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Short Communication

Ecological benefits of *Anystis baccarum* in an orchard ecosystem and the need for its conservation

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ABSTRACT: Integrated pest management programs are very important in the control of invertebrate pests within apple orchards. Many current integrated pest management strategies concentrate on specialist predatory species. However, generalist beneficial insects, such as several mite species, must also be fully researched for their potential in controlling pests. Previous research has shown that the generalist predatory mite *Anystis baccarum* (Linnaeus) can offer much potential in controlling invertebrate pests within Northern Irish apple orchards. However, apple growers have been mis-identifying this beneficial species as the economic pest European fruit tree red spider mite, *Panonychus ulmi* (Koch). As a result, unnecessary pesticide applications have been applied against what has now been confirmed as a beneficial species. To aid apple growers in the identification of *A. baccarum*, identification cards were produced. Positive uptake of the cards by many apple growers has resulted in correct identification of *A. baccarum* from *P. ulmi*, and therefore, a reduction in chemical pesticide applications. The benefits of *A. baccarum* within orchard ecosystems is discussed.

Keywords: *Beneficial mite; Biocontrol; Identification card; Pesticide*

INTRODUCTION

The development of orchard integrated pest management (IPM) systems have become an increasingly important concept throughout the world. Increasing public concern over the use of chemical insecticides and their impact on the environment (Horowitz *et al.*, 2003; Banaee *et al.*, 2008) and non-target species (Michaud, 2002; Goulet, 2003; Cuthbertson and Murchie, 2005a; Joy *et al.*, 2005; Cuthbertson and Brown, 2009) is continuing to drive the need to develop new and novel means of pest control in what is an increasingly competitive business. Internationally and more specifically in the United Kingdom (UK), much research regarding orchard IPM has concentrated on the predatory mites *Typhlodromous pyri* Scheuten and *Zetzellia mali* (Ewing). These mites have been shown to have much potential to offer control of many economic invertebrate pest species (Santos, 1976 a,b; Easterbrook *et al.*, 1985; Dicke *et al.*, 1989; Croft *et al.*, 1995). Studies have also shown *T. pyri* to have the potential to be successfully incorporated along with insecticide treatments for the control of orchard pests (Cranham and Solomon, 1981; Easterbrook, 1984; Cross and Berrie, 1994). However, for the full implementation and success of pest control programs within orchard ecosystems, there is also the need to investigate the potential of other generalist predatory species and determine their potential for inclusion within such schemes (Cuthbertson and Murchie, 2007a). Apple orchards form a major part of the horticultural industry within the UK, covering approximately 27,000 ha (Cuthbertson and Brown, 2006; Cuthbertson and Murchie, 2006a; Defra, 2007). Within Northern Ireland specifically, mostly culinary apples are grown, with approximately 90 % of the apple production within a six-mile radius of the village of Loughgall in County Armagh. The local apple industry is highly important to the rural economy of Northern Ireland. Commercial

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apple growing (orchards 0.5 ha and above) is estimated to provide employment for upwards of 800 people on approximately 782 farms. A further 700 people can be employed on a part-time basis including 150 – 200 (depending on crop size) in on-farm peeling for servicing processors (Cook, 1998). On average, Northern Ireland contributes between 20-25% of the UK's production of culinary apples (Anonymous, 1972; 1992), which overall can account for as much as 66% of total UK apple production (Carter and Shaw, 1993; Defra, 2001).

Predatory fauna

Within the Bramley's Seedling apple orchards in Northern Ireland both *T. pyri* and *Z. mali* occur, though in smaller numbers compared to their English counterparts (Cuthbertson and Murchie, 2005b). The study undertaken by Cuthbertson and Murchie (2005b) discovered that the generalist predatory mite *Anystis baccarum* (Linnaeus) (Fig. 1) was the most commonly occurring beneficial species within the Bramley orchards. However, upon consultation with many Northern Irish apple growers it was determined that the presence of *A. baccarum* within the orchards was unknown and that many had actively sprayed chemical insecticides against this beneficial species, confusing it with the pest *Panonychus ulmi* (Koch) (Fig. 2) (Cuthbertson, 2004; Cuthbertson and Murchie, 2005a; Cuthbertson and Murchie, 2007b).

Fig. 1: The beneficial 'whirligig' mite, *Anystis baccarum*

Fig. 2: European fruit tree red spider mite, *Panonychus ulmi*

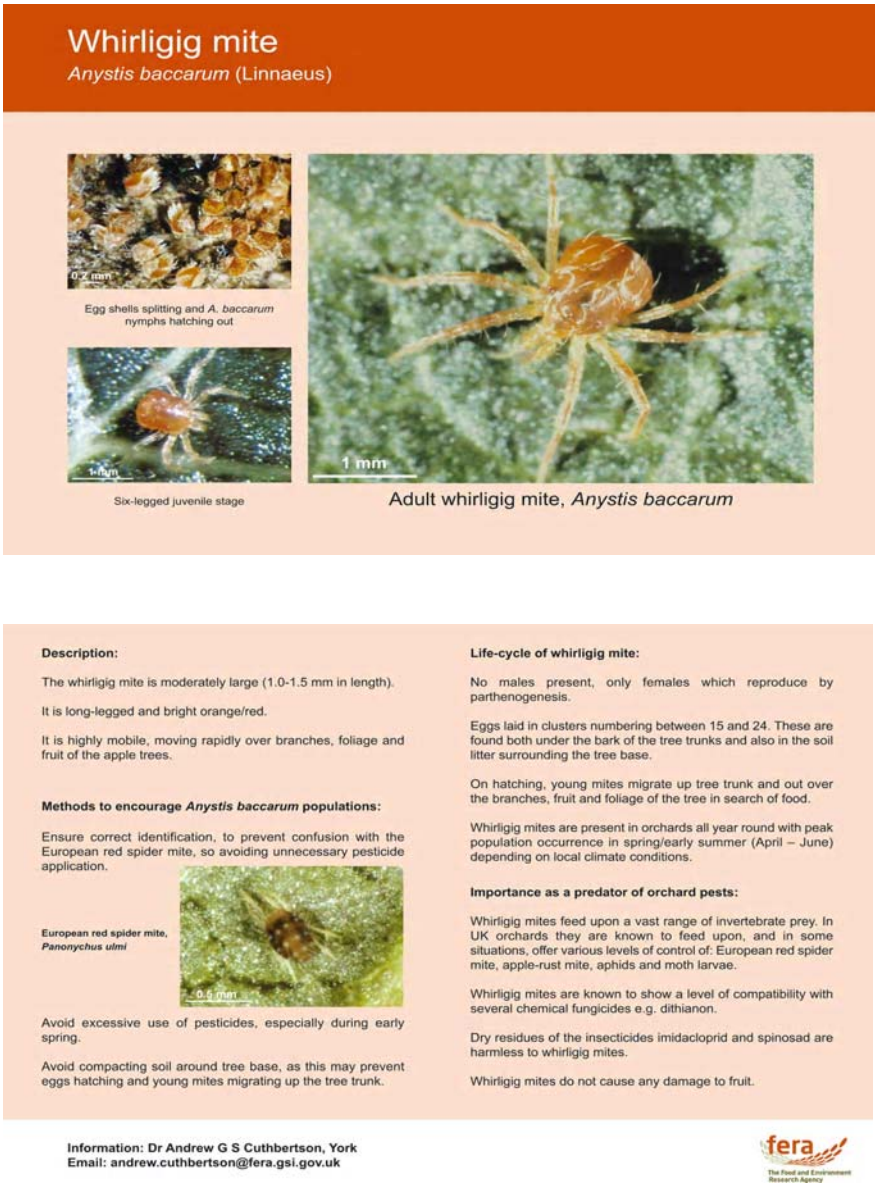

Fig. 3: The *Anystis baccarum* identification card

Identification cards

To help overcome the problem of mis-identification of this beneficial mite and to ensure the elimination of unnecessary pesticide sprays, *A. baccarum* identification cards (Fig. 3) were designed and distributed around the apple growers during the 2009 growing season. These have been gratefully received and the information uptake by the local apple growers has been very positive. As a result, several apple growers have now prevented the need to apply chemical sprays on what has been confirmed as a beneficial species within their orchards.

Description of Anystis baccarum

According to Oudemans (1937), Hooke in 1665 was the first person to find this species (*Anystis baccarum*) but he only referred to it as an insect mite. Linnaeus (1758) first named this species *Acarus baccarum.* It was renamed to *Actineda baccarum* by Stoll (1886) and was first called *Anystis baccarum* by Trägardh

Fig. 4: Egg batch of *Anystis baccarum* (on leaf surface for photo)

(1905) as cited in Meyer and Ueckermann (1987). This mite belongs to the order Prostigmata which contains both predators and plant feeding species and the subfamily Anystinae (Krantz, 1978). Mites of this genus are moderately large (1.0-1.5 mm in length), long-legged and bright orange/red (Krantz, 1978; Titov, 1987). They lay eggs in batches of 15-24 (Fig. 4) in loose soil surrounding the tree base or under the tree bark. Eggs then hatch and six-legged juveniles emerge which then develop into the eight-legged adult. Certain characteristics are listed by Meyer and Ueckermann (1987) and Cuthbertson and Murchie (2007b) from which *A. baccarum* may be easily identified in the field. Also, the production and distribution of the identification card will aid growers in field identification of this beneficial species.

Distribution of Anystis baccarum

Anystis baccarum is a cosmopolitan species capable of surviving a range of climatic conditions and occurs in numerous places including Australia, U.S.A, Europe, Juan Fernandez Islands (close to the coast of Chile), St. Helena, Faeroe Islands, Mexico, Japan and northern and southern Africa (Meyer and Ueckermann, 1987). In Northern Ireland, mites belonging to the genus *Anystis* have been reported to occur (MacQuillan, 1966) but until recently no individual species had ever been identified (Cuthbertson, 2004; Cuthbertson and Murchie, 2004a; Cuthbertson, 2005). At least three other species of the genus are known to occur in the British Isles: *Anystis salicinus* (Linnaeus), *Anystis cornigerum* (Hermann) and *Anystis cursorium* (Gervais). *Anystis agilis* Banks has also been recorded in the British Isles (Anne Baker, British Natural History Museum, London, UK, *personal communication*). Monitoring of *A. baccarum* populations within Northern Ireland's apple orchards proved that the mite occurred almost all year round, with peak occurrence in spring and early summer (Cuthbertson and Murchie, 2004b). This is at the same time as when pests such as red spider mite eggs are beginning to hatch and apple rust mite (*Aculus schlechtendali*, (Nalepa)) 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 (Baker, 1967; Cuthbertson and Murchie, 2004b). Over-wintering eggs of apple-grass aphid (*Rhopalosiphum insertum*, (Walker)) 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 *et al*., 2003a; Cuthbertson and Murchie, 2006 b,c; Cuthbertson and Murchie, 2007 a,c).

Potential biocontrol agent

Mites of the genus *Anystis* have been suggested as agents for bio-control of various pest arthropods (Gerson and Smiley, 1990) as they have been observed feeding on a variety of prey species (Baker, 1967). In England, *A. baccarum* can become

abundant during times of aphid infestation in cereal fields (El Banhawy *et al*., 1993), whereas in New Zealand, *A. baccarum* plays an important role in the predation of tortricid larvae in apple orchards (Baker, 1983; Cuthbertson and Murchie, 2005c). *Anystis baccarum* was also found to increase in number during outbreaks of fruit tree red spider mite in Canadian peach orchards (Putman and Herne, 1966) and also to offer control of phytophagous mites in orchards and blackcurrant plantations in Russia (Lange *et al*., 1974; Livshits and Mitrofanov, 1981; Titov, 1987). Further research investigating the impact of *A. baccarum* upon economically important orchard invertebrate pests, such as apple rust mite and apple-grass aphid, proved that this species has the potential to form a valuable component of orchard IPM strategies (Cuthbertson *et al*., 2003 a,b; Cuthbertson and Murchie, 2004 b, 2005 d, 2006 c).

Compatibility with chemical pesticides

A study undertaken by Cuthbertson and Murchie (2003) indicated that *A. baccarum* can show various levels of compatibility with chemical fungicides commonly used within orchard ecosystems for the control of the fungal disease *Venturia inaequalis*, a major problem in Northern Irish apple orchards (Watters and Sturgeon, 1990). The study by Cuthbertson and Murchie (2003) also showed a link between leaf quality and apple rust mite numbers. Cuthbertson and Murchie (2006 d,e) also showed that orchard winter-washes and chemical pesticide applications aimed at controlling invertebrate pests which had detrimental effects on non-target species populations, such as *A. baccarum*. 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 apple rust mite increased within the orchards (Cuthbertson and Murchie, 2006d). In Canada, recent work by Laurin and Bostanian (2007 a,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 spinosad. *Anystis baccarum*, therefore offers much potential to be incorporated into IPM strategies in apple orchards for invertebrate pest control (Cuthbertson and Muchie, 2009). Unnecessary chemical applications can also have negative impacts on other beneficial insects within orchard ecosystems, for example, honey bees which are vital for pollination of the crop (Fourez, 1995; Aizen *et al*., 2009; Cuthbertson and Brown, 2006; 2009).

CONCLUSION

In the development of orchard IPM programs, generalist predatory mites, such as *A. baccarum*, must also be fully researched to determine their impact upon pest species and included within any such IPM system implemented. Horticultural advisors and fruit growers alike must be fully aware of the biodiversity that occurs within an orchard ecosystem and ensure the correct identification of pest and beneficial species, thus eliminating unnecessary chemical applications. The inclusion of generalist predatory species within pest control programs has the potential to lead to a more sustainable apple production system, not only within Northern Ireland, but the British Isles as a whole (Cuthbertson and Murchie, 2006a; 2009).

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