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Observations on the enemies of the oyster shell scale, Lepidosaphes ulmi, on apple in the Netherlands

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The oyster shell scale, *Lepidosaphes ulmi* (L.), is a secondary apple pest in the Netherlands. According to Pickett (1946, 1967) the natural enemies, the predator *Hemisarcoptus malus* Shimer (Acarina) and the parasite *Aphytis mytilaspidis* (Le Baron) (Hymenoptera, Aphelinidae), may keep it in check in apple orchards in Nova Scotia (Canada), where an integrated control scheme is applied. Both species occur in the Netherlands and thus it seemed important to study their role in the natural control of the scale in this country. These investigations were done as part of the research on the importance of parasites and predators of phytophagous apple insects in the Netherlands.

During the summer of 1971 specimens of *Lepidosaphes ulmi* were collected in several non-sprayed apple orchards or individual trees in the Netherlands. The following hymenopterous parasites were reared from them: *Aphytis mytilaspidis* (Le Baron) (Aphelinidae) (16 specimens), *Aphytis proclia* (Walker) (Aphelinidae) (17 specimens), *Apterencyrtus microphagus* Mayr (Encyrtidae) (50 specimens) and *Anabrolepis zetterstedti* Westwood (Encyrtidae) (1 specimen). Only the first three species mentioned were reared in sufficient numbers to be discussed as possible agents in the natural control of the oyster shell scale.

Both *Aphytis* species are ectoparasites. The morphological differences have been described by Bénassy (1955). The parasitizing action seems to be similar in both species. The female adult parasite places itself on the middle of the scale and palpates it with her antennae several times from the centre to the edge. During egg laying the ovipositor is stung in the centre. Host feeding, giving rise to an extra mortality, was observed in both species. The adult parasite leaves its host by an oval exit hole in the shell.

Apterencyrtus microphagus is an endoparasite. The female palpates the edges of the scale and pierces the edge with its ovipositor during egg laying. At the time that the parasite larva is full-grown, the body wall of the scale beneath the shell is mummified; it hardens and becomes parchmentlike and brownish. The adult parasite leaves its host by making a round exit hole.

The shape of the exit hole (Fig. 1) and the mummification allow the distinction between scales parasitized by *Apterencyrtus microphagus* and by *Aphytis* spp. after the adult parasites left their hosts. This may be important in comparing the relative numbers of the different parasite species. A few endoparasite larvae were observed which could not be identified.

Fig. 1. Two specimens of *Lepidosaphes ulmi* with exit holes of hymenopterous parasites of a. *Aphytis* sp., b. *Apterencyrtus microphagus*.

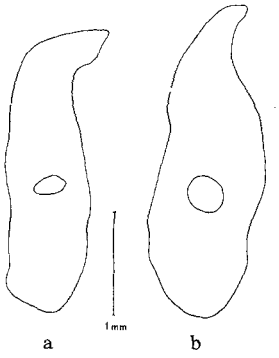

Fig. 1. Twee exemplaren van Lepidosaphes ulmi met uitkruipopeningen van parasitaire Hymenoptera van a. Aphytis sp., b. Apterencyrtus microphagus.

Parasites apparently are not important in reducing oyster shell scale populations; the highest parasitism determined by dissecting a sample of 100 living scales collected from one individual tree, amounted to 26%. In most cases the percentage was much lower.

Hemisarcoptus malus was only found sporadically. Obviously it does not play an important role in this country, in contrast with Canada (Tothill, 1918; Lord and MacPhee, 1953). However, the common earwig, *Forficula auricularia* L., was found to be an important predator locally in autumn. Scales with eggs were wholly destroyed by the action of this insect in the field and in laboratory experiments.

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Samenvatting

Waarnemingen over de natuurlijke vijanden van de kommaschildluis, Lepidosaphes ulmi, op appel in Nederland

Tijdens een in het zomerseizoen van 1971 ingesteld onderzoek werden vier soorten parasitaire Hymenoptera uit kommaschildluizen gekweekt. Een verschil tussen door *Aphytis* spp. en door *Apterencyrtus microphagus* beparasiteerde schildluizen wordt gegeven (Fig. 1).

Oorwormen (*Forficula auricularia*) bleken soms als vrij belangrijke roofvijanden te kunnen optreden. Parasieten en roofvijanden bleken in het algemeen een ondergeschikte rol te spelen.

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Book review

Kuprevich, V. F. & Shcherbakova, T. A.: Soil enzymes. Translated from the Russian edition (1966), published by the Indian National Scientific Documentation Centre, New Delhi 1971. 392 pp., offset printing from type script, paper cover. Obtainable from U.S. Department of Commerce, National Technical Information Service, Springfield, Va. 22151.

Determination of free enzymes is often used as a substitute for an overall estimation of microbial activity in a soil and for its biochemical characterization. In the 1950's such enzymes as invertase, amylase, urease, protease and catalase were studied especially by E. Hofmann and co-workers in Weihenstephan, West Germany. More recently some essential and universally present enzymes such as dehydrogenases have received more attention. This book shows that Russian workers, in particular V. F. Kuprevich, have taken an active part in the study of soil enzymes from the beginning.

Two large chapters deal with the hydrolases and with the oxidoreductases, lyases and ligases (synthetases). Quantitative techniques are fully described. Numerous assessments of enzymes present in Russian soils are included. The various enzymes were usually studied in different soils at different times. Correlations with microbiological or respirometric observations were not really looked for. In a subsequent chapter, however, the effects of draining a peat-bog soil (variation of the watertable) on the content of 5 enzymes and free amino acids were studied simultaneously. In a chapter on external, non-biological factors it is shown that drying and storage of soil have comparatively little influence on enzyme activities, while various sterilizing agents can have different effects. In the final discussion on the origin and role of soil enzymes it is stated that various enzymes originate largely from plant roots, while proteases are mainly produced by bacteria. This chapter shows also how labile enzyme production by various organisms is. The bibliography (including short abstracts of most papers) covers 106 pp.: 50 for Russian, 56 for non-Russian publications.

The value of enzyme figures for the characterization of a soil is somewhat questionable; this is reflected in the often unconnected and unexplained observations. Nevertheless this book represents an important source of primary and secondary information on the topic.

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