To spray or not to spray mirids in mungbeans immediately, that is the question.

Low thresholds and inexpensive sprays make it tempting to spray at the first sign of mirids in early-budding crops, but is this the wisest approch?

This case study looks at the factors influencing mirid mangement decisions in mungbeans, and examines the most rational approach, both economically and from an integrated pest magement perspective.

Mirids (*Creontiades* sp.) are major pests of mungbeans from flowering onwards. While mirids may be present in low numbers in pre-flowering crops, the pest does not inflict any damage at this stage. However, from flowering onwards, numbers can increase rapidy due to in-crop breeding and mirids will remain in the crop until harvest. Damage to buds and flowers causes flower and pod abortion, reducing yield by the equivalent of up to 60 kg/ha for each mirid found in a square metre sample. Both green and brown mirids are equally damaging, and nymphs are as damaging as adults.

The two main mirid pests of summer pulses are the green and brown mirid (*Creontiades dilutus* and *C. pacificus* respectively). Other less-frequent mirid species that can cause similar damage are the broken backed bug (*Taylorilygus pallidulus*) and the Australian crop mirid (*Sidnia kingbergii*). The major pulse crop at risk is mungbeans which has very low mirid thresholds (<0.5/m^2). In contrast, soybeans are far more tolerant of mirid attack, with no yield loss in field trials with up to 5 mirids/m^2.

Mungbean thresholds are very low in part because of the relatively high rate of damage per mirid, but also because the most-commonly used registered insecticide, dimethoate, costs only $11-$25/ha, depending on whether half or full rate is used, and the method of application (ground rig vs aerial sprays).

Consequently, crop managers are often trigger-happy when it comes to mirids, spraying at the first sign of mirids in early-buding crops. This nervousness is fueled by the old belief that a bud lost is a pod lost; however, mungbeans always set more flowers than they can convert to pods. Early sprays increase the risk of flaring *Helicoverpa armigera*, because of dimethoate's impact on beneficial insects. Given that *H. armigera* is developing resistance to two key insecticide groups, Group 22A (indoxacarb; e.g. Steward®) and Group 28 (chlorantraniliprole; e.g. Altacor®), mirid-management strategies that better align with helicoverpa resistance management strategies are needed.

In this case study, we demonstrate that a moderately delayed first mirid spray (a) will not sacrifice yields, but (b) may reduce the number of subsequent mirid sprays required and may consequently (c) reduce the risk of flaring helicoverpa. Data from previous projects is presented as it is highly relevant to the increasing need for multi-pest management to combat insecticide resistance.

Key findings

1. Delaying the first mirid spray by 1-2 weeks post early budding/flowering won't jeopardise your yields and may reduce the number of sprays you apply against this pest.
2. This approach may also reduce the risk of flaring *Helicoverpa armigera*, which is developing resistance to key group 22 and 28 insecticides.
3. A more strategic mirid approach will have even greater economic benefits if dimethoate is banned, and replaced by newer more-expensive inseticides.

Factors affecting damage and thresholds

Crop stage

Mungbeans are most susceptible during the budding and flowering stages, when mirid feeding can cause these structures to abort. Because of the indeterminate habit of the crop, buds and flowers are often present in crops for lengthy periods of time, favouring mirid breeding in-crop.

Mirid feeding can also result in abortion of small pods. In laboratory trials, mirids have damaged seeds in pods with constrictions (R4), (Volp & Teese 2019), however this has not been replicated under field conditions where mirids have a choice of buds, flowers and pods (Williams et. al. 2018).

Mirid population dynamics

Mirid populations are usually present in mungbean crops for an extended period of at least 28 days from early budding, and it is this prolonged exposure to mirids that increases the damage potential of mirids. Exposure time is an often misunderstood factor when considering mirid thresholds.

Helicoverpa thresholds in mungbeans and many other crops are based on the yield loss inflicted by a single generation of the most damaging later instars over a 7-day period. Consequently, for helicoverpa, time is of the essence, as larvae must be controlled before they reach the very damaging larger instars that inflict >90% of that pest's damage. However for mirids, damage occurs over a 28-day or longer period, providing more leeway for control decisions.

Queensland Government

Testing this theory: mirid threshold trials

Three trials have investigated the relationship between mirid density, spray timing and yield loss.

Trial 1 (single vs multiple sprays)

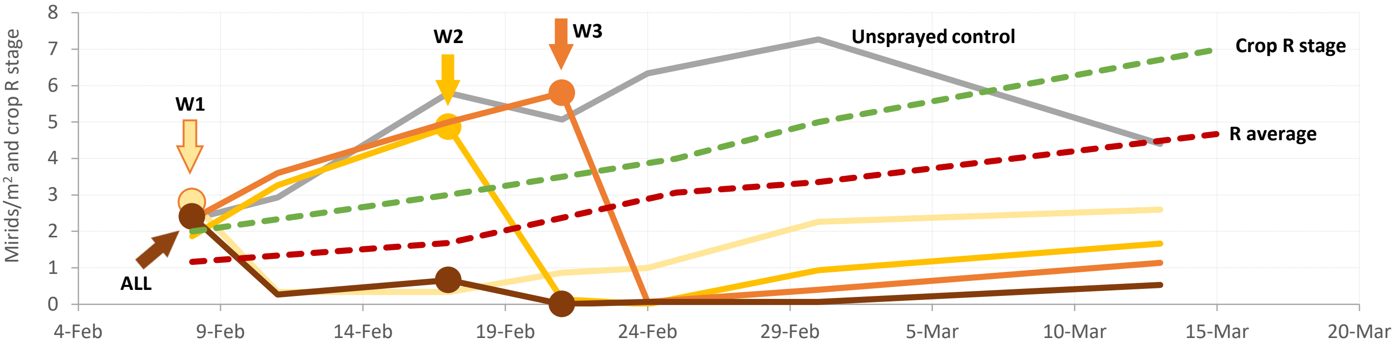

Figure 1. Mirid populations and crop stages in Trial 1.

Note: Arrows indicate when each single spray treatment occurred; R average (red dotted line) indicates the average stage of all reproductive structures present.

Treatments were sprayed at Week 1 (W1), W2 and W3 respectively with dimethoate at 500mL/ha, at nominally 7-day intervals. A fourth treatment (ALL) was sprayed each time the other treatments were applied, and the final treatment was an unsprayed control. Mirids were sampled weekly or twice weekly, and the crop's reproductive (R) stages were regularly assessed. Mirid density data is shown in Figure 1.

Mirid populations in the unsprayed control increased from 2.3/m² at the start of the trial at R2 (start of podding), to 7.3/m² at the R5 (1st black pod) stage. The respective average R crop stages (average R stage of all reproductive structures present) were 1.2 (early flowering) and 3.4 (mid podfill) respectively. Populations declined immediately post-spray for all treatments. Overall mirid pressure was determined by calculating cumulative mirid counts per square metre (mirid days/m²). Cumulative caterpillar pressure (mostly loopers) was similarly determined (Figure 2).

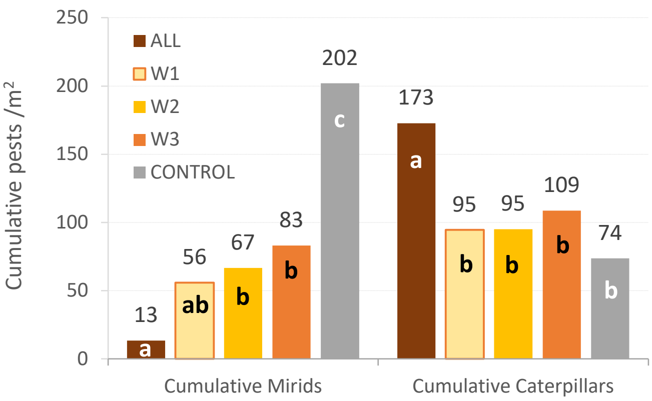

Figure 2. Cumulative mirids and caterpillars/m² in Trial 1.

Means followed by the same letter within each pest type are not significantly different.

Figure 2 shows significantly fewer mirids in the ALL (3-spray treatment), than in the single spray treatments, but no significant difference between the latter (W1-W3) treatments. All spray treatments had significantly fewer mirids than the untreated control. In contrast, the ALL treatment had significantly more caterpillars than the single spray and control treatments, between which differences were not significant.

No significant yield differences occurred between the sprayed treatments, which all yielded significantly more than the control (Figure 3). The net crop value for the spray treatments (compared to the control) are shown in Figure 4, and include the cost of the dimethoate insecticide ($25/ha per aerial application). However, if an additional caterpillar spray was required for the ALL treatment (as suggested by Figure 2 data), then the net value would be no different to the single spray treatments. Note that the ALL-treatment, which required an extra $50/ha in spray costs (2 extra dimethoate sprays) only resulted in an additional $37/ha net benefit over the W3 treatment. *Note also that current APVMA regulations pemit only 2 dimethoate sprays per crop*.

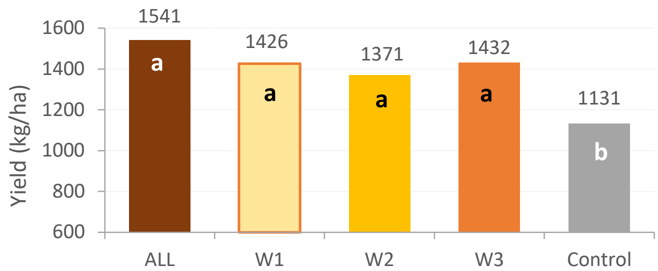

Figure 3. Yields in Trial 1.

Means followed by the same letter are not significantly different.

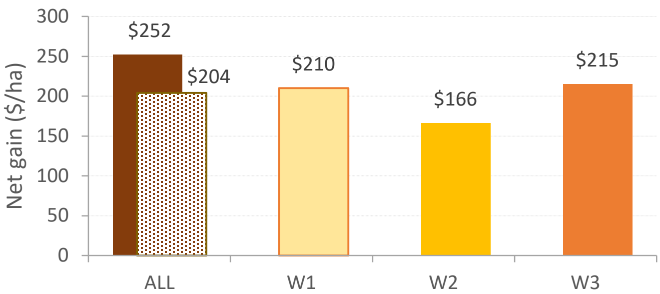

Figure 4. Net gains ($/ha) in mirid sprayed plots with respect to the untreated control. The spotted ALL bar indicates the reduced gain if an extra spray was required to control caterpillars flared by the application of multiple mirid sprays.

Costings are based on a crop value of $800/t, dimethoate (aerial) at $25/ha and a caterpillar spray (aerial) of $48/ha.

So delaying the first mirid spray by as much as 2 weeks had no impact on yield or net spray benefit, and the extra benefits of multiple mirid sprays could be negated by any subsequent caterpillar sprays.

Trial 2 (staggered multiple sprays)

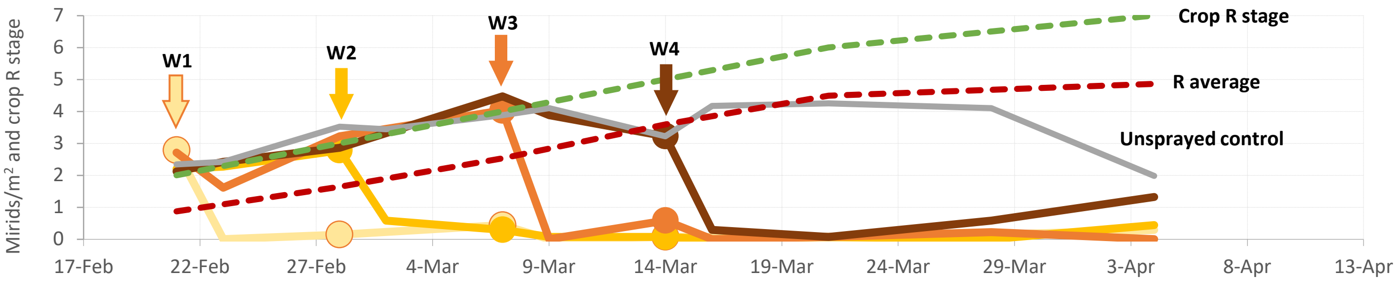

Figure 5. Mirid populations and crop stages in Trial 2.
Arrows indicate initial sprays for each treatment; R average (red dotted line) indicates the average stage of all reproductive structures present.

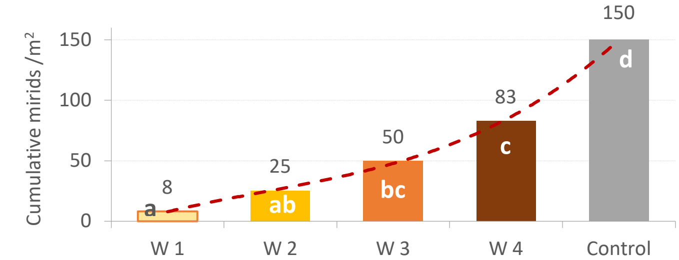

Figure 6. Cumulative mirids/m² in Trial 2.
Means followed by the same letter are not significantly different.

Four dimethoate (500 mL/ha) treatments with weekly applications were staggered to allow a comparison of multiple sprays; W1 began on 21 February, W2 on 28 February, W3 on 7 March, and W4 was a single spray on 14 March. The rationale was that any impact on yields would therefore be influenced by (a) mirid activity prior to the treatment's first spray, and (b) by the absence of mirids post the first spray, the latter period giving the plant time to compensate for early damage. Mirid counts and crop stages are shown in Figure 5. Populations in the unsprayed control increased from 2.3/m² at R2 (start of podding), to 4.3/m² at the R6 (50% black pod) stage. The R average at these times was 1 (early flowering) and 4.5 (late podfill) respectively.

Figures 6 and 7 show cumulative mirid counts and yields and net crop value in Trial 2. While there was a sequential and significant increase in mirid numbers from treatments W1 to W4, the corresponding decrease in yields from W1 to W4 was less pronounced, with no reduction until W4. Net crop value followed the same trend.

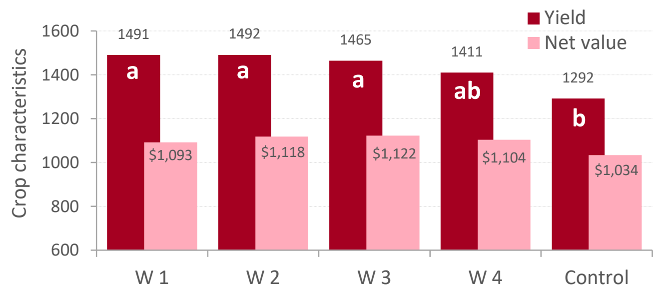

Figure 7. Per hectare yields (kg) and net crop value ($) in Trial 2.
Based on crop value of $800/t and aerially-applied dimethoate costing $25/ha. Note that spray treatments W1, 2, 3 and 4 had 4, 3, 2 and 1 dimethoate sprays respectively.

Again, delaying the first mirid spray by 2 weeks had no significant impact on yield or net crop value.

Trial 3 (impact in a low yielding crop)

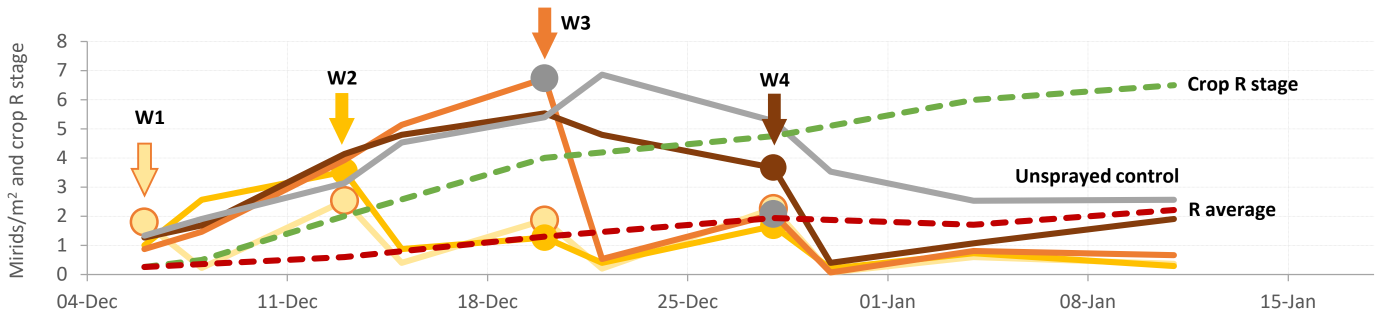

Figure 8. Mirid populations and crop (R) stages in Trial 3.

A very low-yielding trial (300 kg/ha) is included to address the concern that stressed crops are less able to compensate for early damage. Treatments and protocols were as per Trial 2. Trial 3 commenced at early budding (R0.25) and mirids peaked at 7/m² at R4 (late podfill); a little earlier than Trials 1 and 2, possibly because the crop was stressed by bacterial blight.

While there was a sequential increase in mirid numbers from treatments W1 to W4, the corresponding decrease in yields from W1 to W4 was less pronounced with no significant reductions in yield until W4 (Figure 9). Trends for net crop value (NCV) were similar with no reduction until W4.

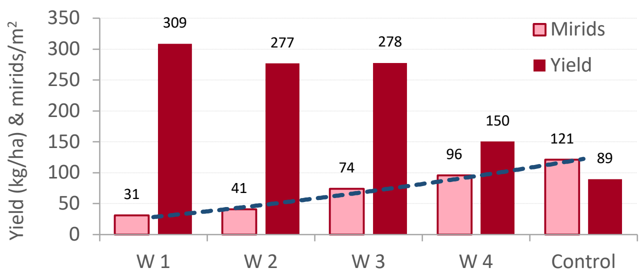

Figure 9. Cumulative mirids/m² and yields in Trial 3.
Means followed by the same letter are not significantly different.

And for the third time, the same pattern was observed, where delaying the first mirid spray by 2 weeks had no significant impact on yield or net crop value, despite the crop being low yielding and disease-stressed.

Summary

All trials displayed a consistent outcome where delaying the first mirid spray by up to 2 weeks had no significant impact on yield, despite mirids being well-above traditional thresholds (<0.5/m²) in all trials. This is because the crop had time to compensate post spraying for early damage. The data does not indicate mungbeans can tolerate the peak pre-spray populations without pesticide intervention within the suggested slightly delayed time frame. As such, the current mirid threshold model holds.

Despite the greater than 5-fold yield difference in yield between Trials 1-2, and Trial 3 due to other factors, mirid damage rates in all trials were not significantly different (Figure 10). The Trial 3 data shows that even stressed crops can compensate for early damage, provided the pests in question are not allowed to continue unchecked.

Current research is also finding no yield loss due to early mirid damage in cotton (Paul Grundy *pers. comm.*).

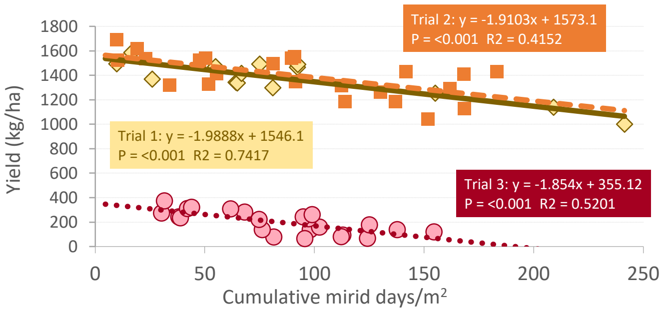

Figure 10. Relationship between cumulative mirid pressure (mirid days) and yield in three mungbean trials.
Yields ranged from 300 to >1500 kg/ha. Differences in slopes (rates of damage) between trials were not significant. Note that the 3-trial average yield loss of approx. 2 kg per mirid day/m² equates to 60 kg/ha per mirid/m².

These findings have ongoing implications for mirid management, as a 1-2 week delay in the first mirid spray may reduce the need for subsequent mirid sprays, and by default, reduce the probability of flaring helicoverpa. Figure 11 (data from a separate spray trial) shows how quickly a single dimethoate spray (at 500 mL/ha) can flare a below-threshold *Helicoverpa armigera* population to above threshold within 7-10 days (*H. armigera* populations in the unsprayed plots remained below threshold). This data highlights that once you start spraying for mirids, you run the risk of getting on the 'helicoverpa treadmill'.

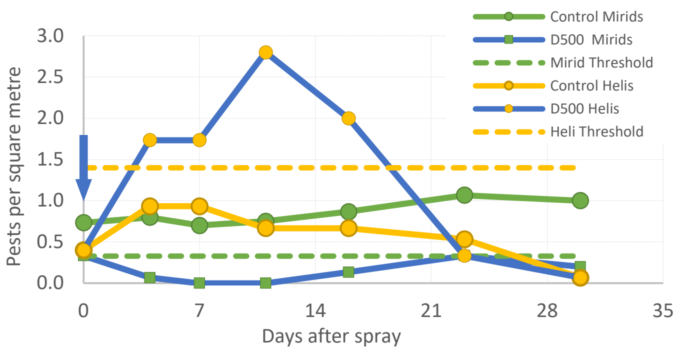

Figure 11. Impact of a single dimethoate spray @ 500 mL/ha (blue arrow) on mirid and *Helicoverpa armigera* populations in flowering mungbeans.

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Still not convinced?

Figure 12 clearly shows mungbeans can compensate for dramatic bud loss (80%) inflicted by a short (7-day) but severe burst of helicoverpa (6/m²). The control data shows how more buds are set than can be converted into pods.

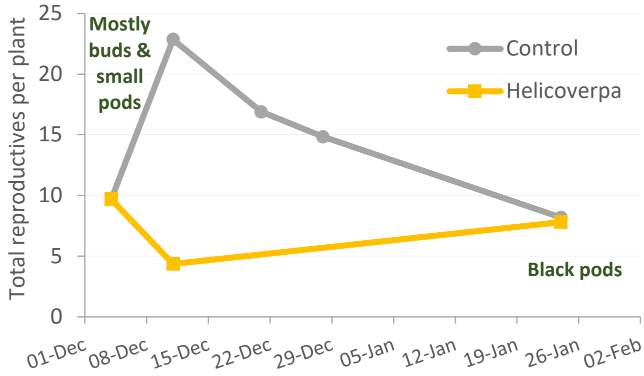

Figure 12. Compensation in well-grown mungbeans infested with 6 *Helicoverpa armigera*/m² for 7 days at the flowering stage.

Considerations

1. Regular crop scouting is still required to detect the start of budding, the crop stage in mungbeans at which the crop becomes very attractive to mirids, Helicoverpa and bean podborer.
2. Little to no yield was sacrificed by delaying the first mirid spray in these trials with up to 7 mirids/m². However, very rare but extreme cases with up to 30 mirids/m² at early budding can occur. Obviously, in that instance, prompt spraying would be required.
3. 80% of mirids in a crop can be nymphs, so be aware of what the nymphs look like.
4. Only two dimethoate sprays 14 days apart are now allowed in mungbeans (APVMA regulations).

More information

The Beatsheet website (thebeatsheet.com.au) contains information on mirids, including an identification gallery of the species in this case study, and an online economic threshold calculator that factors in crop value and cost of control (insecticide + application).

Acknowledgments

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References

Williams E.R., Teese E. and Brier H. (2018). *Mirid damage in late mungbean pods*. DAF report (MUNG18-1).

Volp T. and Teese E. (2019). *Mirid damage to late mungbeans*. DAF report (MUNG19-3).

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