

two days and did not feed on the 20% sucrose provided.

Given the low natural parasitism rates of *Beskia* and the apparent difficulty in rearing the adult flies, prospects for the biocontrol of *Oebalus* using *Beskia* are poor. However, this investigation has provided essential background information on the field abundance of *B. aelops*. This will undoubtedly be a useful contribution to an IPM programme, as knowledge of when parasitoids are most abundant and active can often determine the optimum times for insecticide treatment so as to limit the effects on natural enemy populations.

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***Phytomyptera* sp. (Diptera: Tachinidae): An important natural control agent of the quinoa moths, *Eurysacca* spp. (Lepidoptera: Gelechiidae) in central Peru (by C. Rasmussen¹, A. Lagnaoui¹ and P. Delgado²)**

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Introduction

Chenopodium quinoa Willdenow (Chenopodiaceae), known as quinoa, is an important staple food crop of the Andean region of Latin America, with an annual (1998) production of 50,000 t in Bolivia, Peru and Ecuador. It has a high nutritive value and is well adapted to the dry, saline conditions found in southern Peru and Bolivia. Traditional farming practices such as crop rotation are usually the only form of control applied to combat insect pests, although chemical controls are used in some areas.

The main insect pests are *Eurysacca quinoae* Povolny and *E. melanocampta* (Meyrick) (Lepidoptera: Gelechiidae) (identifications by Ole Karsholt, Zoological Museum, Copenhagen, Denmark). The two species were only recently separated adding some confusion to the identity of species treated in older literature (Povolny, 1997).

Parasitoid

According to our research, an undescribed neotropical tachinid fly species of *Phytomyptera* Rondani (identifications by Norm E. Woodley in Delgado (1989) and James E. O'Hara, Systematic Entomology Section, Agriculture and Agri-Food Canada) is the most important parasitoid of *Eurysacca quinoae* in central Peru.

The adult flies are active during the day and are frequently seen flying around quinoa plants or walking up and down plant stems and inflorescences. According to the literature, *Phytomyptera* spp. comprise larviparous flies with a reproductive potential of up to 200 non-planidium type larvae (Andersen 1988).

Sampling

Third to fifth instar larvae of *E. quinoae* were sampled for mass rearing in the laboratory, and larval parasitism was evaluated by collecting and separating all pupae resulting from the collections. Because the sampling was not originally designed for evaluation of parasitoid presence, it was relatively unsystematic for this purpose.

Collections were made on 29 January and 21 February 2000 from the interandean Rio Mantaro valley of Junín in central Peru (c. 3300 m.a.s.l., 12°07'S 75°12'W). A third collection was made on 6 April 2000, from the Puno altiplano in southern Peru at 3874 m.a.s.l. (15°42'S 70°05'W).

For Junín, total parasitism for the two collections was 30.6% (N=281) and 28.7% (N=157), respectively. The tachinid fly was the most important parasitoid group, constituting 95.4% and 71.1% of the parasitoid community; *Phytomyptera* sp. was found in 29.2% and 20.4% of the larvae. Ichneumonidae and Braconidae (Hymenoptera) parasitoids were also detected, with 1.4% and 8.3% presence in the two samplings, respectively.

In Puno, we found 27.0% parasitism (N=1016), with 0.5% from *Phytomyptera* sp., which constituted 1.8% of the total parasitoid community. Other parasitoids were present in 26.5% of the sampled larvae, mainly Ichneumonidae (20.7%) and, to a lesser extent, Encyrtidae and Braconidae (Hymenoptera).

Discussion

A major difference between Puno and Junín was detected with respect to the presence of *Phytomyptera* sp.: In Puno we found less than 1% parasitism from this parasitoid, whereas in Junín we found levels of more than 20%. There was c. 30% control of the quinoa moth in both regions, with *Phytomyptera* sp. as the main parasitoid in Junín.

Records from the literature on *Eurysacca melano-*

campta confirm that *Phytomyptera* sp. control in Puno is low during other months of the year (January to March) and higher in the valley areas, which have a lower elevation and thus a different climate. For example, while average parasitism of *E. melanocampta* in Puno ranges from 15 to 45%, parasitism of *Phytomyptera* sp. during January and March is only 1.2 to 4.6% (Delgado, 1989; Zanabria and Bargas, 1997). On the other hand, the positive effects of climate variation may be seen in data from localities in the valleys of Cusco, in southern Peru, which indicate an average *Phytomyptera* sp. parasitism of 11.7%, again on *E. melanocampta* (Ormachea and Quispe, 1993).

Puno and Junín differ in both climate and elevation. Junín is an interandean valley protected by mountain ranges, with an average temperature during the quinoa growth season (October to April) of 12.6°C and diurnal variation from 6.1 to 19.2°C. The climate in the altiplano of Puno is colder, with an average temperature of 9.7°C and diurnal variation from 4.7 to 14.8°C (CIP and SENAMHI weather station data).

In conclusion, there is very good natural control of *E. quinoae* by *Phytomyptera* sp. in Junín. Puno, with its distinct climate, marked by its colder night temperatures, is better adapted to control by the Hymenoptera species. Therefore, this study indicates the potential for good control of *E. quinoae* through the release of *Phytomyptera* sp. in areas with climate and conditions similar to Junín, where quinoa production has been promoted during recent years, as well as a demand for more studies on how to further encourage the activity of this parasitoid in relation to quinoa fields.

Voucher specimens

Phytomyptera vouchers have been placed in the American Museum of Natural History (New York), the Canadian National Collection (Ottawa) and the Universidad Nacional Agraria La Molina (Peru).

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Pictures of natural and *in vitro* development of *Exorista larvarum* (L.) (by M. Dindo)

The tachinid *Exorista larvarum* (L.) is a polyphagous, gregarious larval parasitoid of Lepidoptera that is well distributed throughout Europe, northern Africa and several Asian regions (Herting, 1960).

The biology of *E. larvarum* was studied by Hafez (1953) in the noctuid host *Prodenia litura* F. and is very simple. Females lay macrotypic eggs on the host body. The newly-hatched larvae penetrate the host integument in front of the egg, bore into the host body and form primary integumental respiratory funnels. Parasitoid larvae grow continuously until maturity. Pupation generally occurs next to host larva remains.

Several characteristics make *E. larvarum* particularly suitable for *in vitro* rearing. They include non-synchronised development with the host, polyphagy, and the fact that both in the host and in the diet the larvae remain in contact with atmospheric oxygen from the beginning of their development. Complete development of this tachinid was obtained on various insect material-free artificial diets based on crude ingredient, with adult yields approaching those commonly obtained in the factitious host *Galleria mellonella* L. (Mellini and Campadelli, 1995; Bratti et al., 1995; Dindo et al., 1999). Fly longevity and fecundity of the females obtained on a diet composed of commercial meat homogenate, chicken egg yolk, yeast extract and wheat germ were comparable to those of females that emerged from puparia formed in *G. mellonella* larvae (Dindo et al., 1999).

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