AN ATTEMPT TO ANTICIPATE BIOLOGICAL CONTROL OF
DIURAPHIS NOXIA (HOM., APHIDIDAE)

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Responding to the threat posed to the Australian wheat industry by the world-
wide spread of the Russian wheat aphid, Diuraphis noxia (Mordvilko), an attempt
to anticipate its biological control was made by introducing its oligophagous
hymenopteran parasite Aphelinus varipes (Foerster) into the current Australian
cereal aphid community. Details of the source of the parasite material and its
introduction, mass-rearing and release in Australia, together with follow-up studies
in the field and laboratory are given. No evidence of establishment has been found
so far and the possible reasons for this are explored and discussed.

KEY-WORDS : Diuraphis noxia, Aphelinus varipes, Australia, anticipating biologi-
cal control.

In the last fifty years and especially since the 1970s, the Russian wheat aphid, Diuraphis
noxia (Mordvilko), has spread to and become a major pest of wheat and barley crops in
several drier regions of the world. In South Africa, western USA and Canada, the arrival of
the pest resulted in multi-million dollar losses and increased costs, causing major disruption
to their wheat industries (Hughes, 1988). A recent study shows that in Australia the
environment of the wheat belt would be extremely favourable to D. noxia (Hughes &
Maywald, 1990), and thus the pest poses a serious threat to the local wheat industry if it
arrives in the country. As a result the Australian Wheat Research Committee funded a group
of pro-active projects to prepare for the eventual arrival of this pest aphid, including the
novel biological control project described in this paper.

Host-specific natural enemies of D. noxia have not yet been recorded, most of the agents
reported from its native range being polyphagous, or at best, oligophagous in the cereal
aphid community (Berest, 1980). As would be expected, the same applies in each region of
the current extended range of D. noxia (Aalbersberg et al., 1988 ; Feng, 1988 ; Gilstrap &
McKinnon, 1988 ; Gilstrap et al., 1991). In a situation where specific enemies are lacking an
ad hoc approach has to be adopted and, in the USA, several of these polyphages,
collected from many areas of the current range of D. noxia, have been reared and released
(Gilstrap et al., 1991) in the hope that some of the geographic strains may be more effective
in particular environments. An alternative strategy where no specific enemies are known is
to seek oligophages which show at least some specialisation to the micro-habitat of the
target pest. Among the natural enemies of D. noxia, few are able to penetrate the tight
leaf-rolls on cereal seedlings caused by the aphids and within which they are protected. This behaviour has, however, been recorded for the hymenopterous parasite *Aphelinus varipes* (Foerster) (as *A. hordei* Kurdjumov) and a small unidentified spider by Grossheim (1914) in the Ukraine, and for the coccinellid beetle *Scymnus moreletti* Mulsant by Aalbersberg *et al.* (1984) in South Africa.

The availability of known natural enemies of *D. noxia* which, although not specific, had highly appropriate searching behaviour, led to the idea of establishing a potential biological control agent before the arrival of the pest in Australia. *A. varipes* was chosen as the most suitable enemy as some of its other known cereal aphid hosts were already present in Australian wheat and barley crops. It was considered that if the parasite could be established on the other aphid hosts infesting wheat and barley it would be ready to attack *D. noxia* whenever it arrived in Australia.

Such a project has analogies to recent proposals for “collective control” of alternative hosts (Carver, 1989) and for enhancing the effect of natural enemies of pest aphids by the encouragement in the environment of plants carrying alternative aphid hosts (e.g. Štarý, 1983). The likelihood of achieving such goals has been questioned by Powell & Wright (1988) because of difficulties of transferring even apparently polyphagous aphidid hymenopterous parasites between different aphid host species. However, Michel (1970) has shown that with the aphelinid, *Aphelinus asychis* Walker, rearing for only three successive generations was sufficient to adapt that parasite to a different aphid host. As *A. varipes* belongs to the same family it was decided to proceed with the project. Nevertheless, although *A. varipes* was potentially available from many sources, including *Rhopalosiphum maidis* (Fitch) on sorghum in Australia, to give the project the best chance of eventual success it was decided to use parasite material collected from *D. noxia* in its native range, around the Black and Caspian Seas.

This paper describes our attempt to establish a strain of *A. varipes* collected from *D. noxia* in the Ukraine on field populations of *Rhopalosiphum padi* (L.) in Australia. It was intended to bring in *A. varipes* material for preliminary study in the insectary before a fresh batch was introduced for mass-rearing and release. As it turned out the research and release programs had to proceed together, the former including a comparative study of host transfer in two strains of *A. varipes*.

**MATERIALS**

Mummies of *D. noxia* presumed to be parasitised by *A. varipes* were collected from wheat trial plots at Odessa, in the Ukraine, in the month of June in both 1989 and 1990. They were sent by air to a quarantine insectary at Canberra.

Parasites emerged from both batches of mummies, but attempts to rear the 1989 material on one of the recorded alternative hosts, *R. maidis*, failed. To overcome the rearing problems, advice was sought from Dr C. Höller of Kiel University and a strain of *A. varipes* from a culture on *R. padi* kept at Kiel in Germany, was brought in for study.

This material was readily cultured on *R. padi* in Canberra, so when the next batch of *D. noxia* mummies containing *A. varipes*, arrived from the Ukraine in 1990, *R. padi* was used successfully to establish a culture of the Ukrainian strain too.

Material of all four cereal leaf aphids commonly occurring in Australia, *Sitobion nr. fragariae* (Walker), *Metopolophium dirhodum* (Walker), *R. maidis* and *R. padi*, was obtained from established cultures in Canberra.