

## Review paper

# INTEGRATED PEST MANAGEMENT IN BRAMLEY'S SEEDLING APPLE ORCHARDS IN NORTHERN IRELAND

*Controle de pragas integrado ao manejo em plantações de  
maçã do tipo Bramley's na Irlanda do Norte.*

Andrew G. S. Cuthbertson<sup>1</sup>

Archie K. Murchie<sup>2</sup>

Apple orchards form a major part of the horticultural industry within the United Kingdom (UK), covering approximately 27,000 ha (1). Within Northern Ireland, mostly culinary apples are grown, with approximately 90% of apple production within a six-mile radius of the village of Loughgall in County Armagh (2). The Bramley Seedling apple industry is highly important to the rural economy of Northern Ireland. Commercial apple growing (orchards 0.5 ha and above) is estimated to provide employment for 800 people on a total of 782 farms. A further 700 people are employed on a part-time basis including 150 – 200 (depending on crop size) in on-farm peeling for servicing processors (3). On average, Northern Ireland contributes 20% of the total UK production of culinary apples (3,4). However, over the past number of years the market for fresh Bramley apples has declined. The percentage of production going for processing had risen from 60% in 1986 (3) to 90% in 1999 (Economics and Statistics Division, Department of Agriculture and Rural Development for Northern Ireland (DARDNI), *unpublished data*). This would appear largely due to the reduction of home baking in modern society. One area that has expanded is the apple juice market. *Green Gate* still apple juice was the first apple juice product to be launched onto the Northern Irish market by a home company, *Killyman Co-operative Society* in 1984. Sales were initially slow but gradually increased, and as a result, in 1988 sparkling apple juice was launched. Apple juice was the second most popular fruit juice after orange in Northern Irish households in 1991 (5).

Increased competition from other European countries such as Germany, which has increased its total apple (dessert and Bramley) production area from 27,000 ha in 1987 to 39,000 ha in 1996 (6), requires

---

<sup>1</sup> Central Science Laboratory, Sand Hutton, York YO41 1LZ, UK. E-mail: a.cuthbertson@csl.gov.uk

<sup>2</sup> Agri-Food and Biosciences Institute, Newforge Lane, Belfast BT9 5PX, UK. E-mail: archie.murchie@afbini.gov.uk

management practices in the orchards to be constantly reviewed to ensure effectiveness. In addition, apple growers need to be aware of changes in consumer concerns and address them in relation to their crop production. There is growing awareness among consumers about environmental and public health issues. Partly as a result of this, there was an average annual growth of 25% in organic produce in the UK during the 1990's (7). With this change in attitude towards crop production, there is a need to investigate alternative means of pest control, rather than chemicals. This may ensure environmental compatibility and ease (often unfounded) concerns over food safety by consumers. However, at the present time, organic apple production is not a viable option. Orchards in Northern Ireland suffer because the Bramley's Seedling cultivar is susceptible to apple scab (*Venturia inaequalis*) which requires much fungicide treatment (8). Although alternatives to fungicides, such as aqueous compost extracts (9), are being investigated, their commercial realisation is unlikely in the near future.

Invertebrate pest surveys undertaken by DARDNI within Northern Irish apple orchards found that many pests were present during the winter months. However, in spring/summer when damage would be expected, large summer populations of pests fail to materialise and significant loss of crop rarely occurs, even though pest numbers are often above the UK Agricultural Development and Advisory Service (ADAS)

recommended spray thresholds (10, 11, 12). This could be due to several factors. First, the climate of Northern Ireland is cooler and wetter than that of, for example, the south of England; as a result, population growth and number of generations of pests per year is smaller. Second, the Bramley fruit is acidic (13) and may therefore not be as favourable for mite feeding as cultivars of eating apples. Spray thresholds have been calculated on unspecified cultivars in England and Wales (11), and therefore, there is no guarantee that they will apply to the Bramley's Seedling cultivar (14). Third, in Northern Irish orchards, on average 14 applications of protectant fungicide are applied to control apple scab. These are applied in the early part of the year and, as many are known to have acaricidal effects, will help to lower pest numbers. It is only when these sprays are discontinued in late summer that pest numbers begin to increase significantly (12,15), but by then it is often too late to cause damage.

The re-discovery of the large predatory mite, *Anystis baccharum* (Plate 1a) (16, 17, 18) offers a possible explanation for the lack of serious pest problems in Northern Irish Bramley orchards. This predatory mite is commonly occurring in the orchards (19), yet its impact had never been studied, possibly because it is only rarely found in English orchards. *Anystis baccharum* has a world-wide distribution (20). Mites of this genus are described as voracious, generalist predators consuming any prey they can overpower and puncture (Plate 1b) (21, 22).



(A)



(B)

**Plate 1. (A) The predatory mite *Anystis baccharum*; (B) *Anystis baccharum* attacking and feeding upon *Collembola* prey.**



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

Much recent work has now shown that *A. baccharum* is a predator of invertebrate pests commonly found in apple orchards. It has been observed in the laboratory to feed on different prey species at varying rates (19). Using exclusion techniques, *A. baccharum* was found to reduce *Aculus schlechtendali* (apple rust mite) numbers in commercial orchards (23). It is probable that the same effect would occur with other pest species, for example, *Rhopalosiphum insertum* (apple-grass aphid) or *Panonychus ulmi* (European fruit tree red spider mite; Plate 2). The development of molecular techniques to identify predation of pest species will further help to assess prey preferences and hence the predatory role of *A. baccharum* within the orchards (24). Due to the importance of scab control, it is probably true to say that the heavy fungicide application in Northern Ireland's orchards has more of an effect on both pest and beneficial species than pesticide application. Two of the most frequently sprayed fungicides within Northern Irish orchards, captan/penconazole and mancozeb, have been shown to have detrimental effects on *A. baccharum* while dithianon is non-toxic (15). Various pesticides, for example, phosalone, which is frequently used in orchard pest control, has also been shown to be detrimental to *A. baccharum* (25).

The widespread presence of *A. baccharum* within Northern Irish Bramley orchards is largely unknown. Fruit growers presented with live specimens of *A. baccharum* stated that they would have identified it as European fruit tree red spider mite, *P. ulmi* (16, 26). Some also said that they had seen an orange/red mite on the foliage and thinking that their orchard was infected with spider mites,

they sprayed against this mite. There is thus the need to ensure proper identification of mite species and to educate growers about the presence of natural enemies (16, 27) and indeed other beneficial insects such as honey bees (28). Northern Ireland's Bramley apple growers are aware of the changing market towards 'greener' produce and are keen to learn of new orchard management practices that will reduce the number of sprays required for pest control. Some fruit growers envisage that within 5-10 years, due to both economics and consumer pressure, biological control will play a major role in the management of their orchards (Cuthbertson AGS, *pers. comm.*). However, at the present time Northern Irish fruit growers are more concerned with apple scab than invertebrate pest control. They view the application of fungicides as a necessity, and are often little concerned about side effects on beneficial species. The small extra cost of pesticide application is viewed as little, compared to the loss suffered in crop yield due to apple scab infection (Cuthbertson AGS, *pers. comm.*).

Biological control may offer the potential to be an alternative means of pest control in the Bramley orchards, provided compatible fungicide sprays are applied. *Anystis baccharum*, along with the other predatory mite and insect species recorded in the orchards (29) is a tool to be exploited. *Anystis baccharum* is described as a predator of tortricid larvae in New Zealand apple orchards (30), which could be why it is difficult to locate tortrix larvae in Northern Irish Bramley orchards (31). The prospect of mass rearing and release of *A. baccharum* into orchards to help control or lower pest numbers is a possibility, though a major drawback in rearing the mite is its cannibalistic nature (21, 32).

There is now a trend in crop and fruit production for the implementation of integrated pest management (IPM) programmes (33, 34). These use a combination of both cultural and selective chemical means to control pest problems, while at the same time trying to enhance biological control by natural enemies. Only compatible sprays are used and precise timing is involved to try and ensure as little disruption as possible to natural enemies. The activity of *A. baccharum* will most certainly be a component of any such IPM programme introduced into the Bramley's Seedling apple orchards in Northern Ireland.

## Acknowledgement

Dr Andrew G S Cuthbertson was funded by a Department of Agriculture and Rural Development (Northern Ireland) Studentship.

## References

1. Solomon MG. Exploitation of predators in UK fruit and hop culture. *Phytoparasitica* 1992; 20:51-56.
2. Cuthbertson AGS, Murchie AK. *Anystis baccarum*: an apple orchard assassin. *Biologist* 2005; 52:324-327.
3. Cook MCF. An economic review of Northern Ireland apple production and marketing with special reference to Bramley Seedling. Report for Department of Agriculture for Northern Ireland Economics and Statistics Division; 1988. 26 p.
4. Anon. Apples. UK farming and the Common Market. A report by the Economic Development Committee for Agriculture. National Economic Development Office. London, UK 1972. 22 p.
5. Anon. A report on the market for processed apples. Belfast, UK: Local Enterprise Development Unit for Northern Ireland; 1992. 46 p.
6. Anon. Eurostat. Agriculture Statistical Yearbook 1997 Luxembourg; Office des Publications Officielles des Communautés Européennes; 1997. 256 p.
7. Anon. Organic Conversion Information Service. London, UK: Ministry of Agriculture Fisheries and Food; 1999. 21 p.
8. Watters BS, Sturgeon SR. An evaluation of fungicides against apple scab (*Venturia inaequalis*) in Bramley's Seedling. *Tests of Agrochem. Cult. No.11 Ann. Appl. Biol. Suppl* 1990; 116:38-39.
9. Yohalem DS, Nordheim EV, Andrews JH. The effect of water extracts of spent mushroom compost on apple scab in the field. *Phytopathology* 1996; 86:914-922.
10. Mowat DJ, Clawson S. The need for pest control in Northern Ireland Bramley apple orchards. *Crop. Prot. North. Br* 1996; 2:225-230.
11. Cross JV, Berrie AM. Sampling and assessment of pests and diseases as the basis for decision making in orchards in the UK. *Asp. Appl. Biol* 1994; 37:225-236.
12. Cuthbertson AGS, Murchie AK. Environmental monitoring of economically important invertebrate pests in Bramley apple orchards in Northern Ireland. *Int. J. Environ. Sci. Tech* 2006; 3:1-7.
13. Merryweather R. The Bramley. A world famous cooking apple. Newark and Sherwood District Council; 1992. 31 p.
14. Cuthbertson AGS, Murchie AK. Economic spray thresholds in need of revision for Northern Irish Bramley orchards. *Biodiversity News* 2005; 32:19.
15. Cuthbertson AGS, Murchie AK. The impact of fungicides to control apple scab (*Venturia inaequalis*) on the predatory mite *Anystis baccarum* and its prey *Aculus schlechtendali* (apple rust mite) in Northern Ireland Bramley orchards. *Crop Prot* 2003; 22:1125-1130.
16. Cuthbertson AGS. Unnecessary pesticide applications in Northern Ireland apple orchards due to mis-identification of a beneficial mite species. *Res J Chem Environ* 2004; 8(3):77-78.
17. Cuthbertson AGS. Re-discovery of a predatory mite in Northern Irish apple orchards. *Biodiversity News* 2005; 30:29.
18. Cuthbertson AGS, Murchie, AK. The presence of *Anystis baccarum* (L.) in Northern Ireland Bramley apple orchards. *Ir Nat J* 2004; 27:465-467.
19. Cuthbertson AGS, Murchie AK. The phenology, oviposition and feeding rate of *Anystis baccarum*, a predatory mite in Bramley apple orchards in Northern Ireland. *Exp. Appl Acarol* 2004; 34:367-373.
20. Krantz GW. A manual of Acarology. 2<sup>nd</sup> ed. Corvallis: Oregon State University Book Stores; 1978. 509 p.
21. Baker WV. Some observations on predation in an anystid mite. *Ent Mon Mag* 1967; 103:58-59.
22. Sorensen JT, Kinn DN, Doult RL, Cate JR. Biology of the mite, *Anystis agilis* (Acari:Anystidae): A California vineyard predator. *Ann Entomol Soc Am* 1976; 69:905-910.

23. Cuthbertson AGS, Bell AC, Murchie AK. Impact of the predatory mite *Anystis baccarum* (Prostigmata:Anystidae) on apple rust mite *Aculus schlechtendali* (Prostigmata: Eriophyidae) populations in Northern Ireland Bramley orchards. *Ann Appl Biol* 2003; 142:107-114.
24. Cuthbertson AGS, Fleming CC, Murchie AK. Detection of *Rhopalosiphum insertum* (apple-grass aphid) predation by the predatory mite *Anystis baccarum* using molecular gut analysis. *Agric For Entomol* 2003; 5:219-225.
25. Cuthbertson AGS, Murchie AK. A preliminary study into the direct effect of chemical pesticides on the predatory mite *Anystis baccarum*. *Int J Ultra Sci Phys Sci* 2006; 18(2):177-180
26. Cuthbertson AGS, Murchie AK. European red spider mite: an environmental consequence of persistent chemical pesticide application. *Int J Environ Sci Tech* 2005; 2:287-290.
27. Cuthbertson AGS, Murchie AK. Correct identification required to ensure beneficial mite species survival in Northern Irish Bramley orchards. *Biodiversity News* 2006; 34:16.
28. Cuthbertson AGS, Brown MA. Vital pollinators: honey bees in apple orchards. *Biologist* 2006; 53:78-81.
29. Cuthbertson AGS, Murchie AK. Techniques for environmental monitoring of predatory fauna on branches of Bramley apple trees in Northern Ireland. *Int J Environ Sci Tech* 2005; 1:1-6.
30. Baker RT. Predation of leafroller larvae by spiders and mites. *Weta* 1983; 6:22-23.
31. Cuthbertson AGS, Murchie AK. Environmental monitoring of *Archips podana* (fruit tree tortrix moth) in Bramley apple orchards in Northern Ireland. *Int J Environ Sci Tech* 2005; 2:101-104.
32. Golovach GP. Characteristics of the phenology of the predatory mite *Anystis* and its rearing under laboratory conditions. *Vest Zool* 1989; 3:84-86.
33. Blommers LHM. Integrated pest management in European apple orchards. *Ann Rev Entomol* 1994; 39:213-41.
34. Cuthbertson AGS, Murchie AK. The role of *Aculus schlechtendali* (apple rust mite) in orchard pest management strategies in Northern Ireland. *J Entomol* 2006; 3(4):267-270.

Recebido em / Received: January 31, 2006.

Aceito em / Accepted: March 24, 2006.