Management of mirids with reduced rate of chemical plus additive - a case study

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Introduction

Australian cotton, with the increasing adoption of Bollgard II, has been experiencing elevated levels of mirid infestation for the last few seasons. To manage this pest, the only available option is chemical intervention. During the 2007/8 cotton season, between 2 and 4 sprays were required to manage mirids in the different valleys. Researchers in Australia found that mixing additives with insecticides increased mortality to the target pests (Khan *et al.* 2002; Khan 2003 & Mensah *et al.* 2005). One such additive is table salt (NaCl). Previous studies showed that mixing table salt with insecticide allowed the chemical rate to be reduced by 70% without compromising efficacy and also reduced the impact on beneficials. Adoption of this technology in the Australian cotton industry is encouraging. However, some confusion exists among consultants and growers regarding the effectiveness of this technology. A large scale trial involving a consultant and a grower was conducted to verify this technology.

Methodology

The non-replicated trial was conducted in a 67 ha irrigated cotton field near Dalby. The field of skip row Bollgard II cotton, variety Sicot 71BR, was planted on 17 October, 2007 and divided into three blocks to accommodate 3 treatments. Blocks 1 and 2 were each 4 ha and block 3 comprised of the remainder of the field. Treatments 1 and 2 were predetermined salt / insecticide mixtures and treatment 3 was the grower's commercial practice (Table 1). Cotton was sprayed 3 times (Table 2) according to consultant's and grower's decision. All other operations such as irrigation, fertilization etc. were constant across each of the three blocks.

Table 1. Treatments used in the trial

Treatments	Comments
T1. Dimethoate 250 mL/ha plus salt (10 g/L) Fipronil 40 mL/ha plus salt (10 g/L) Fipronil 50 mL/ha plus salt (10 g/L)	Fourth spray would be grower's practice if needed. However, previous experience showed that 2 to 3 sprays were required to manage mirids in the field.
T2. Dimethoate 250 mL/ha plus salt (10 g/L) Dimethoate 250 mL/ha plus salt (10 g/L) Fipronil 50 mL/ha plus salt (10 g/L)	
T3. Fipronil 50 mL/ha Fipronil 50 mL/ha Fipronil 80 mL/ha	Grower's practice

The field was sampled weekly using a suction machine across 5 X 20 m lengths of row in each of block 1 and 2 and 8 X 20 m lengths of row in block 3, until the crop was at the 8 node stage. Thereafter a beat sheet was used to sample, 8 X 1 m lengths of row in each of block 1 and 2 and 12

X 1 m lengths of row in block 3. Plants were mapped, 3 x 1 m lengths of row in each block, to assess fruit loss and boll damage at squaring stage on 18/12/07 and 02/01/08; at early boll stage on 15/01/08 and 21/2/08; at late boll stage on 25/3/08 and at harvest on 17/4/08.

Since the field was also infested with green vegetable bug (GVB) and cotton stainer bugs (CSB) in the later part of the season, damage assessments were made on 12/03/08 to determine if damage from these pests varied with the treatments. First position bolls on the 7th node (counted from 1st unfolded leaf), 100 bolls per treatment, were randomly selected and assessed in the laboratory for damaged locks. Lock damage was recorded in 3 categories as low (≤ 25% lint of a lock is damaged), medium (25 -50% lint of a lock is damaged) and high (≥ 50% lint of a lock is damaged). Data were analysed as percentage of boll damage for each category if at least one lock was damaged for such a category.

Cotton was harvested with a 4 row picker on 09/05/08 from 2.76, 2.72 and 2.70 hectares in treatments 1, 2 and 3 respectively.

Table 2. Spray detail

Date of spray	Crop stage Days after sowing (DAS)	Treatment	Chemical	Rate (mL/ha)	Spray volume (L/ha)
15/12/07	Early Squaring 59 DAS	1 2 3	Dimethoate 400EC Dimethoate 400EC Fipronil 200SC	250 250 50	80 80 80
31/12/07	Squaring 75 DAS	1 2 3	Fipronil 200Sc Dimethoate 400EC Fipronil 200SC	40 250 50	80 80 80
20/02/08	Maximum Boll 126 DAS	1 2 3	Fipronil 200SC Fipronil 200SC Fipronil 200SC	50 50 80	100 100 100

Results

Mirid, GVB and cotton stainer bug population

Weekly data of mirid, GVB and CSB populations are presented in Figure 1. Mirid numbers were low irrespective of treatments. The highest numbers, 1.17, 1.75 and 2.13/m in treatments 3, 2 and 1 respectively, were found during the squaring stage on 24/12/07. The trends of the mirid population for different treatments were more or less similar except on 2 occasions. On 04/02/08 in T1 and T3 mirid numbers reduced to zero and to 0.92/m respectively whereas in T2 mirid number increased to 1.63/m. On 13/02/08 mirid numbers reduced in T2 and T3, whilst in T1 mirid number increased from their previous date. From 3rd week of February 2008, the mirid population died down encompassing with 3rd spray targeted stinkbugs.

Trends of GVB and CSB populations in relation to treatments were inconsistent throughout the season. On one occasion in one treatment the population was higher while on another occasion the population was higher on the other treatment.

When data were analysed for the whole season, the number of mirids and GVB did not vary significantly between treatments (Figure 2). Cotton stainer bug number, however, was 3 – 4 times lower in T3 than T1 and T2 (Figure 2).

Beneficial population

Beneficial numbers in different treatments on each sampling occasion were more or less similar (Figure 3). However, the apple dimpling bug population in T2 on 13/02/08, ladybird population in T3 on 15/01/08, red and blue beetle population in T1 on 04/02/08 and brown smudge bug population in T3 on 19/03/08 were significantly higher than other treatments.

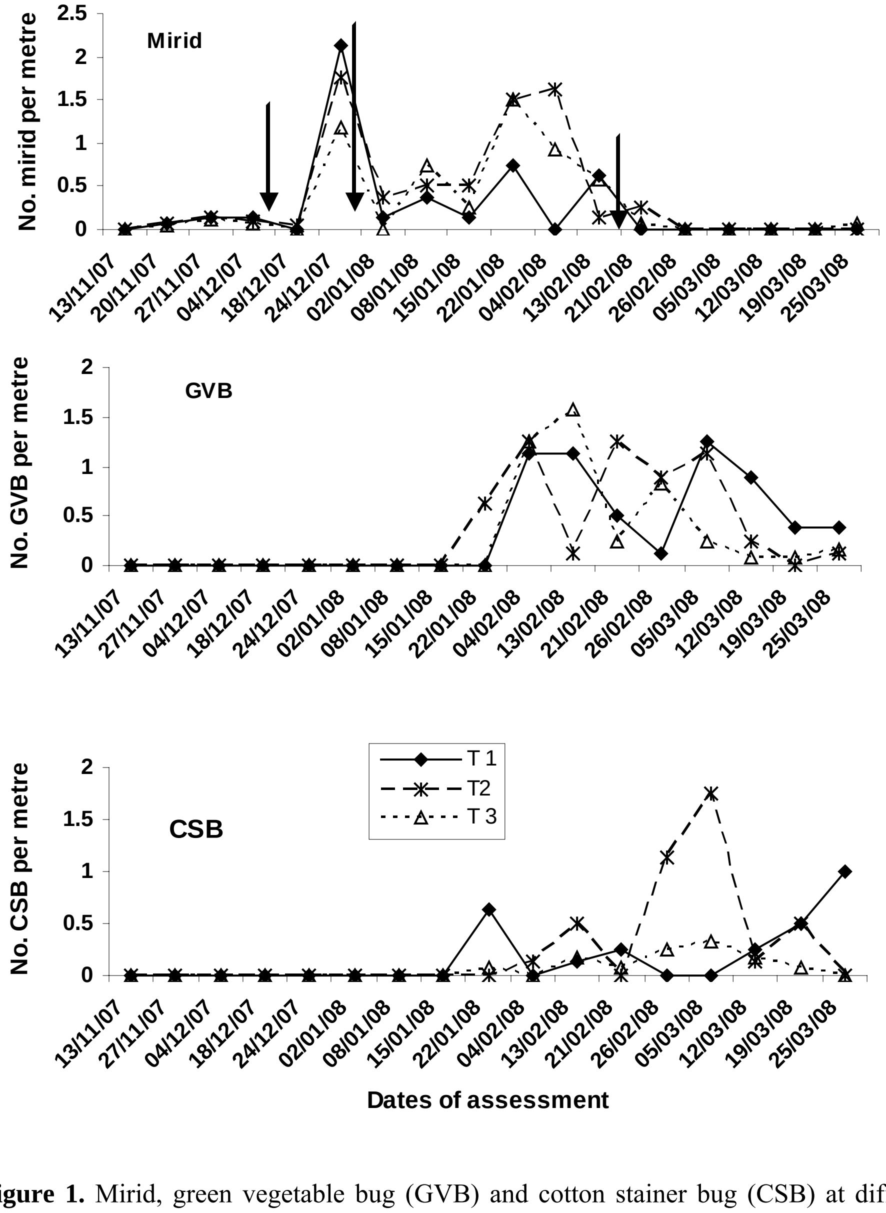

Figure 1. Mirid, green vegetable bug (GVB) and cotton stainer bug (CSB) at different sampling dates in different treatments. Arrows indicate time of spray.

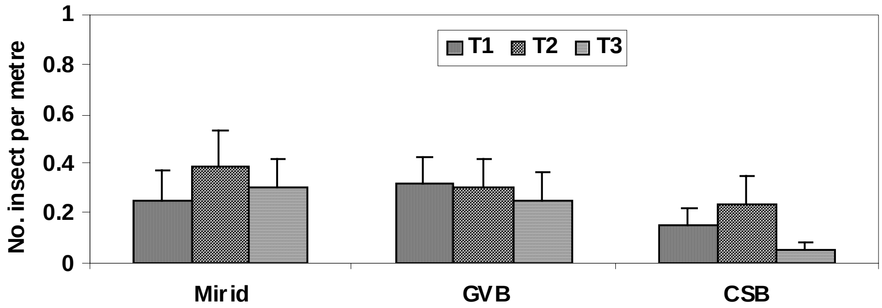

Figure 2. Mirid, green vegetable bug (GVB) and cotton stainer bug (CSB) number per treatment. Error bars indicate standard error of mean.

Damage and yield

Percent fruit loss at early squaring (18/12/07) and squaring stage (02/01/08) were low to medium (9 - 31%), however the loss in T3 was significantly lower than other treatments (Figure 4). At maximum boll stage (21/02/08) percent fruit loss was 39 to 42 percent and the difference between treatments was not significant.

Percent boll damage in the low category was 48 to 64% and the damage in T3 was significantly lower than other treatments (Figure 4). However, for the medium and high category damage there was no significant difference between treatments. The percent of damage was very low, 3 to 7% for medium and 1 to 3% for high category.

There was no significant difference between treatments in yield. Lint yield for T1, T2 and T3 were 9.3, 9.1 and 8.9 bales/ha respectively.

Discussion and conclusions

In this study we are not recommending any particular product or group of chemistry for mirids. The purpose of this study was to show that additives when mixed with chemical are effective. There are chemicals other than those used in the study registered for mirids which can be mixed with additives to have similar effect.

The study clearly showed that reduced rate of chemical plus additive was as good as grower practice if not better. Grower practice used similar chemicals at a marginally higher rate than the predetermined (T1 and T2) rate, which limited the scope of the study to show significant difference between treatments. Perhaps for this reason the study also did not show differences between treatments in terms of impact on the beneficials (see Figure 3). Only apple dimpling bug, ladybird, red and blue beetle and brown smudge bug at the peak population time showed differences between treatments (see Figure 3).

Other than mirid, GVB and CSB was the major pest. Most of the GVB during early to mid February were adult, possibly having moved from an adjacent sorghum field after harvest. Significantly more CSB number in T2 on 26/02/08 and 05/03/08 was not due to treatment difference, but rather that most of the population was 1^{st} instar nymphs which were found crowded inside open bolls.

Cotton was invaded with whitefly and aphids from the middle of February. Perhaps, beneficials which survived because of the low chemical rate (including grower practice) kept this insect under control for the rest of the season. It is possible that mild seasonal temperatures also contributed to the low whitefly population build up.

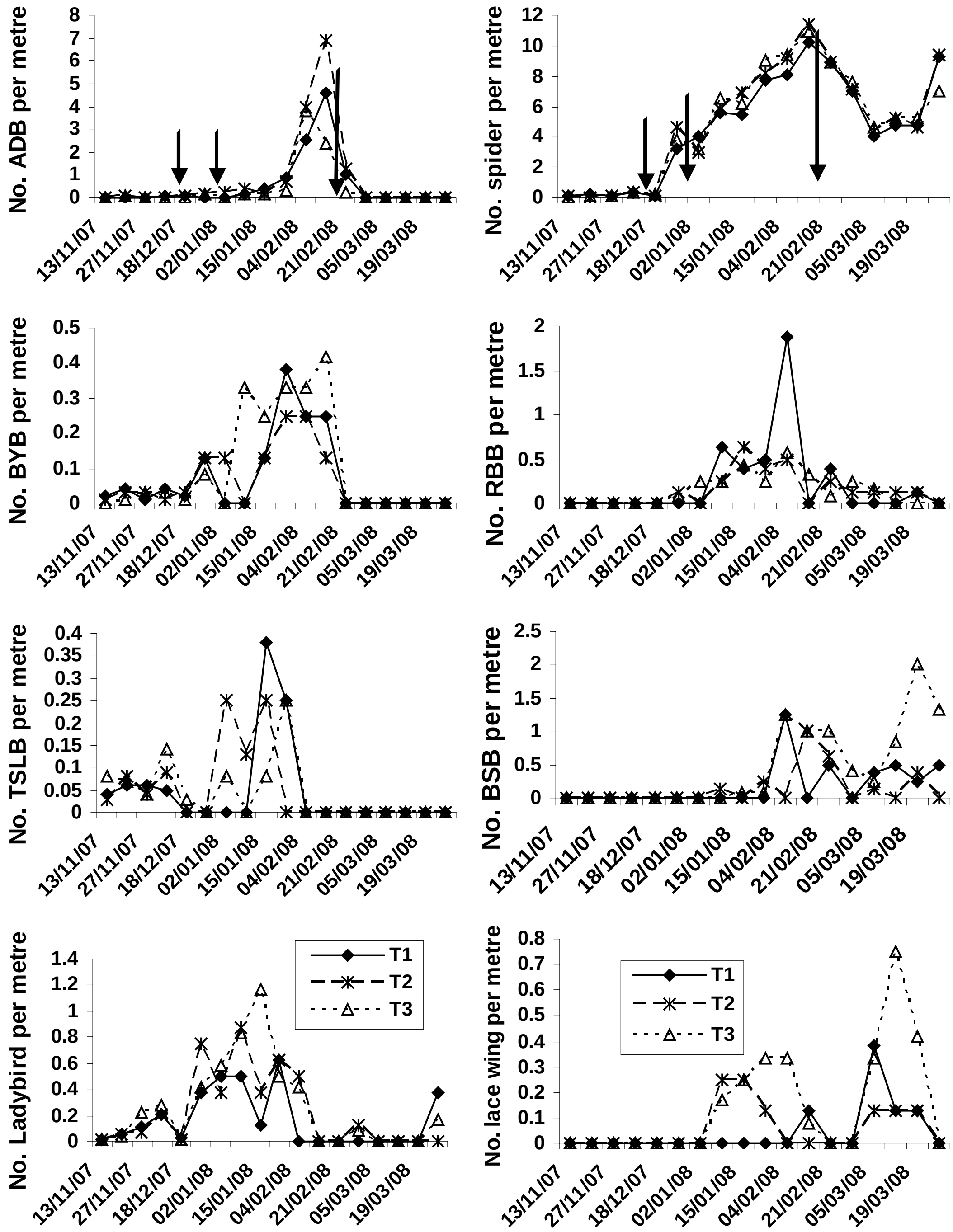

Figure 3. Beneficial numbers at sampling dates. ADB- Apple dimpling bug, BYB- Big eyed bug, TSLB- Two spotted lady beetle, LBB- Ladybird beetle, RBB- Red and blue beetle, BSB- Brown smudge bug. Arrows indicate time of spray.

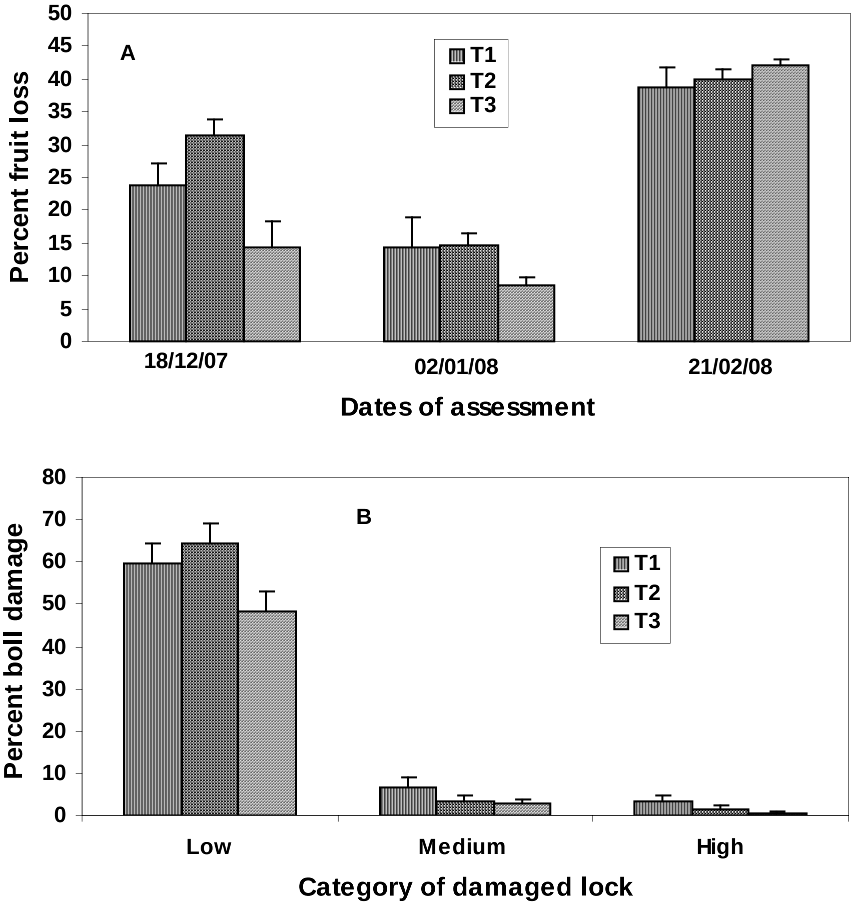

Figure 4. Fruit loss immediately after or before spray (A) and boll damage at late boll stage (B). Error bars indicate standard error of mean.

Boll damage data presented here was probably caused by GVB and CSB, since at the time of damage assessment mirid number had already diminished. Percent boll damage in the low category, at least one lock had ≤ 25% lint damage, was quite high (see Figure 4). However, this damage diminished at harvest. Bolls with such damage were still harvestable by the pickers and did not contribute to any yield loss. Medium and high categories of lock damage, some of which were tight locked (un-harvestable by the pickers), usually contribute yield loss. In this trial however medium and high categories of lock damage were very low and hence did not show any significant yield difference between treatments. A slightly lower yield in T3 might be due to herbicide contamination.

Clearly grower practice used sub-threshold (low mirid number) in their spray decision, particularly for first and second spray. The percentage fruit loss was also low on those days (see Figure 4). Though the scope of this trial was limited and did not allow comment on spray decision, it is worthwhile to mention that and future work should include comparison of mirid threshold at different crop stages with grower practice.

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