *Rhyssa persuasoria himalayensis* Wlk. is a common parasite of siricids. In the light of the work already carried out in India various biocontrol possibilities against forest insect pests are discussed.

INTRODUCTION

The advantages of biological control of forest insect pests have been discussed by various workers (e. g., BALCH, 1958, 1960; PSCHORN-WALCHER, 1961; FRANZ, 1970-71). Several major insect pests of forest trees in India appear suitable targets for biological control and for which the possibilities of introducing additional natural enemies from other areas are very promising. Attempts to control the teak defoliators *Pyrausta machaeralis* Wlk. (Lep., Pyralidae) and *Hyblaea puer*a CRAM. (Lep., Hyblaeidae) and the shisham defoliator *Plecoptera reflexa* GN. (Lep., Noctuidae) by transferring some of their indigenous parasites from one area

to another within the Indian subcontinent have not been followed up by an assessment of the results achieved (RAO *et al.*, 1971). The first two species are widely distributed in South-east Asia and *Hyblaea* also occurs in parts of Africa (BROWNE, 1968). Parasites from other areas could be introduced into India and *vice versa* to control these pests. With the establishment of its Indian Station in 1957 the Commonwealth Institute of Biological Control has carried out fairly extensive studies on the natural enemies of various other forest pests, *Adelges* spp., *Pineus laevis* MASKELL, *Lymantria obfuscata* Wlk., *Hypsipyla robusta* MOORE, *Petrova cristata*¹ (WALSHINGHAM), *Dioryctria* spp. and *Sirex* spp., etc. These species provide not only the basic information to consider additional species for introduction in India from other parts of the world, but also the specific parasites and predators which

¹ Dr. WILLIAM E. MILLER, Principal Insect Ecologist, North Central Forest Experiment Station, U.S.D.A., St. Paul, Minnesota, U.S.A., has recently re-examined the Indian specimens and found that they represent a new species.

warrant trials in other areas for possible biological control of the same or allied forest pests. Many of these natural enemies have been shipped to Canada and the U. S. A., which have largely supported this research work in India.

Balsam woolly aphids

Adelges spp. and *Pineus laevis* MASKELL (Hom., Adelgidae)

Over fifty species of predators are found associated with *Adelges knucheli* S. O. & S. and *Adelges* spp. The most important predator of *A. Knucheli* on *Abies pindrow* in the Western Himalayas is the anthocorid *Tetraphleps Abdulghanii* GHOURI. Other important predators in the same region are *Anystis* sp. (Acarina, Anystidae), *Leucopis* spp. (Dipt., Chamaemyiidae), *Chrysopa carnea* STEPHENS, *C. albolineata* KILLINGTON and *Tumeochrysa indica* NEEDHAM (Neur., Chrysopidae), *Hemerobius adelgivorius* KIMMINS (Neur., Hemerobiidae), *Exochomus lituratus* GORHAM and *E. uropygialis* MULS. (Col., Coccinellidae). The Neuroptera feed on various other aphids when *Adelges* is in abeyance but the other predators are restricted to *Adelges* (RAO & GHANI, 1972). In Assam, *Tetraphleps raoi* GHOURI is the most important predator of *Pineus laevis* MASKELL on *Pinus insularis*. Several *Leucopis* spp. also attack *P. laevis* in this area (CHACKO, 1973).

Most of these predators have been shipped to Canada and the U. S. A. and limited field releases made in both countries. None became established. Inability to adapt to a new and different host (*Adelges piceae* (Ratz.)) and unsuitable overwintering conditions are the most probable reasons for their failure (CLARK *et al.*, 1971; AMMAN & SPEERS, 1971).

Lymantria obfuscata WLK. (Lep., Lymantriidae)

The gypsy moth *Lymantria dispar* (L.) does not occur in India, where the closely

related *Lymantria obfuscata* WLK. has been confused with it in the past (NAGARAJA *et al.*, 1968). The latter is mainly a pest of *Alnus*, *Populus*, *Salix* and *Quercus*. Five species of egg-parasites, 33 species of larval parasites, 11 species of pupal parasites and 10 species of predators of *L. obfuscata* have been recorded in north-western India. Some of the parasites, e.g., *Anastatus bifasciatus* (FONSC.), *Apanteles liparidis* (BOUCHE), *Apanteles por-thetriae* MUES., *Brachymeria intermedia* (NEES) and *Compsilura concinnata* MEIG., are also found in Europe and other areas and have already been introduced against the gypsy moth in the U. S. A. Rearing techniques have been developed for two of the Indian parasites, *Rogas indiscretus* REARDON and *Exorista rossica* MESNIL and the chances of their establishment in the U. S. A. are considered to be good (REARDON *et al.*, 1973). Cultures of *R. indiscretus*, *Coccygomimus turionellae* (L.), *Coccygomimus* sp., *Palexorista inconspicua* (MG.) and *P. inconspicuoidea* (BAR.) are presently being maintained for field releases (W. W. METTERHOUSE, personal communication). It would also be desirable to try some of the other *Lymantria* parasites against the gypsy moth in the U. S. A.

Hypsipyra robusta MOORE (Lep., Pyralidae)

This is a widely distributed major pest of *Cedrela*, *Swietenia* and other Meliaceae in tropical and sub-tropical areas of the Old World. *H. grandella* ZELLER is a serious pest of Meliaceae in the New World. In India *H. robusta* is attacked by 50 species of hymenopterous and dipterous parasites, most of which were found for the first time during surveys carried out by C. I. B. C. The more important of these are *Trichogrammatoidea robusta* NAGARAJA (manuscript species), *Phanerotoma* sp., three *Apanteles* spp., *Afrophialtes latiannulatus* (CAM.), *Tetrastichus spirabilis* WISTON, *Antrocephalus destructor* WISTON and *A. renalis* WISTON. These have been shipped to Trinidad, bred further in the

laboratory and released against *H. grandella* in Trinidad, the Windward Islands and British Honduras (BENNETT & YASEEN, 1972). Some have also been shipped to Brazil and Mexico. In Trinidad *T. robusta* has been recovered several times up to half a mile from the release site.

Petrova cristata (WALSHINGHAM) (Lep., Tortricidae) and **Dioryctria** spp. (Lep., Pyralidae)

Eight species of shoot-borers have been found infesting pines in the Himalayas. These are *Petrova cristata*, *Dioryctria sylvestrella* complex, *D. assamensis* MUTUURA and *D. castanea* BRADLEY on *Pinus insularis*, *D. raoi* MUTUURA and two other *Dioryctria* spp. on *Pinus roxburghii*, and *Recurvaria* sp. (Lep., Gelechiidae) on *Pinus longifoial*. Several hymenopterous parasites attack these pine shoot-borers. *P. cristata* is attacked by 15 species, of which *Apanteles* sp. nr. *tachardiae* CAM. is the commonest. Other important ones include a *Campoplex* sp., *Devorgilla* sp., *Bracon* sp. and *Bathystomus* sp. *D. sylvestrella* complex is attacked by 10 parasite species, *D. assamensis* by 8, *D. castanea* by 19 and *D. raoi* by 18 species. *Bathystomus* sp., *Parasierola* sp., *Pimplopterus* sp. nr. *transversus* BRIGG. and *evetriae* UCH., and *Pristomerus* sp. are common to *P. cristata* and to the first three *Dioryctria* spp. *Cremastus* (*Trathala*) sp., *Syzeuctus* sp. and *Trichomma* sp. are major parasites of *D. raoi*, which appear to be effective even at low host densities. *Bathystomus* sp., *Bracon* sp., *Elasmus hyblaeae* FERR., *Parasierola* sp., *Trichomma* sp., *Elachertus nigrifulus* ZETT. and *Cremastus* sp. have been successfully bred in the laboratory, using their natural hosts. More detailed studies on the promising species of parasites are required to evaluate them as possible candidates for introduction into other areas. In the U. S. A., artificial diets

and special techniques have been developed for breeding the European pine shoot-moth *Rhyacionia buoliana* (SCHIFF.) in the laboratory (DATERMAN, 1970). These may prove helpful in breeding the Indian species to build up cultures of their parasites for further studies and for use on biological control programmes.

Sirex spp. and other wood-wasps

In the north-western Himalayas *Sirex cyaneus* F., *S. imperialis* KIRBY, *S. juvenis* L. *Urocerus xanthus* CAM. and *Xeris himalayensis* Bradley are pests of *Abies pindrow* and *Picea morinda*. *Rhyssa persuasoria himalayensis* WLK. is a common parasite of these Siricids. This has been introduced into Australia and New Zealand but it is not known whether it is established. On one occasion a specimen of *Megarhyssa* sp. was seen attacking a Siricid larva (possibly *S. imperialis*) (DHARMADHIKARI & ACHAN, 1965).

DISCUSSION

These investigations on some of the major forest insect pests in India have led to the discovery of a complex of parasites and predators, many of which were previously not known, and also provided valuable data on the biology and phenology of the more important species. Only about a dozen of the more than fifty species of predators of *Adelges* spp. have been tried on a limited scale in Canada and the U. S. A. (CLARK *et al.*, 1971; AMMAN & SPEERS, 1971). Although these failed to become established the prospects of success with some of the other species cannot altogether be ruled out. In both East Africa and Hawaii the Eurasian *Pineus pini* (L.) is reported to be a serious pest of pines. Predators of *Pineus laevis* from India could be introduced into these countries. Various *Lymantria* spp. are highly destructive to forest trees all over the world. In spite of the occurrence of a large

number of parasites *L. obfuscata* sometimes causes extensive defoliation of avenue and orchard trees in the Kashmir valley. Many species of parasites are common to *L. dispar* and *L. obfuscata*. As noted by LEONARD (1974), in certain areas some of the parasites may have established ecological homeostasis with their hosts and it is therefore important to obtain parasites of allied species. There are many more parasites of lymantriids in Asia than Europe and additional species could be introduced not only from Asia into the U. S. A. but also from one part of Asia into another where there is scope for such introduction. According to a recent report, *Hyblaea pueria*, *Lymantria flavoneura* JOICEY, *L. ninayi* BETHUNE-BAKER and *Hypsipyla robusta* are important forest pests in Papua New Guinea (GRAY & WYLIE, 1974). Parasites of the same or related pests from India may prove useful in controlling these pests. Several species of *Hypsipyla* parasites that exist in India have not been tested against *H. grandella* for want of adequate funds. For the same reason, none of the parasites of pine shoot-borers has yet been tried in other areas. It would thus be seen that based on the work already carried out in this country there are several biocontrol possibilities against forest pests that are well worth exploring fully.

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