Suggestions for the management of hazelnut big bud mites in New Zealand

Janette Webber

Hazelnut growers have often considered big bud mites a common and generally difficult pest to control. Much of the information on control of big bud mites comes from overseas, and it is debatable as to how much of that information can be applied to New Zealand conditions. This brief article summarises the results of two seasons' research in Canterbury that was aimed at determining the spring emergence of big bud mites from big buds, and developing an approach that would provide growers with a more reliable way of timing control measures. Other prospects for control of big bud mites are also identified.

The two hazelnut big bud mites, *Phytoptus avellanae* and *Cecidophyopsis vermiformis* (Nalepa 1889) (Acari: Eriophyoidea), are generally found together in hazelnut big buds (Krantz 1974). Both *P. avellanae* and *C. vermiformis* have been identified in New Zealand (Lamb 1960; Webber 2007). These white, worm-like mites are microscopic, being approximately 0.2 mm long (Plate 1). They cause hazelnut buds to become swollen, fleshy, deformed and pinkish ('big buds') (Plates 2 & 3). Infested vegetative buds develop weak and unhealthy shoots, damaged male catkins become stiff and brittle producing little pollen, and weakened female buds produce no nuts (Jeppson et al. 1975).

Injury to buds by big bud mites may cause significant economic loss (Ecevit et al. 1992; Stamenkovic et al. 1997). Bud losses as high as 90% have been reported in the Republic of Georgia (Tavamaishvili 1990) and 80% in England (Massee 1930), however, the percentage of infested buds is generally less than 20% in most cultivars (AliNiazee 1998). The actual damage caused by big bud mite in New Zealand hazelnut orchards is unknown. Neither is there any idea of the effect of bud damage on the final yield, and neither an economic threshold nor economic impact has been established in New Zealand.

The research findings from overseas are not able to be directly applied to the situation in New Zealand because of the differences in seasonal weather patterns, cultural practices that are used, natural enemies present, and other environmental conditions. Also, none of the research overseas has been conducted on 'Whiteheart' the main cultivar in New Zealand although other cultivars (such as 'Ennis'), which are grown in New Zealand and other countries, have been occasionally included in overseas research.

Recent research in New Zealand by Webber (2007) indicated that the presence of big bud mites does have a harmful effect on the hazelnut tree. The length of twig growth from normal buds was found to be usually significantly longer than growth from big buds. The infestation of big bud mites was shown to have has less effect on the growth from the big buds on 'Ennis' than on 'Whiteheart'. Twig length is a key part of hazelnut production. Painter (1959) found that vigorous shoot growth is vital as the longer the twig, the greater the number of nuts produced.

At present, many growers consider big bud mites are easy to control without the use of pesticides by collecting and burning infested buds in winter. However, it appears this approach is not effective and big bud mite infestation of hazelnut is causing increasing concern to growers.

Overseas, many chemicals have been tested against big bud mite with little agreement between the results of the studies. However, the successful control of big bud mites by chemical is dependent not only upon the efficacy of the chemical but also the correct timing of the application of the chemical (Ozman-Sullivan & Akça 2005). Hazelnut big bud mites are difficult to control with chemicals or other methods because they are protected inside the bud. It is well accepted that the only time the big bud mites are vulnerable to chemical control is in the spring, when the mites have emerged from the old big bud and before they enter the new bud (AliNiazee 1980; Petanovic et al. 1989; Childers et al. 1996).

In Canterbury, Webber et al. (2008) found hazelnut big bud mites emerge from the winter big buds from early spring until late spring, i.e., from the end of August to the end of November. This emergence period could occur over 86 days depending on environmental conditions, cultivar and location. The rate of emergence from big buds appears to be influenced by fluctuating temperatures as well as growth stage of the plant, but the relationship is difficult to define. Big bud mites appear to leave the bud at maximum temperatures above 15°C and at mean temperatures greater than 9°C with the rate of emergence increasing as the temperature increased.

Clearly it is important to consider the development of the new bud as well as the number of emerging mites. To be effective, any control should be introduced before the new bud has developed to the stage that the big bud mites are able to achieve entry (Plate 4). Webber et al. (2008) suggested the appropriate timing should be before the new hazelnut buds measure approximately 0.5 mm x 0.5 mm (width x height), are still enclosed within the axil, and have a rounded tip, or, at 50% accumulated emergence of the big bud mites, whichever occurs first.

Webber et al. (2008) developed an accumulated heat sum (= degree-day) model to predict the start of big bud mite emergence and a multiple regression model (using the relationship between leaf number, bud height, bud width, degree-days and Julian date from the start of emergence) for determining the approximate percent emergence of the big bud mites.

The *accumulated heat sum model* provided an acceptable prediction of the start of emergence. Using a start date of Julian date 152 (01 June) with a lower threshold (LT) temperature of 6ºC, the start of emergence was predicted for both cultivars at both Canterbury study sites to be 172 DDs with an absolute mean error of 4.7 Julian days. Such a forecast could be very useful for growers to establish a start date for monitoring and visual inspection of the growth of the hazelnut.

The *multiple regression model* provided a satisfactory means of determining the approximate accumulated percent emergence of the big bud mites and, with further refinement, could be especially useful to growers for determining the most efficient time to introduce a control. The equation for the regression model is:

$$\% \text{ Emergence} = -254 - 4.24 \text{ Leaf No.} + 57.3 \text{ Bud length} - 41.1 \text{ Bud width} + 0.102 \text{ DDs} + 1.03 \text{ Julian date}$$

where Leaf No. is the number of new open leaves, free from the bud, DDs are the number of degree-days (LT 6°C) from the start of emergence to the event of interest and Julian date is the day of the year from January 01. The degree-day variable can be eliminated from the current model to make it more 'user-friendly' for the commercial grower with little loss of precision.

These two models can be used on conjunction with each other. Once the start of emergence was confirmed by the accumulated heat sum model, degree-day accumulation could then be used in conjunction with the regression model to predict approximate times for levels of emergence. However, both models are based only on two years of data from two sites. Additional research in other years and at a number of sites would be required to refine and validate the models (Webber et al. 2008). There are no plans at present to conduct further research on prediction models for hazelnut big bud mite emergence.

The use of the commercial agrichemical NO FUNGUS SUPER SULPHUR (active ingredient 800g/kg Sulphur), applied at 40 g product/10 litres, was found to be effective in reducing the number of emerging big bud mites (Ozman-Sullivan & Akça 2005; Webber & Chapman 2008).. Ideally, a protective surface deposit of acaricide needs to be maintained over the entire time that the mites are emerging from the big buds. Consideration could also be given to adding a surfactant to the spray mix to improve sticking, and to the application of a second spray, especially if rain or high temperatures occur after spraying.

It is important to determine the infestation rate each year before applying any control as the application of agrichemicals may not be required. The infestation rate was shown to decrease from one year to the next at Fernhill, Canterbury, without any control intervention suggesting seasonal fluctuations in big bud mite populations in relation to environmental conditions (Webber 2007). Mite numbers, and hence bud infestation, have been shown to be considerably reduced when there were high temperatures and low rainfall during the emergence period in Poland (Ganter 2001).

However, effective decision-making based on infestation rate requires knowledge of the economic threshold and, as noted, this has not been determined for New Zealand cultivars and conditions. Information from overseas cannot be applied to the control of big bud mites in New Zealand as both the cultivars and the growing environment differ.

Appropriate choice of agrichemical and their efficient use is extremely important in pest management. The indiscriminate and/or inefficient use of chemicals, both against the big bud mites and other pest arthropods, appears to have increased the severity of infestations of big bud mite on hazelnut overseas (AliNiazee 1998). Some agrichemicals are very destructive of beneficial organisms and are the initial cause of some of the pest outbreaks, e.g., filbert aphid (*Myzocallis coryli* (Goetze) [Hemiptera: Aphididae]) and obliquebanded leafroller (*Choristoneura rosaceana* (Harris) [Lepidoptera: Tortricidae]) (AliNiazee 1997; Viggiani 1994).

To safeguard the beneficial action of predators, non-selective pesticides should be used as sparingly as possible, coupled with optimal timing through the use of plant developmental stages and degree-day predictions. Sulphur has been shown to be effective against hazelnut big bud mites (Webber & Chapman 2008). The additional attributes of sulphur are low mammalian toxicity and less harmful effects on beneficial fauna.

An alternative to spraying is to develop a source of resistant cultivars. If 'Whiteheart' is to be remain the primary cultivar, a breeding programme (such as those carried out overseas) aimed at developing big bud mite resistance should be encouraged. Several, cultivars known to be resistant to big bud mite are available in New Zealand and are of good quality (e.g., 'Barcelona', 'Merveille de Bollwiller', 'Tonda di Giffoni' and 'Tonda Romana'). Although anecdotal evidence is available, an assessment of the resistance to big bud mite of the cultivars already available within New Zealand would be worthwhile.

A further alternative to spraying is to encourage the natural enemies already present within the hazelnut system. Natural enemies are abundant on hazelnuts, according to AliNiazee (1998) and Tuncer and Saruhan (2001), and are of great importance in suppressing hazelnut pests, and may play a significant role in the commercial production of hazelnuts. In a study of the acarofauna associated with hazelnut in Christchurch and Lincoln (Webber 2007), five species of predator mites were found to be present from the families: Ascidae, Bdellidae, Cheyletidae, Phytoseiidae and Tydeidae. Phytoseiids and Tydeids (the latter was found in very high numbers) were of particular importance as they have been shown to feed on eriophyoid mites (Schicha, 1987; Walter & Proctor, 1999). *Typhlodromus doreenae* Schicha (Acari: Phytoseiidae) appears to have good potential as a biological control agent for the hazelnut big bud mites in New Zealand. It is considered that a large number of mite species are yet to be discovered in the hazelnut growing areas of New Zealand and further studies are needed. The relatively few pests of New Zealand hazelnuts and low insecticide input, provide an excellent opportunity for the development of an integrated pest management programme for big bud mite.

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Plate Captions

Plate 1 *Phytoptus avellanae* (0.18 mm x 0.06 mm (length x width))

Plate 2 Normal hazelnut bud

Plate 3 Hazelnut big bud

Plate 4 Big bud mites inside and on outside of new hazelnut bud (Magnified)

Plate 1 *Phytoptus avellanae* (0.18 mm x 0.06 mm (length x width))

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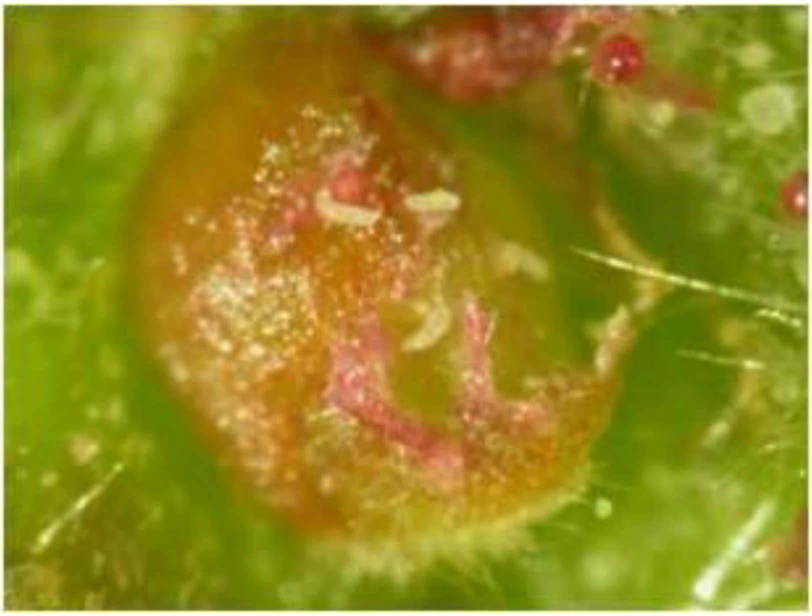

Plate 4 Big bud mites inside and on outside of new hazelnut bud (Magnified)