

## Apple Dimpling Bug: what do we know

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### Introduction

The apple dimpling bug (ADB), *Campylomma liebknechti* (Girault) is a sucking insect, indigenous to Australia which occurs in all cotton growing area. Bishop (1980) and Chinajariyawong and Walter (1990) reported that ADB is a pest as well as a predator of *Heliothis* eggs in cotton. ADB is also considered a predator of two-spotted mites in cotton (Wilson *et al.* 1998). Currently there are mixed conceptions within the cotton industry about the status of ADB; whether it is a pest or a beneficial insect. Some growers and consultants consider ADB as a pest in the same category as the green mirid and recommend insecticide sprays against it if numbers are over the current entomoLOGIC threshold. Some growers and consultants do not classify ADB as a pest or as a beneficial insect, but will control it with synthetic insecticides if populations are high, plants are being tipped out or pin squares are being lost and other pests like green mirids or thrips are absent. Thus the cotton industry's mixed attitude towards ADB, in contrast to the green mirids, shows there is a substantial gap in our knowledge of the true status of this insect. Detailed study of the basic biology, behaviour, pest status and population dynamics of ADB is required so that appropriate control measures can be identified to manage them. In this paper we present some of the results of our recent research on ADB, particularly some aspects of the pest status, lifecycle, sampling and diurnal activities. In addition, we will report on the different species of apple dimpling bug found in the cotton growing areas in NSW

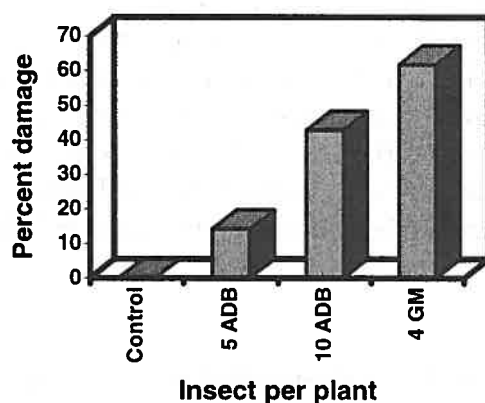
### Is ADB a cotton pest?

Experiments conducted in the glasshouse showed that the type of damage caused by ADB to cotton is similar to but less intense than that of green mirids. We found that 4 green mirid adults feeding on a cotton plant for one day caused more damage than 10 ADB adults feeding for 3 days (Figure 1). The economic threshold for ADB, should therefore be considerably higher than that of green mirids. Studies are continuing to determine ADB densities which may cause economic damage. Despite the differences in the extent of damage they cause to cotton both green mirids and ADB have similar feeding habits preferring to feed on growing tissues, particularly the tips of cotton plants and folded leaves. ADB will also feed on unfolded leaves. Feeding on unfolded leaves causes a characteristic blackening and curling of the leaf margin at the feeding points and also perforation of the leaves. Feeding on seedling cotton causes abrasive brown spots at the feeding points on the plants. Damage caused by ADB can also retard the growth of the plants. In an experiment where we placed 10 ADB adults onto cotton plants for two weeks and compared the plant's growth with uninfested plant of the same age we found that infested plants had 60 per cent less nodes than the uninfested plants (Figure 2A). The study also showed that the ADB infested plants had reduced leaf area, leaf dry weight, stem and root dry weights than uninfested plants (Figure 2B and C).

### Is apple dimpling bug a predator of *Helicoverpa* spp. and other cotton pests ?

Though the predatory ability of *C. liebknehti* has not been studied, preliminary trials indicate that both adults and nymphs can feed and survive well on *Helicoverpa* spp. eggs. They are also well recognised as predator of mite eggs in orchards (Readshaw 1975). During egg feeding they insert their stylets into the egg and suck all the juice out of the egg. On one occasion we observed a female feeding on *Helicoverpa* spp. eggs. It took the female about 12 minutes to locate and consume the egg. They feed on both white and brown eggs. The insect's abdomen is transparent and this enables us to determine whether it has fed on cotton plant or white and brown *Helicoverpa* spp. eggs. If the insect has fed on brown eggs, the colour of the abdomen is brown but if it has fed on either cotton or white eggs the colour of the abdomen remained unchanged i.e. pale yellow. Based on our preliminary trial we incorporated *Helicoverpa* spp. eggs into our diet to study the insect's life cycle. In 1998-99 season we plan to study the feeding numerical and functional responses of ADB to *Helicoverpa* spp and other cotton pests.

**Figure 1.** Damage caused by apple dimpling bug on young cotton plants in the glasshouse.

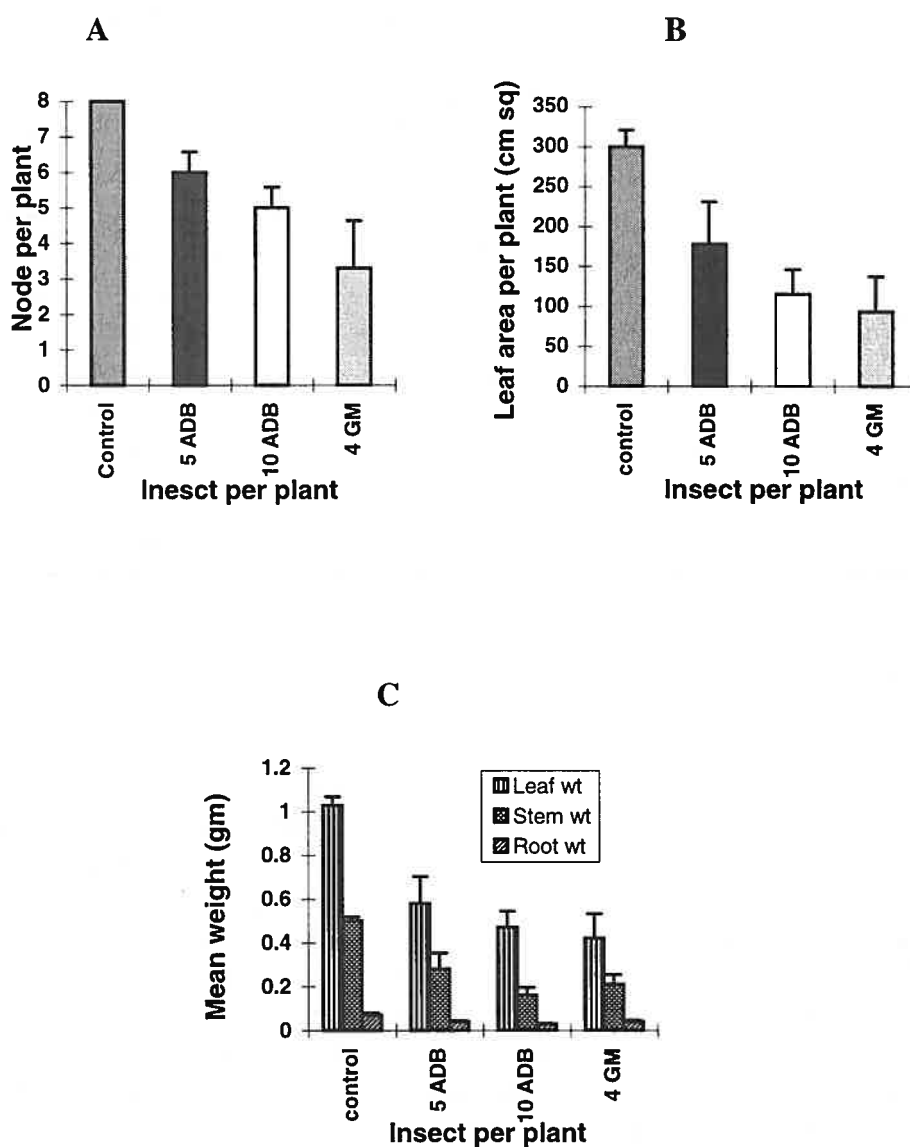


### Is there only one Apple Dimpling bug species in the cotton arena?

Malipatil (1992) reported that there are 5 species of Apple dimpling bug distributed throughout Australia. Which of these species are found on cotton, particularly in the cotton growing areas of New South Wales? To determine this, we surveyed cotton crops and weeds in 4 cotton growing areas in NSW viz; Boggabilla, Moree, Narrabri and Warren during early, mid and late season in 1997-98. Most of the weeds surveyed were those which remained green throughout the year at all the locations. These include lucerne (*Medicago sativa*); salt bush (*Atriplex* spp); black pig weed (*Trianthema portulacastrum*). The results of this survey are summarized in Table 1. The results showed that whereas two species of Apple dimpling bug, *Campylomma*

*liebkechti* (Girault) and *C. seminigracaput* (Girault) occur on weeds in all the locations, only one species, *C. liebkechti* occurs on cotton. This species was abundant in both early and mid season (Table 1).

**Figure 2.** Feeding by apple dimpling bug on young plant in the glasshouse reduces node production, leaf area and dry weights of leaf, stem and root



**Table 1.** Apple dimpling bug species found on cotton, other crops and weeds at Narrabri, Boggabilla, Moree and Warren in New South Wales, 1997-98.

Location	Early season		Mid season		Late season	
	<i>C. liebknechti</i>	<i>C. seminigricaput</i>	<i>C. liebknechti</i>	<i>C. seminigricaput</i>	<i>C. liebknechti</i>	<i>C. seminigricaput</i>
<b>Narrabri</b>						
Cotton	9	0	1	0	2	0
Lucerne	8	1	2	0	16	0
Saltbush	-	-	-	-	-	-
Pig weed	-	-	-	-	-	-
<b>Boggabilla</b>						
Cotton	3	0	4	0	0	0
Lucerne	4	0	0	0	1	0
Saltbush	1	1	0	0	0	1
Pig weed	-	-	-	-	0	0
<b>Moree</b>						
Cotton	18	0	5	0	0	0
Lucerne	3	0	1	1	0	0
Saltbush	-	-	-	-	-	-
Pig weed	-	-	-	-	-	-
<b>Warren</b>						
Cotton	17	0	4	0	2	0
Lucerne	13	0	2	0	0	0
Saltbush	4	58	12	2	0	0
Pig weed	-	-	8	0	0	0

### Life cycle of *C. liebknechti*

The life cycle of apple dimpling bug, unlike green mirids, is difficult to study because they do not survive well on beans, which green mirids do well on, in the laboratory. However, we successfully studied the life cycle of ADB in the laboratory by culturing them on a diet of cotton leaves and *Helicoverpa* spp. eggs in a petridish.

We found in our study that ADB has the same egg laying behaviour as the green mirid. Eggs are laid singly and embedded in the plant tissue leaving only the egg cap outside to provide air to the developing nymph. Eggs are kidney-shaped and when newly laid a transparent white colour. With age, the eggs turn pale yellow with two red spots on top indicating the development of the compound eyes of the developing nymph. After hatching, ADB passes through 5 nymphal stages before becoming an adult (Table 2). The first instar nymph is initially a pale white in colour and gradually becomes a pale to bright yellow as it matures. The wing pads developed at the third instar stage. There are two distinguishing characters found on ADB. The first is a dark spicules on the legs, which develop in the 5<sup>th</sup> instar prior to moulting to adult. The second is a dark brownish ring at the far end of second antennal segment and this developed in the adult stage. ADB takes about 18.1 days from egg to adult at an

average temperature of  $25\pm 1^{\circ}\text{C}$ . The duration of the developmental period for ADB males and females from egg hatching was 11.1 for males and 10.8 days females. The female was found to live longer than male (Table 2).

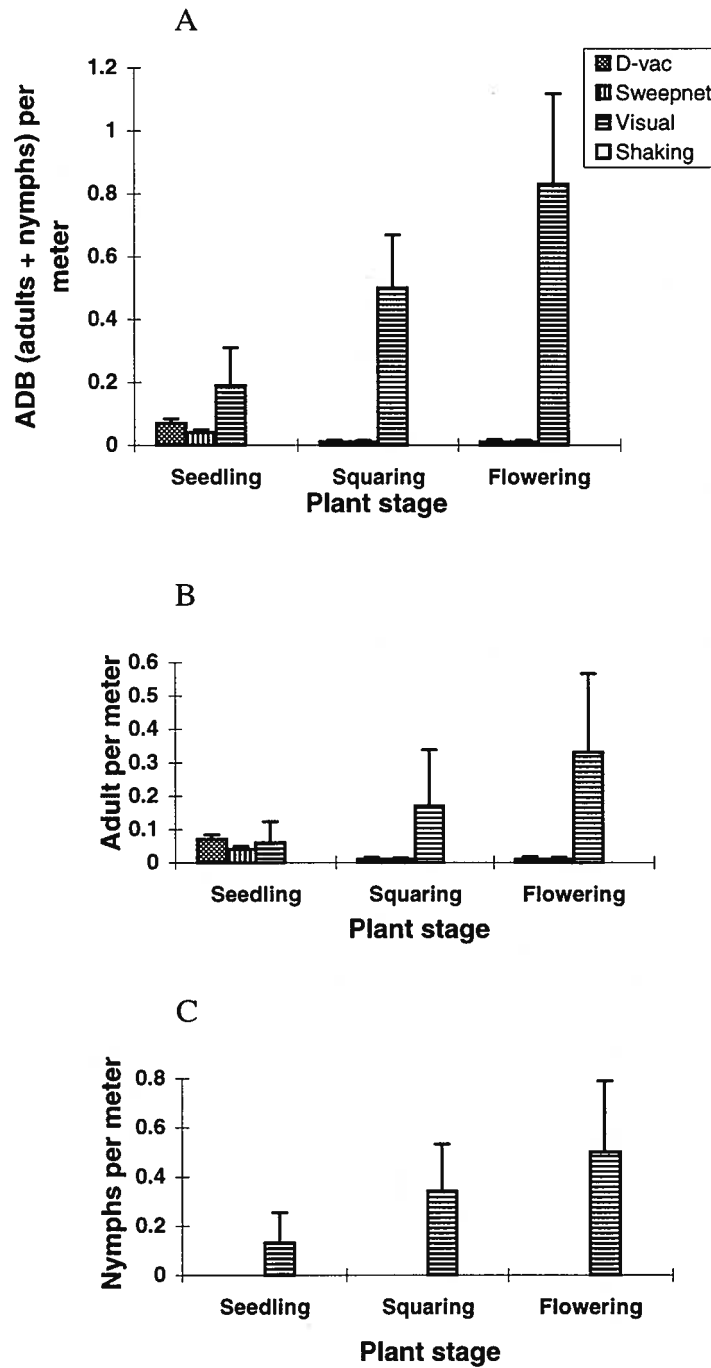
**Table 2.** Time in days required for *Campylomma liebknechti* to develop in the laboratory ( $25\pm 1^{\circ}\text{C}$ ).

Stage	Mean duration (days) $\pm$ se		Range (days)	
	Male	Female	Male	Female
Egg	-	$7.3\pm 0.12$	-	5-11
1 <sup>st</sup> instar	$2.6\pm 0.16$	$2.6\pm 0.17$	2-4	2-4
2 <sup>nd</sup> instar	$2.1\pm 0.18$	$2.0\pm 0.17$	1-4	1-3
3 <sup>rd</sup> instar	$1.6\pm 0.12$	$1.7\pm 0.17$	1-2	1-3
4 <sup>th</sup> instar	$2.2\pm 0.15$	$1.8\pm 0.13$	1-3	1-3
5 <sup>th</sup> instar	$2.7\pm 0.18$	$2.7\pm 0.17$	1-4	1-4
Preoviposition	-	$7.3\pm 0.33$	-	7-8
Fecundity	-	$41.3\pm 4.33$	-	34-49
Longevity	$11.4\pm 0.98$	$15.4\pm 4.73$	9-13	8-34

### Sampling

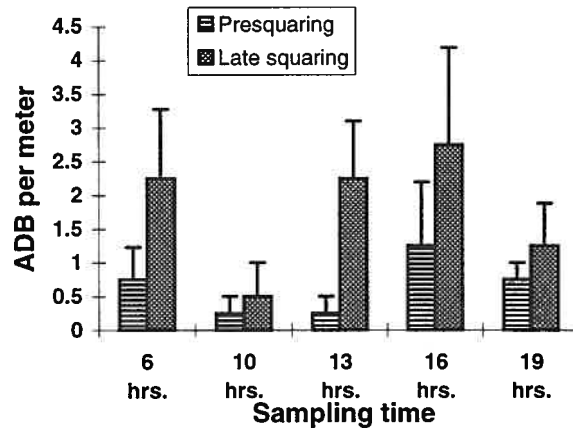
A simple and effective sampling method is considered the cornerstone for successful pest management programmes. Within the cotton industry, all levels of the decision making process in pest management are based on pest sampling. With this in mind, an effective and economical way of sampling ADB is required. We compared four different sampling methods viz, D-vac, sweepnetting, visual counting and shaking, to determine the most efficient method with which to estimate the abundance of ADB in cotton crops. All four sampling methods tested are currently being used by growers and consultants in their day-to-day sampling. The study was conducted in both conventional and transgenic cotton fields at Yarral in Narrabri. All the sampling was undertaken during the seedling, squaring and flowering stages of the cotton crops. The result of this study is summarised in Figure 3 and showed that except shaking other three sampling methods were equally effective in sampling ADB adults on seedling cotton. However, during the squaring and flowering stages of the cotton plant, visual counting was more effective for sampling adults than the other methods (Figure 3B). For ADB nymphs, visual counting was found the most efficient sampling method for all plant stages (Figure 3C), while other methods failed to catch any insect, perhaps nymphs are hard to suck or dislodge from the plants particularly when they are inside the squares. Also, with ADB adults the shaking method, in particular, can seriously underestimate the population since most of them flew away during shaking. Sweepnetting, on the other hand, in the seedling and squaring stages was as effective as vacuum sampling, however, substantial amount of plants and fruits were damaged as a result of the sweeping. Also vacuum sampling with D-vac may be quicker than visual sampling, the efficiency of this method dropped significantly when the cotton

**Figure 3** Comparison of sampling methods for Apple dimpling bugs in cotton fields at Yarral, Narrabri. (A) adult and nymph together, (B) adult and © nymph



crop matured and the canopy closed. In all counts visual method was the most effective method, but its efficiency will depend on the expertise of the bug checker and the time of the day checking is done. Our study indicated early morning or late evening are the best times of the day to sample for ADB (Figure 4).

**Figure 4.** Number of Apple dimpling bugs caught at different times of a day in cotton fields at Yarral, Narrabri.



## Conclusion

- ADB can cause damage to cotton but not to the same degree as green mirids.
- Both ADB and green mirid feed on growing tissues.
- Both adults and nymphs of ADB feed and survive well on *Helicoverpa* spp. eggs
- Growers and consultants should not at this stage spray against this pest until their true pest status is well defined.
- If ADB is a pest, their economic threshold may well be higher than the current threshold.
- Like green mirids ADB places its egg in the plant tissue,.
- Two species of apple dimpling bug are abundant in cotton growing areas of NSW, however, only *C. liebknechti* occur on cotton.
- D-vac or visual counts are the two most effective methods for sampling ADB.
- Early morning and late evening are the best times of the day to sample ADB effectively.

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