The olive branch: a passageway for predators?(*)

Las ramas de olivo: ¿un camino para los depredadores?

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ABSTRACT

The indigenous olive entomofauna is a relatively untapped resource of potential natural enemies towards many key olive pests. As part of an ongoing study into their importance as controlling agents of *Prays oleae* (Bernard), the role of the olive branch as a passageway to the pests was evaluated. In an olive grove in Granada transparent plastic sheets wrapped around main branches were coated with two types of glue and left for 10 day periods. Over the sampling period trap catches decreased. This reflected falling prey numbers and increasing ambient temperatures. The prey species recorded were: the antophagous generation of *Prays oleae,* first instars of *Saissetia oleae* (Olivier) and nymphs of *Euphyllura olivina* (Costa). The most numerous predatory groups were ants and lacewings. Carabids were also represented to a larger extent than was shown by beating-tray studies, implying the use of trunks to access prey. The other groups were flying insects possibly caught in the traps by accident.

RESUMEN

La entomofauna del olivar es relativamente desconocida, sobretodo en relación con su potencial como enemigos naturales de las principales plagas. Como parte de los estudios llevados a cabo para conocer su importancia como agente de control de *Prays oleae* (Bernard), se ha evaluado el papel de las ramas como vía para alcanzar las presas. En un olivar de Granada se colocaron bandas de plástico transparente alrededor de las ramas principales, engomadas con dos tipos de pegamento y se dejaban durante 10 días. A lo largo del periodo de muestreo las capturas disminuyeron, lo cual posiblemente es debido a la reducción del número de presas y al incremento de las temperaturas. La presas disponibles fueron: la generación antófaga de *Prays oleae*, los estadios larvarios de *Saissetia oleae* (Olivier) y las ninfas de *Euphyllura olivina* (Costa). Los grupos depredadores más numerosos fueron las hormigas y los crisópidos. Los carabidos estuvieron representados en mayor proporción que en los estudios en los que se agitan las ramas para obtener el material, lo cual implica el uso del tronco para acceder a las presas. Los otros grupos presentes eran insectos voladores capturados posiblemente de forma accidental en las trampas.

INTRODUCTION

Olive groves are monocultures typified by vast tracts of land planted solely with olives. They are frequently cleared, either chemically or mechanically, to prevent competition from weeds. Their characteristic lack of floral diversity is ideal for the rapid development of pest populations (Van Emden, 1990). Of these the olive moth, *Prays oleae* Bernard, 1788, olive fly, *Bactrocera oleae* Gmelin, 1788, and olive scale, *Saissetia oleae* Olivier, 1791, are by far the most important (Arambourg, 1986; De Andrés, 1991).

In 1997 a study was made in Granada (Spain) (Morris, 1997) into the possible role of indigenous predators in controlling olive pests. ELISA results suggested that in the canopy the most important group to pray upon *Prays oleae* (Bernard) was the ant followed by Heteroptera and Coleoptera (Morris *et al.*, 1999b). In the soil ants were the most prevalent capture and the number of species found was low, probably due to the sylvicultural practice of eliminating weeds in the olive grove (Morris & Campos, 1999). Part of this present work has been to investigate how potential predators reach their prey. It was presumed that ants and hunting spiders would be the groups most likely to use the branches to reach the foliage above. Consequently sticky traps were placed around the main branches to detect such foraging excursions.

MATERIAL AND METHODS

In a managed olive orchard at Arenales, in Granada, Spain, ten branches were randomly chosen on ten individual trees. Contiguous branches were removed to guarantee that the only access to the branch (apart from flight) was via the trap. The traps were placed in the trees in June 1994 and May 1995 and trapping continued until September.

The branches were first smoothed with sandpaper and a layer of cling film placed around them to provide the traps with a good seal. 20-cm-wide strips of transparent polythene were wrapped around the branches. Transparent polythene was chosen to avoid any problems associated with coloured traps (Southwood, 1978). The strips were coated with two marginal bands of one make of glue (Agrisense-BCS Ltd, Treforest, South Wales) and a central band of another (Rat Stop, Frabo S.A., Milan). The latter brand was used as ants have been observed to escape from Agrisense glue. Clingfilm was then placed just in front and behind the sticky trap to cover any bark that might have been accidentally smeared with glue, thus preventing insects from sticking to the branch before reaching the trap.

After ten days the traps were collected and replaced with freshly coated traps. In the laboratory the traps were left in turpentine for 24 hours to facilitate the removal and identification of the arthropods.

The data were analysed using a one-way analysis of variance.

RESULTS

There was no significant difference between years in the numbers caught in each tree ($p>0.05$).

The graphs in Figure 1 show the mean capture per trap during both sampling seasons. Although it would seem that more were captured in 1995 (Fig. 1), the first two dates of 1995 cannot be compared due to the differences in the initial date of trap placement. On comparing the months there was no significant difference in captures between the two years ($p>0.05$). In both years the numbers dropped from the end of June to the beginning of September. In 1994 and in 1995 the peak captures differed significantly ($p<0.05$) from all or the majority of the subsequent dates (Fig. 1).

Ants were the group most commonly found in the sticky traps. The species captured were predominately the tree-nesting species *Lasius alienus* Foerster, 1850, *L. niger* Linneo 1758, *Crematogaster scutellaris* Olivier, 1792 and *Plagiolepis pygmaea* Latreille, 1798.

In 1995 the next most frequently captured group were the neuropterans (Fig. 1), particularly *Chyrsoperla carnea* Stephens, 1836. They were the only group whose captures were significantly different between years. In 1995, although present all year, they were more common in late May and early July.

The Hemiptera found were mainly the anthocorid, *Anthocoris nemoralis* (F.) and mirids. They were most common in June/July 1994 and June 1995. During the later summer months they were only present in low numbers (Fig. 1).

Both spiders and coleoptera were caught throughout the trapping season (Fig. 1). The coleoptera were represented by carabids, coccinellids (predominately

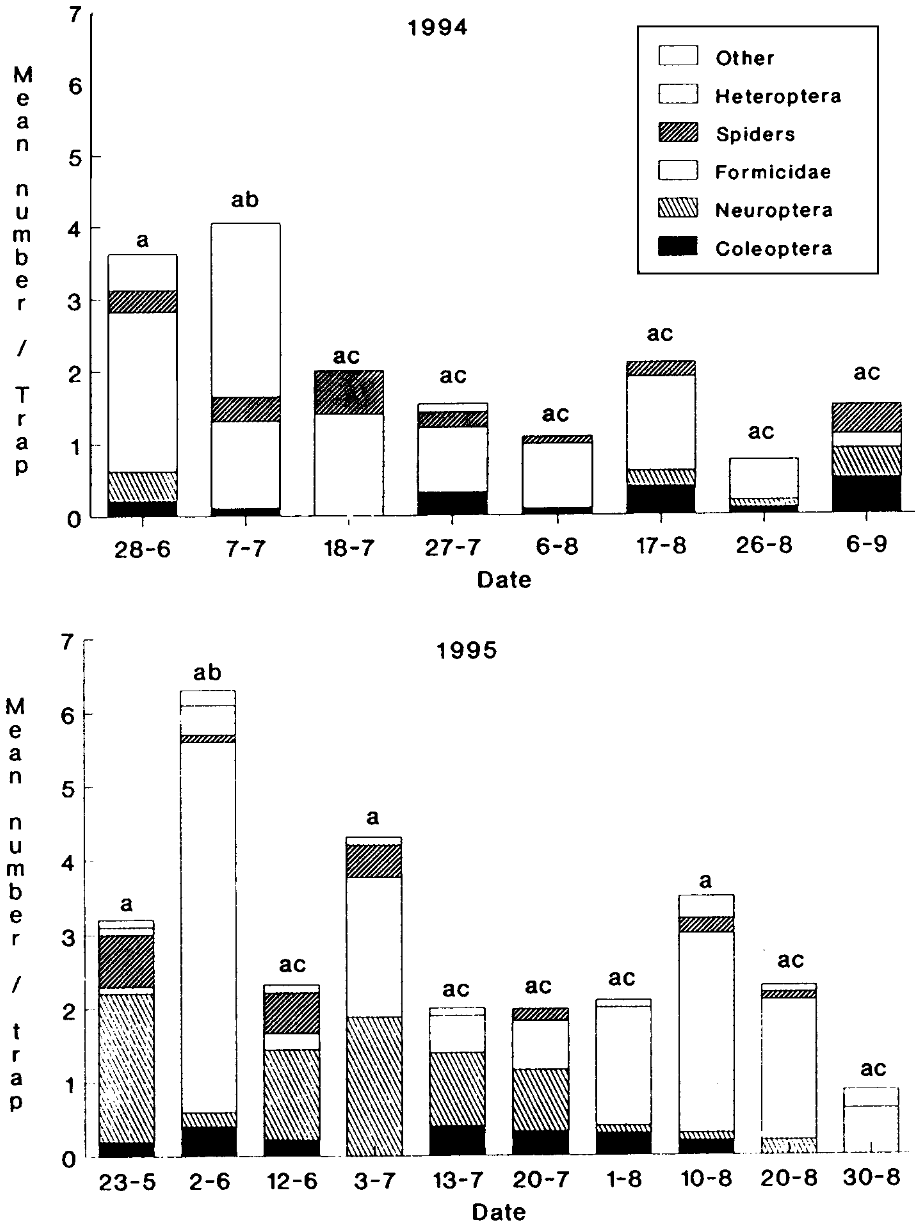

Fig. 1.—Catches in sticky traps placed around olive branches in Granada in 1994 and 1995. Dates followed by the same letter are not significantly different (Fisher's LSD, $p<0.05$).
Fig. 1.—Capturas en trampas con pegamento colocadas en ramas de olivo en Granada 1994, 1995. Datos seguidos con la misma letra no son significativamente diferentes (Fisher's LSD, $p<0,05$).

Scymnus spp.), and the staphylinid *Aleochara olivieni* Fauv. The other groups caught were syrphid adults and thrips.

DISCUSSION

The results may reflect the summer temperatures in Granada, in which the last weeks of July and the first weeks of August are the hottest. It is unlikely that the fall in captures represents trap avoidance due to increased familiarity as beating-trap catches displayed the same drop in numbers over time (Morris, 1997). Peak captures also coincided with the time when *Prays oleae* was ovipositing on the fruits, and when *Saissetia oleae* first instar larvae and *Euphyllura olivina* Costa, 1877 nymphs were present (Morris *et al.*, 1999 a).

Of the groups found using the branches, ants were among the most common (Fig. 1). This reflects their tendency to nest in the canopy or trunk from where the workers leave on foraging excursions. For this reason the mean captures do not mirror the true situation, since most of the species found in the olive grove by beating-tray capture, such as *Tapionoma nigerrimum* Nylander, 1856, make their nests in the soil under the canopy (Morris, 1997; Redolfi *et al.*, 1999).

A predominance in the sticky traps of *C. carnea* of the neuropterans agrees with McPhail's trap captures (Campos & Ramos, 1983; Morris, 1997). Since only adults were caught and the appearance of the larvae lags behind that of the adults, and it is the larval stage that is predacious, they would have been present when prey was most available, particularly in 1995. Adult lacewings and antlions were probably caught accidentally however, alighting on the branch rather than using it for access to a given food source or ovipositional site, as *C. carnea* adults deposit eggs wherever they land (Duelli, 1984). Oviposition has been noted on branches, which would suggest that recently hatched larvae traverse the branches, as do later instars (Morris pers. obs.). The larvae are known to cover large distances in search of prey and the greater the hunger the wider the area searched (Fleschner, 1950; Bond, 1980; Baumgaertner *et al.*, 1981).

Many Heteroptera are omnivorous and feed upon whatever is available. Being alate, flight is no problem and is in fact probably the preferred method of transport between feeding sites. As eggs were frequently seen in the floral buttons where different prey, such as *P. oleae*, *S. oleae* and *E. olivina* were available (Morris *et al.*, 1999a), it is unlikely that the nymphs moved far to locate food. Russell (1970), Dixon & Russell (1972), Evans (1976) and Von Lauenstein (1980) have all studied the searching behaviour of anthocorids.

They conclude that starved anthocorids increase their chance of encountering prey by increasing their speed of movement, by searching patches where prey are more likely to be found and remaining there once prey has been found. Adult Heteroptera trap captures suggest that branches were indeed used as a causeway. *Anthocoris nemoralis* proved to be the primary Heteropteran predator of *Prays oleae*, the phenology and activity of the former coinciding with the development of Lepidoptera in the olive flowers (Morris *et al.*, 1999c).

Spider numbers were much lower than in beating-tray studies, where they were generally the second most prevalent group, accounting for some 20% of all the predators captured (Morris *et al.*, 1999 a). Spiders, including many species of active hunter spiders, are considered to be sit-and-wait predators (Riechert, 1992). Consequently site selection is of paramount importance. In olive groves hunter spiders represent 80% of all spiders captured, Salticidae and Philodromidae being the two most common families (Morris *et al.*, 1999d). Hunger is a deciding factor in initiating location changes (Turnbull, 1964), especially for spiders occupying favourable prey environments with low investment in foraging sites (Janetos, 1982). Because spiders lack wings they rely on walking and ballooning for transport (Bristowe, 1971). Problems associated with the drag line being caught by the trap, and the spiders subsequently ascending the line and being captured by the glue are discussed by Topping and Sunderland (1995). As the traps are wrapped around the branch in the interior of the canopy it is improbable that immigration or emigration movements will be recorded. Web-builders are poor walkers and probably seldom go far, whereas hunter spiders are good walkers (Turnbull, 1973). Spiders were seen moving around the trunk and branches (Morris pers. obs.).

Of the different Coleoptera families, many carabids are weak fliers or are incapable of flight and are typically associated with ground fauna. Thus it is likely that the trunk and principal branches are used to reach the canopy. Most staphylinids are more adept at flying than carabids, but their capture in the sticky traps may indicate that they too walk along the branches. Coccinellids were observed walking along the trunk (Morris pers. obs.), thus confirming that trap catches were not accidental. Although, as was found in beating-net results, predatory beetle numbers were low (Morris *et al.*, 1999 a; 2000), carabids were the principal family caught by the traps, suggesting that the trunk is of importance to them as an avenue to food sources.

Of the other groups, syrphid larvae are often predacious and apterous and would, if caught, have been foraging, although they rarely move far from where they were laid until they have depleted the local food resources (García *et al.*, 1996). The adults, however, along with the thrips, were probably caught by chance.

Unlike Raspi & Malfatti (1985) and Petacchi & Minnocci (1994), who also used sticky traps, our study was concerned solely with predators. Spiders were not mentioned in their studies and thus comparisons are difficult to make. Parasitoids and non-predatory groups were discounted from the results although they were frequently caught in the traps. Parasitoid species are known to host-feed (Jervis & Kidd, 1986) but which of those found in olive groves display this behaviour is unknown.

CONCLUSION

The sticky banding placed around principal branches proved to be an effective means of sampling predators. Numbers caught over the season varied concomitantly with temperature and prey abundance, maximum numbers coinciding with the antophagous generation of *P. oleae,* first instars of *S. oleae* and nymphs of *E. olivina.* Of the groups caught, ants, spiders and carabids seem to be most likely to use the branch for access to prey. Neuroptera adults and other groups were probably caught in the traps by accident when alighting or blown there by gusts of wind. It is possible that adult Heteroptera traversed the branch deliberately to search for new prey.

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