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Host-plant ranges and pest potential: habits of some thrips species in areas of southern Italy

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Abstract

Data on host-plant ranges are scanty for several thrips species. Published records often refer to collecting sites of adults that have dispersed from their breeding sites. Thus there are difficulties in knowing the plants that are essential to population maintenance for most Thysanoptera species. Despite this, different patterns of host exploitation permit a distinction between monophagous, oligophagous and polyphagous species. Such biological differences can help in the identification of pest species, although some thrips species are known to exhibit remarkable host shifts, such that they became pests on plants unrelated to their "natural" hosts. In the present contribution, related to southern areas of Italy, the following species are reported: *Neohydatothrips gracilicornis* becoming a pest on Pinaceae, and *Drepanothrips reuteri* on *Quercus,* also the polyphagous species *Heliothrips haemorrhoidalis*, a pest on *Citrus* until a few years ago, has been supplanted by *Pezothrips kellyanus* in the intensive southern citrus orchards (Navel orange, lemon and bergamot). At present *H. haemorrhoidalis* is expanding as a pest in forest areas. For each thrips species, data on field observations and some aspects of their biology on the "new" hosts are provided and discussed.

Key words: host plant range, host shift, feeding behaviour, *Drepanothrips reuteri*, *Heliothrips haemorrhoidalis*, *Neohydatothrips gracilicornis*.

Introduction

Data available in the published literature on the host plant ranges of thrips species are often scanty. Such records often refer only to winged adults (Berzosa, 1994), and these may have dispersed from their breeding sites on quite different plants. However, with such new plants they may establish different relationships, such as feeding, searching for suitable sites to lay eggs or to carry on part of their life cycle, or merely resting. Host exploitation occurs at different levels, and we can distinguish monophagous, oligophagous and polyphagous species. With pest species it is important that we are able to distinguish between these different life-history strategies, although the biology of many species has not been studied exhaustively. Some biological features, and their variability within natural populations, are often not considered and, consequently, the "way" that a thrips species becomes a pest is unknown. Such features include host associations, transmission of tospoviruses, threshold temperatures for development, adaptability in pupation site, and variability in the length of larval life and body size at pupation (Mound, 2005). Polyphagous thrips species are more likely to be pest species than monophagous or oligophagous species (Lewis, 1997; Marullo, 2004a; Moritz *et al*., 2004; Mound, 2005). However, polyphagous species sometimes produce localized strains with a strong attachment to a particular plant species. Polyphagy and host range might be related to availability of particular compounds in the host plants (Terry, 1997), or such thrips species might be unusually flexible in their feeding behaviour.

Not all populations of a polyphagous thrips species are necessarily pestiferous; sometimes they produce host-limited strains, or are pests only in restricted geographical areas. Similarly, some monophagous species exhibit remarkable host shifts, such that they become pests on plants unrelated to their natural hosts (Mound, 1997). For example, *Drepanothrips reuteri* Uzel in Europe is largely specific to *Quercus* (Bournier, 1983; Palmer, 1986; Marullo, 2004b), although it is well known as a pest of grape vines in other parts of the world. Similarly, *Neohydatothrips gracilicornis* (Williams) is generally considered host specific to *Vicia* species, but produces pest populations on Pinaceae and Betulaceae in Spain and South Italy (Berzosa, 1981; Marullo, 1990; 2004b). The highly polyphagous species, *Heliothrips haemorrhoidalis* (Bouchè) produces large natural populations on many unrelated plants including *Camellia*, *Citrus*, *Pinus* and *Dicksonia*, although plants that are severely attacked are usually growing sub-optimally (Mound, 2005). A recent study (Scott Brown and Simmonds, 2006) has demonstrated the influence of morphology of the leaf surface of plants in the selection of hosts by *H. haemorrhoidalis*. This thrips species was known for several years as a pest of *Citrus* in the intensive orchards (Navel orange, lemon and bergamot) of south Italy (Calabria and Sicily), but in recent years it has been completely supplanted by *Pezothrips kellyanus* (Bagnall) (Marullo, 2003).

The objective of the present paper is to focus on the main features of the life history of the above thrips species based on field data, and to assess their "status" on the new host plants.

Materials and methods

Samplings

On the host plants were carried out monthly from June 2004 to July 2005, and from March to the end of October 2006, in two forest areas of southern Italy, Roccadaspide (1000 m a.s.l., province of Salerno) and Gambarie (Aspromonte, 1200 m a.s.l., province of Reggio Calabria). Samples were taken from leaves, branches and buds of *Pinus* spp. and *Quercus* spp., also from plants and flowers, leaves and shoots of wild Fabaceae living in the two areas. Soil samples, including litter, were also taken from around the sampled plants, to look for the pre-imaginal stages (prepupa and pupa) of the three species (*D. reuteri*, *H. haemorrhoidalis*, *N. gracilicornis*). Both litter and soil samples were "filtered" through a set of sieves of decreasing mesh size and the smallest part (including eventually pre-imaginal stages) was examined under a stereo microscope.

Laboratory studies

Adults and immature stages of the three studied species were mounted on slides for identification. Specimens of larvae were mounted directly into Faure's medium or Hoyer's medium, instead adults in Berlese, not as permanent slides.

Results

Data from the field surveys are given in table 1. These data may provide the "rebuilding" of the life history of the three thrips species referred to the investigated host plants.

N. gracilicornis breeds on plants of wild *Vicia* spp., and also other wild Fabaceae, during spring and summer (from end of March until July). Adults feed on flower and bud tissues but also on leaves during full summer (end of July and August). Larvae develop mainly in the flowers of the Fabaceae host plants, but no pre-imaginal specimens were collected from flowers, buds or leaves of *Vicia* plants. However, a few prepupal specimens were extracted from soil samples, and this suggests that the larvae of this species fall into the soil for pupation (the superficial layers of soil). Surveys on *Pinus* plants found adult but no larval thrips on the leaves (needles), in all samples taken from September until February. The available data suggest that *N. gracilicornis* is univoltine and overwinters as prepupa and pupa living in litter or amongst plant debris in the soil.

D. reuteri breeds on *Vitis* as well as on *Quercus* leaves and buds; larvae can be found during late spring (May/June), but adults feed on leaves until the end of September. Several specimens of immature stages (larvae) and adults can live on leaves from spring until end of summer. No pre-imaginal specimens have been found on leaves; presumably pupation occurs in the soil or on branches of the plants. Adults were found until September and early autumn, instead prepupae and pupae overwinter in soil or under branches. The species is univoltine. *Quercus* as well as *Citrus* is a host plant for *H. haemorrhoidalis*. This thrips breeds on leaves, where young stages, larvae, and adults can be found from June to July. In early autumn only adults are found and pre-imaginal stages overwinter in the soil or on branches. Also on *Quercus*, this species has more than one generation per year.

Discussion

The results focus on the host-associations of the three thrips species and distinguish between:

1. The real host plants on which a thrips breeds and maintains its populations - this knowledge requires much field work over a long period of time;
2. The feeding plant associations, that is those plants used by thrips only for feeding activity;
3. Host-shifts associated with a change in host plant associations.

Field data indicate that *Pinus* needles cannot be used by *N. gracilicornis* for breeding, because no larvae were collected on these plants, but only adults as feeders; larvae were not found either on young or on senescent leaves. Adults and the feeding damage they cause were associated with dried or stressed *Pinus* and *Picea* trees. These observations are in accordance with studies by Fennah (1963; 1965) regarding thrips feeding sites and the nutritional status of host plant leaves. Characteristic patterns of thrips can be seen on individual leaves ac-

Table 1. Field surveys referred to three thrips species and their host plants.

Thrips species	Host-plants family and genus	Breeding			Feeding		
		Sites	Development stages	Month	Sites	Development stages	Month
Neohydatothrips gracilicornis	Fabaceae *Vicia*	flowers buds	eggs, larvae, adults	from March to September	flowers and leaves	adults	June and July
	Pinaceae *Pinus*, *Picea*				leaves	adults	from September to February
Drepanothrips reuteri	Vitaceae *Vitis*	young leaves or buds	eggs, larvae	from March to June	leaves and tips of buds	adults	from May to July
	Fagaceae *Quercus*	young leaves	eggs, larvae	May and June	leaves	adults	from June to September
Heliothrips haemorrhoidalis	Rutaceae *Citrus*	leaves	eggs, larvae, prepupae and pupae, adults	from May to July	leaves	adults	August and September
	Fagaceae *Quercus*	leaves	eggs, larvae, prepupae and pupae, adults	June and July	leaves	adults	from September to October

cording to the age and within leaf variation in the physiological condition of the tissue. Thrips also gather around damaged tissue. These all appear to be responses to the balance of available nutrients and the level of soluble nitrogen, which increases in mature, stressed or damaged leaves (Kirk, 1997). *Pinus* trees are not host plants, and in this way *N. gracilicornis* can be considered as a "tourist" in forest areas.

D. reuteri breeds on *Vitis* as well as on *Quercus*, and can produce damage on both these host plants. This thrips is associated with the leaves in the canopy of several tree species, particularly *Quercus* species (Palmer, 1986). However, there is no evidence from which to deduce the original host associations of this thrips; it may have host-shifted from tree leaves onto vines a long time ago, or it may have evolved as an oligophage on young leaves in the tree canopy including those of vines that grow at that level.

The biology *H. haemorrhoidalis* is very different, because adults of the thrips search for old leaves of *Quercus* on which to oviposit. Laying eggs into non-expanding leaf tissue presumably avoids these eggs being crushed as plant cells enlarge and proliferate. Instead, in citrus leaves, cork cells are produced in reaction to eggs of *H. haemorrhoidalis* (Terry, 1997).

Further studies might be carried on relating to:
- movements of populations of a species in new areas;
- the reproduction and feeding behaviour of species (for example, to explain how *H.haemorrhoidalis* has been supplanted by *P. kellyanus* in the intensive citrus orchards);
- the feeding associations and the role of attractive substances to better understand the arising of pest strains inside the natural populations of a species.

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