Anystis baccarum - a potential biocontrol agent in UK apple orchards

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ABSTRACT.

Increasing concern over the use of chemical pesticides is continuing to pressurise apple growers to look for alternative means of invertebrate pest control. The re-discovery of the beneficial predatory mite, *Anystis baccarum*, in UK Bramley orchards offers a potential alternative control component for incorporation into IPM strategies. *Anystis baccarum* has been shown to readily feed upon economically important invertebrate pest species including European fruit tree red spider mite, *Panonychus ulmi*, and show a level of compatibility with chemical pesticides. Mis-identification of this beneficial mite species has resulted in unnecessary pesticide applications being applied within UK apple orchards. Apple growers must be encouraged to be aware of *A. baccarum*, and indeed all predatory fauna, within their orchards and seek to conserve their populations.

INTRODUCTION.

Apple orchards cover c. 27,000 ha in the United Kingdom (Solomon 1992), of which 14,000 ha are dessert varieties, 9,000 ha culinary varieties, and 4,000 ha are for cider making. The major concentration of dessert apples and culinary apple orchards is in the southeastern county of Kent in England. Mostly culinary apples are grown in Northern Ireland. Within the orchards a wide range of predators have been exploited, or have the potential to be exploited, as biological control agents against pests of fruit. These include members of the families Miridae (mirid bugs) (Hemiptera), Anthocoridae (flower bugs) (Hemiptera), Forficulidae (earwigs) (Dermaptera) and several mite families (Solomon 1992).

In relation to invertebrate pest control in Northern Irish apple orchards, on average, 2-3 sprays of insecticide or acaricide per annum are applied. While this is a small expenditure compared with costs of fungicide application, there are several reasons for the avoidance of unnecessary sprays (Cuthbertson & Murchie 2005a): (**1**) adverse public attitudes to pesticides have intensified in recent years and this has led to a desire by fruit growers to reduce dependence on pesticides, especially broad-spectrum neurotoxic compounds that can adversely affect human health or the environment; (**2**) unnecessary applications of pesticides can foster pest resistance to the chemical making it useless; (**3**) unnecessary chemical applications are a waste of money in an increasingly competitive business and; (**4**) within a comparatively stable ecosystem like orchards, the ability of natural enemies to control pests, completely or partly, is well documented. Loss of natural enemies means that minor pests can become more damaging as the natural constraints on their populations have been removed.

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MONITORING PREDATORY FAUNA.

Leaf-dwelling predators such as the mites *Typhlodromus pyri* Scheuten (Mesostigmata: Phytoseiidae) and *Zetzellia mali* (Ewing) (Prostigmata: Stigmaeidae) can be sampled by leaf washing (Zacharda *et al*., 1988). However, larger predatory species are generally more mobile and cannot be sampled in this way as they disperse when vegetation is disturbed. Various trapping devises have been described by various authors for trapping insect fauna including earwigs, mites and mirids (Helsen *et al*. 1998; McAdam *et al*. 1994; Stewart & Gaylor 1991). Using a selection of trapping devices a study within Northern Irish apple orchards revealed that the predatory mite *Anystis baccarum* (Linnaeus) (Prostigmata: Anystidae), sometimes referred to as the 'whirligig' mite due to its spiral-like running fashion, was the most abundant beneficial species in the orchards (Cuthbertson 2000; Cuthbertson & Murchie 2004a, 2005b). More *A. baccarum* were sampled within Northern Irish orchards than *T. pyri* (Cuthbertson & Murchie 2005b).

DIFFERENTIATION OF *ANYSTIS BACCARUM* FROM RED SPIDER MITE.

Anystis baccarum (Fig. 1a) is easily spotted on the fruit and foliage of apple trees as it is red/orange in colour, long-legged, and very mobile. If growers are unaware of this species, they may assume that any red mite on the apple trees was the pest species, European fruit tree red spider mite, *Panonychus ulmi* (Koch) (Prostigmata: Tetranychidae) (Fig. 1b) (Cuthbertson 2004, 2005; Cuthbertson & Murchie 2005c). However, certain characteristics enable *A. baccarum* to be identified in the field (Cuthbertson & Murchie 2007a):

(1) *Anystis baccarum* ranges in size from 1.0-1.5 mm in diameter. This is a lot larger than *P. ulmi*, which when fully grown is about 0.4 mm in diameter.

(2) *Anystis baccarum* moves rapidly over the branches and foliage of the trees, whereas, *P. ulmi* is relatively sedentary and only found on the under-side of leaves.

(3) Eggs of *P. ulmi* are visible on the twigs of the trees during the winter months, whereas *A. baccarum* lays eggs under loose bark on the trunk or in the soil surrounding the tree base.

(a)

(b)

Fig. 1. (a) The predatory mite *Anystis baccarum*; (b) European red spider mite, *Panonychus ulmi*.

PHENOLOGY OF *ANYSTIS BACCARUM* IN APPLE ORCHARDS.

Anystis baccarum occurs within the orchards almost all year round (Fig. 2), with abundance peaking during spring and early summer (Cuthbertson & Murchie 2004b). This is at the same time as pests such as red spider mite eggs are beginning to hatch and apple rust mite (*Aculus schlechtendali,* (Nalepa) (Prostigmata: Eriophyidae)) are beginning to migrate from their over-wintering sites out onto foliage to feed. Any prey items encountered by *A. baccarum* will be readily devoured. Over-wintering eggs of apple-grass aphid (*Rhopalosiphum insertum*, (Walker) (Homoptera: Aphididae)) and red spider mite, along with apple rust mite, possibly act as a valuable food source to sustain populations of *A. baccarum* over the winter period when other prey items are few (Cuthbertson & Murchie 2006a, 2007b,c).

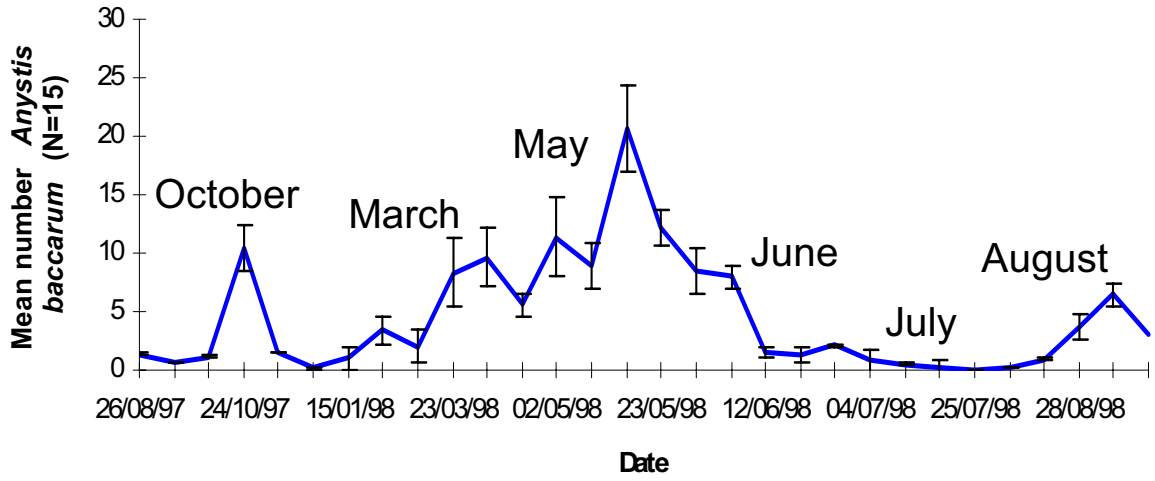

Fig. 2. The phenology of *Anystis baccarum* in a Northern Irish apple orchard.

FEEDING RATE OF *ANYSTIS BACCARUM* ON ORCHARD PESTS.

Anystis baccarum has been cited as feeding on a range of invertebrate prey (Baker 1967). The mite will readily feed upon any prey item it can over-power (Fig. 3). *Anystis baccarum* is not only a potentially valuable predator in orchards but several other ecosystems, including, blackcurrant bushes in Russia (Lange *et al*. 1974; Livshits & Mitrofanov 1981) and cereal fields in England (El Banhawy *et al*. 1993). In these situations it has offered various levels of invertebrate pest control.

(a) (b)

Fig. 3. *Anystis baccarum* attacking and feeding upon (a) aphid and (b) Collembola prey.

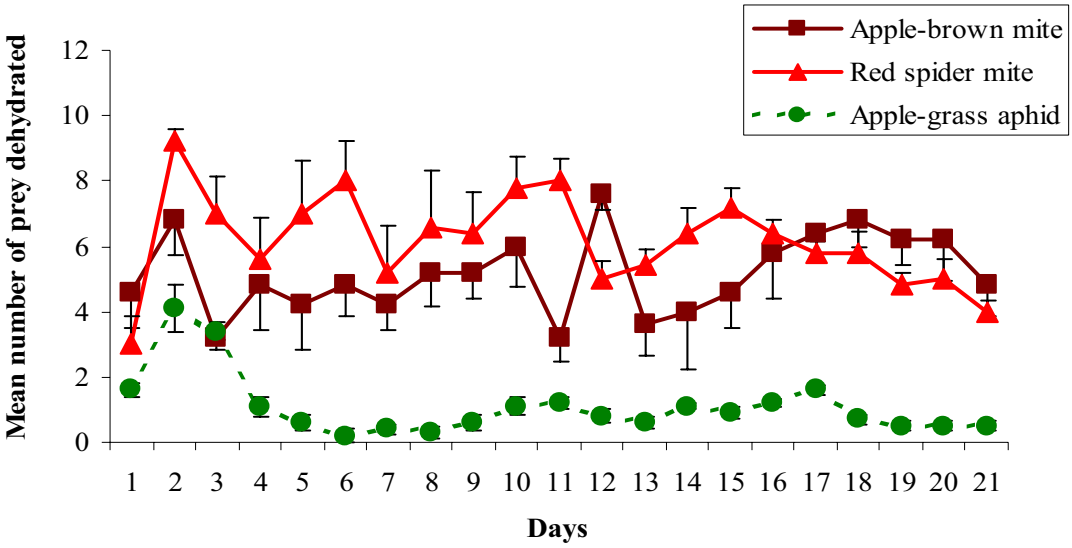

Fig. 4. Feeding rate of *Anystis baccarum* on various orchard pests.

Studies undertaken in the laboratory to look at the potential of *A. baccarum* as a bio-control agent against orchard invertebrate pest species have indicated that *A. baccarum* readily feeds upon various apple pests in the laboratory situation, including: *P. ulmi*, *A. schlechtendali, R. insertum* and apple-brown mite (*Bryobia rubricollis,* (Scheuten) (Prostigmata: Tetranychidae)) (Fig. 4) (Cuthbertson & Murchie 2004b). The former three species have been reported as being of economic importance within Northern Irish orchards (Mowat & Clawson 1996). *Anystis baccarum* has also been recorded within New Zealand apple orchards as being an important predator of tortricid moth larvae (Baker 1983). It will therefore presumably also feed upon fruit tree tortrix moth (*Archips podana* (Scopoli) (Lepidoptera: Tortricidae)) and *Cydia pomonella* (Linnaeus) (Lepidoptera: Tortricidae) larvae within UK orchards (Cuthbertson & Murchie 2005d). *Anystis baccarum* has been shown to be a valuable predator of apple-grass aphid and to offer a degree of apple rust mite control in the orchards (Cuthbertson *et al*. 2003a,b). Exclusion experiments found that rust mite numbers on leaf samples from branches on which *A. baccarum* was

excluded were higher than those from branches where the predator was present (Fig. 5) (Cuthbertson *et al*. 2003a).

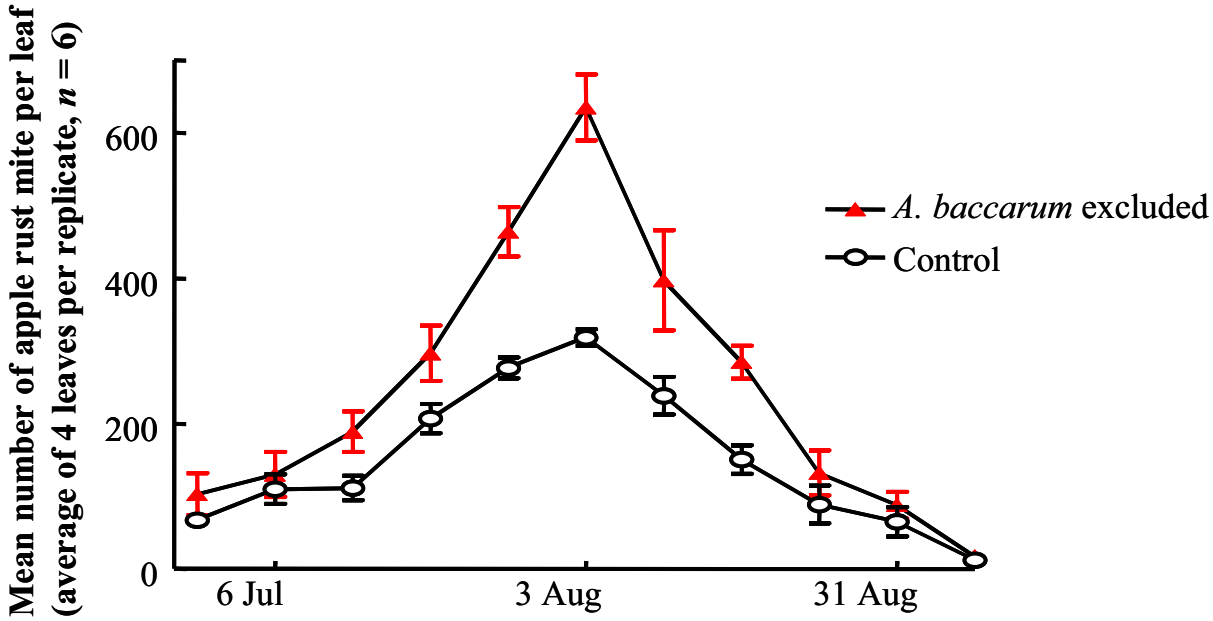

Fig. 5. The effect of excluding *Anystis baccarum* from branches of apple trees on *Aculus schlechtendali* numbers.

COMPATIBILITY OF *ANYSTIS BACCARUM* WITH CHEMICALS.

Until recently the only information on the impact of chemical pesticides or fungicides on *A. baccarum* was a study from the 1970s by Bushkovskaya (1974), working in Russia. Within the British Isles a more recent study found *A. baccarum* had the potential of being compatible with various chemical fungicides (e.g. dithianon) commonly used for apple scab control (Cuthbertson & Murchie 2003). This same study also showed a link between leaf quality and apple rust mite numbers. Cuthbertson & Murchie (2006b,c) also showed that orchard winter-washes and chemical pesticide applications aimed at controlling invertebrate pests had detrimental effects on *A. baccarum* populations. The beneficial mite was removed by the chemicals and as a result of this, and presumably depletion of other natural enemies, pest populations, such as, *A. schlechtendali* increased within the orchards (Cuthbertson & Murchie 2006d). In Canada, work by Laurin & Bostanian (2007a,b) has shown that dry residues of the fungicides sulphur, captan and myclobutanil are harmless to *A. baccarum* as were the insecticides methoxyfenozide, acetamiprid, imidacloprid and □pinosad. *Anystis baccarum* therefore offers much potential to be incorporated into IPM strategies within the orchards for invertebrate pest control.

DISCUSSION.

Anystis baccarum is a commonly occurring beneficial mite within Northern Ireland's apple orchards. This mite has been mis-identified by fruit growers as the pest red spider mite, resulting in unnecessary pesticide applications (Cuthbertson

2004, 2005; Cuthbertson & Murchie 2005c). *Anystis baccarum* offers the potential along with the other beneficial species (e.g. *T. pyri*) occurring within the orchards to be incorporated into integrated pest management schemes that would be introduced into the orchards for the control of invertebrate pest species (Cuthbertson & Murchie 2006e, 2007b). Therefore, in the bid to gain a more environmentally sustainable Bramley's Seedling apple production system within Northern Ireland, and the UK as a whole, apple growers need to be made aware of the presence of *A. baccarum*, and indeed all predatory fauna, within their orchards. They should ensure correct identification of *A. baccarum* from *P. ulmi* so preventing unnecessary pesticide applications and take efforts to conserve its populations within their orchards (Cuthbertson & Murchie 2007a). Such an approach has implications beyond UK and Irish orchards, as *A. baccarum* has a widespread and cosmopolitan distribution, including New Zealand, Australia, Canada, USA, Japan and southern Africa (Meyer & Ueckermann 1987).

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