The efficacy of new insecticides and Dipel for Soybean Looper control in soybeans and effects on beneficial insects and arthropods.

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ABSTRACT

Four trials were conducted in the South Burnett to test the efficacy of three new insecticides (DPX-MP062, RH 2485 and Tracer) and Dipel SC for Soybean Looper, *Thaysanoplusia orichalcea* (Fabricius), in soybeans. Effects on beneficial insects and arthropods were also assessed. *Helicoverpa armigera* control by DPX-MP062, Tracer and Dipel was assessed in trials 1 and 2. DPX-MP062 at all rates showed dual looper/*Helicoverpa* activity and the lower rates showed potential as they had little effect on beneficial species. All insecticides were trialed at several different rates. Cost is an important aspect in chemical application. If loopers can be controlled by insecticides at lower rates application costs can be kept down. Tea Tree Oil was trialed to ascertain its benefits as a moth deterrent. However, there was no further infestation in trial 3 so further investigation is necessary.

INTRODUCTION

Soybean looper, *Thaysanoplusia orichalcea* (Fabricius), is a leaf-feeding pest of soybeans of increasing incidence in coastal soybeans. However during this season (1999-2000) extremely high looper populations have occurred in more inland regions. The South Burnett was one of these areas where over 80 larvae per metre were reported in many crops. Soybeans are most tolerant of leaf loss during the vegetative stage when they can recover from up to 35% leaf loss with no yield loss (Kogan & Turnipseed, 1980). This level drops however, to less than 20% during early podfill. The high populations experienced this season in the Burnett would be expected to cause almost total defoliation, and consequently have a significant impact on yield.

At present, soybean loopers are easily controlled with non-selective insecticides including Decis (deltamethrin) and methomyl. However, the use of these insecticides during the vegetative stage of the crop is undesirable as they kill beneficial insects and arthropods that are important in heliothis Integrated Pest Management (IPM). *Helicoverpa armigera* (Hübner) are becoming increasingly difficult to control with current pesticides and are often present in soybean crops, particularly during flowering. A chemical application of current pesticides at this stage of the crop to control soybean loopers increases the likelihood of both *Helicoverpa* and two-spotted mites, *Tetranychus uticae* (Koch), becoming a major pest problem.

While preserving beneficial insects and arthropods in the agroecosystem is of importance another aspect considered in these trials was application costs. There is a need to keep insecticide application costs as low as possible in soybeans. In order to do so insecticide treatments were applied at several rates. Calf Pab and Amino Feed were added to Dipel and Amino Feed to DPX-MP062 (indoxocarb) to ascertain whether additives increased looper control at lower rates. Tea Tree Oil has been trialed to ascertain its potential as a deterrent for soybean looper moths.

Suspected endosulfan resistance in *T orichalcea* has been reported in the Bundaberg region of southeast Queensland. (N Halpin, pers comm, 2000). Halpin also reported Dipel (*Bacillus thuringiensis*) as successfully controlling soybean loopers in the Bundaberg region. There is therefore a strong need for selective (soft) insecticides with dual looper/*Helicoverpa* activity in soybeans and other pulses. Use of such a product would help preserve beneficial insects and arthropods.

This paper reports on the evaluation of three new insecticides plus Dipel for looper control in soybeans and effects on beneficial insects and arthropods.

MATERIAL AND METHODS

Four trials were conducted on growers properties in the South Burnett. Treatments were applied by a high boy sprayer travelling at one metre per second (3.6k/hr) and with an output of 135L of water/ha at 2 bar pressure via a boom covering 10 rows at one pass. Nozzles used were hollow cone with one (1) 8X above each row and one (1) 4X on either side of each row. The latter were angled at 90° to the plant stems and were at the end of droppers extending 60 cm below the main spray boom. Row spacing for all trials was 90cm. Trials were laid out in a randomised block design, each plot being 10 rows wide by 15m long. All treatments were replicated four times.

In trial 1, (Craig Patteson's, Inverlaw), there were eleven treatments including an untreated control. Treatments were:

Control
Methomyl 2.0 L/ha
Decis 0.5 L/ha
Tracer 0.1 L/ha
DPX-MP062 30 g ai/ha (0.2 L/ha)
DPX-MP062 60 g ai/ha (0.4 L/ha)
DPX-MP062 127.5 g ai/ha (0.85 L/ha)
Dipel SC 1.0 L/ha
Dipel SC 1.5 L/ha
Dipel SC 2.0 L/ha
Dipel SC 1.5 L/ha + Calf Pab 33g/ha

Insecticides were applied in the early morning of the 20th January. Temperatures at the time of application are shown in Table 1. Maximum temperatures in the field exceeded 40°C on 0 and 1 DAT (Days after treatment). Humidity was relatively high at the start of spraying and there was moderate/heavy dew. However by the completion of spraying no dew was present. Plots were sampled at 0, 4 and 7 DAT (on the 19, 24 and 27 January respectively). The cultivar was Pioneer 791 and was at the late vegetative/near flowering stage. Plant height averaged 1.0m. In each plot, beat cloth samples were taken from the two rows either side of the central two rows (reserved for possible MRL sampling). The outer two rows were not sampled in case of drift. At trial 1, five (5) random beat cloth one-metre-long samples were taken per plot. Insects recorded included loopers, *H. armigera*, podsucking bugs, mirids, predatory bugs, ladybirds and spiders.

In trial 2, (Harold Adlem's, near Kingaroy), there were twelve treatments including an untreated control. Yreatments were:

Control
Decis 0.5 L/ha
Tracer 0.05 L/ha
Tracer 0.1 L/ha
DPX-MP062 30 g ai/ha (0.2 L/ha)
DPX-MP062 60 g ai/ha (0.4 L/ha)

DPX-MP062 127.5 g ai/ha (0.85 L/ha)
Dipel SC 0.5 L/ha
Dipel SC 0.75 L/ha
Dipel SC 1.0 L/ha
Dipel SC 1.5 L/ha
Dipel SC 0.5 L/ha + Calf Pab 33g/ha

Insecticides were applied in the early morning of 1st of February. Temperatures experienced during this trial were more moderate with maximum temperatures not exceeding the low thirties (Table 1). There was moderate/heavy dew at the start of spraying but none at the end of spraying. Trial 2 was sampled at 0, 3 and 6 DAT (on the 31 January and 4 and 7 February respectively). The cultivar was Pioneer 791 and the crop was at late vegetative near flowering stage. Plant height averaged 0.9m. The sampling method was the same as for trial 1 but only four (4) beat cloth samples were taken from each plot because of the extremely high looper populations present (>80/m in some plots).

In trial 3, (Gary Truss's, Kumbia), there were twelve treatments including an untreated control. Treatments were:

Control
Decis 0.5 L/ha
Dipel SC 0.5 L/ha
Dipel SC 0.75 L/ha
Dipel SC 1.0 L/ha
Dipel SC 1.5 L/ha
Dipel SC 0.5 L/ha + Amino Feed 1 L/ha
Dipel SC 0.75 L/ha Amino Feed 1 L/ha
Dipel SC 1.0 L/ha Amino Feed 1 L/ha
Dipel SC 1.5 L/ha Amino Feed 1 L/ha
Dipel SC 1.5 L/ha Amino Feed 1 L/ha + Tea Tree Oil 50 ml/ha (Hasten 270ml/ha)
Tea Tree Oil 50ml/ha + Hasten 270ml/ha.

Insecticides were applied in the early morning of 22nd March. Again, temperatures experienced during this trial were moderate with humidity being reasonably high (Table 1). However, there was no dew at the time of application. All treatments in trial 3 were sampled at 0, 2, 5, and 7 DAT (on the 21, 24, 27 and 29 March respectively) using the same sampling method as the previous trial. The control, Decis, Bt 1.5, Bt 1.5 + amino + TTO and TTO were also sampled at 12 DAT (on the 3rd of April). The cultivar was Dragon and the crop was at early podfill. Plant height averaged 1.1m.

In trial 4, (Gary Truss's, Kumbia) there were twelve treatments including an untreated control. Treatments were:

Control
Decis 0.5 L/ha
DPX-MP062 7.5 g ai/ha (0.05 L/ha)
DPX-MP062 15 g ai/ha (0.1 L/ha)
DPX-MP062 30 g ai/ha (0.2 L/ha)
DPX-MP062 60 g ai/ha (0.4 L/ha)
DPX-MP062 7.5 g ai/ha + Amino Feed 1 L/ha
DPX-MP062 15g ai/ha + Amino Feed 1 L/ha
DPX-MP062 30 ai/ha + Amino Feed 1 L/ha

RH-2485 100 g ai/ha
RH-2485 200 g ai/ha
RH-2485 100 g ai/ha + Amino Feed 1 L/ha

Insecticides were applied in the early morning of 24th March. Temperatures were moderate and the humidity high (Table 1). The trial was sampled at 0, 3, 5 and 10 DAT using the same sampling method as described for trials 2 and 3. The cultivar and plant stage were the same as in trial 3. Plant height averaged 1.0m.

Table 1. Time and temperature data for all trials.

Trial	***Time***	**Temp°C**	**Wind m/s**
1	5:50 am	20.5	0.04
	9:05am	32.8	0.4 - 2.0
2	6:00am	19.9	0.08
	8:41am	27.0	1.99
3	7:00am	21.2	0.04 - 2.0
	8:30am	24.4	1.5
4	6:40am	20.6	0 - 0.8
	8:55am	25.4	0.4 - 3.0

Looper larvae were collected from sites one and two and reared through to adulthood to confirm the looper species present. All larvae were sized by length as per the heliothis size card used by the cotton industry. At present there are no size classifications specifically for loopers.

Data was transformed where necessary in excel and analysis by ANOVA was performed using Genstat 5. All significant differences quoted are at 5% level.

RESULTS:

Trial 1 (see Table 2):

Nearly 60% of loopers were medium large to large in size (ie >13mm). The majority of *H. armigera* were small or small medium (ie > 3mm).

DPX-MP062 gave very good looper control (greater than 95%) at all rates at 4 and 7 DAT, which is comparable to the standards Decis and methomyl. All treatments were significant at 4 DAT. There was no significant difference between Decis, Tracer, all rates of DPX-MP062, Bt 1.5, 2.0 and 1.5 L/ha + Calf Pab. Methomyl, Decis, DPX 60 and 127.5 were significantly better than Bt 1.5 L/ha. However, control of the looper population at 4 DAT is acceptable. At 7 DAT all insecticide treatments gave significant control but there were no differences between insecticides.

Tracer, all rates of DPX-MP062, Bt 1.5 L/ha + Calf Pab and Bt 2.0 L/ha gave significant *Helicoverpa* control at 4 DAT. There was no significant difference between Bt 1.5 and 1.5 L/ha + Calf Pab. At 7 DAT, Tracer, all rates of DPX-MP062 and Bt 2.0 L/ha gave significant control. Methomyl and Decis failed to give significant control at either 4 or 7 DAT and at 7 DAT, there were significantly more *Helicoverpa* in the Decis plots than in the control plots.

All insecticide treatments except Bt 1.0 and 2.0 L/ha suppressed the *Nabis kingbergii* population although Decis was by far the worst at 4 DAT. At 7 DAT only Decis significantly suppressed *Nabis*. Dipel results do not seem to be consistent with the results expected of this insecticide but this may have been due to the low numbers present. Spider populations were not significantly affected by any of the chemical treatments at either 4 or 7 DAT.

Trial 2 (see Table 3):

Over 70% of loopers were medium large to large in size this would account for the decreasing population over the sampling dates. The majority of *H. armigera* were small to small medium in size.

DPX-MP062 again gave very good looper control at all rates (93%-100%) at 3 and 6 DAT. All insecticide treatments gave significant control at 3 DAT. There was no significant difference between Decis and all rates of Tracer and DPX-MP062. The lower rates of Dipel gave significantly poorer control than the other products. Bt 0.5 L/ha + Calf Pab was significantly better than Bt 0.5 L/ha indicating that Calf Pab has an effect. At 6 DAT all insecticide treatments still gave significant control. Decis was just significantly better than both rates of Tracer but not significantly more effective than all rates of DPX-MP062. All Bt rates over 0.5 L/ha were as effective as Decis. Again there was a significant Calf Pab effect.

There were no significant differences between the chemical treatments at 3 DAT with respect to control of *H. armigera.* At 6 DAT there was significant control by Tracer and all rates of DPX-MP062. Dipel SC at 0.75 and 0.5 L/ha + Calf Pab also gave significant control. Decis gave no control and there was a trend for *Helicoverpa* to increase at 6 DAT.

As in trial 1, *Nabis* populations were very low. Decis reduced numbers at both 3 and 6 DAT. While there were no significant effects between the insecticide treatments, there were zero (0) *Nabis* in Decis plots at 3 and 6 DAT and a trend for *Nabis* to be less or affected by DPX-MP062 at 30 and 60 g ai/ha

Trial 3 (see Table 4):

Nearly 60% of loopers were medium large to large in size. There were no *Helicoverpa* found at this site.

At 2 DAT only Decis gave significant looper control. At 5 DAT Decis gave significantly better control than all insecticide treatments except Bt 1.5 L/ha + Amino Feed. However, differences between Dipel with and without Amino Feed were not significant at 2 DAT.

Trial 4 (see Table 5):

Over 60% of soybean loopers were medium large to large in size. This could account for the declining population over the sampling dates. There were no *Helicoverpa* found at this site.

At 3 DAT, all insecticide treatments gave significant looper control. DPX-MP062 at 7.5 g ai/ha gave acceptable looper control. The same results occurred at 5 DAT.

As in the previous trials, *Nabis* populations were low (<1/m). At all sampling dates there were no significant differences between insecticide treatments. This is most likely an effect of the very low numbers present. Zero *Nabis* were found at 3 DAT in the Decis plots. Brown smudge bug, *Deraeocoris signatus* (Distant), was not significantly affected by any of the insecticide treatments over the sampling dates, and actually increased in numbers after 3 DAT. Spiders were not significantly affected by any of the chemical treatments at any time post spray.

DISCUSSION

Overall, DPX-MP062 has considerable potential in soybeans, having dual looper/*Helicoverpa* activity. Activity against loopers was excellent and DPX-MP062 gave markedly superior control of *Helicoverpa* than either Decis or methomyl. Previous studies have found that low rates of DPX-MP062 provide control of *Helicoverpa* equal to Tracer (Hammes & Sherrod, 1998). DPX-MP062 gave good control of loopers as low as 7.5 g ai/ha. As mentioned previously, the majority of *Helicoverpa* present in trials 1 and 2 were >7mm in length. Better results may have occurred if larvae present were … 7mm in length. However, the level of *Helicoverpa* control achieved would be acceptable for low *Helicoverpa* populations, or during the vegetative stage, where near total control is not necessary. Also, as previously mentioned, the level achieved was far greater than is frequently achieved by current pesticides. Finally, DPX-MP062 would seem to have IPM potential in pulses as indicated by other trial results (Tilman & Mulrooney, 1998).

Dipel SC showed very good control of loopers in soybeans in two out of three trials. As previously mentioned, Dipel SC was trialed at several different rates to establish if it is possible to control loopers/*Helicoverpa* at lower rates thus saving growers application costs. Lower rates were also trialed with additives to ascertain whether greater control can be achieved. Dipel SC at 0.5 L/ha achieved greater control both of loopers and *Helicoverpa* when applied with Calf Pab. The level of control this rate (0.5 L/ha + Calf Pab) achieved in trial 2 against *Helicoverpa* was higher than that of Decis. In trial 3, looper control achieved by Dipel SC at all rates decreased this may have been due to the absence of dew whilst the insecticides were applied. Overall, Dipel’s dual looper/*Helicoverpa* activity, especially at lower rates increases its usefulness in IPM in pulses. The reasons for its sometimes inconsistent performance (as in trial 3) needs to be investigated. (Note biopesticide inconsistency is not confined to Dipel).

RH 2485 shows good potential with regards to looper control in soybeans. Control achieved by all rates was comparable with that of the standard Decis. Further trials using lower rates may indicate adequate control of loopers whilst lessening adverse impacts on important beneficial species.

Tea Tree Oil (TTO) has been reportedly used in northern NSW to deter looper and *Helicoverpa* moths in soybeans. We trialed TTO to determine if we could replicate these results. Unfortunately, there was no further egg lay in trial 3. In order to discover the potential of TTO as a looper deterrent, further trials will be necessary possibly applying it at higher rates.

Finally, Tracer has good potential for looper/*Helicoverpa* control in soybeans. Its potential is even greater as it has little to no affect on most beneficial species (Murray & Lloyd, 1997).

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Table 2. Mean numbers for 5 1m beat cloth samples for 0, 4 and 7 DAT for 4 blocks Trial 1 Patteson's Jan 2000.

Treatment	**0 DAT**				**4 DAT**				***7 DAT***			
	Looper	**Heli**	***Nabis***	**Spider**	**Looper**	**Heli**	***Nabis***	**Spider**	**Looper**	**Heli**	***Nabis***	**Spider**
Control	9.9 b	0.95a	0.6a	0.65a	4.7b	1.0a	0.9a	0.25a	5.6 b	1.25a	0.6 a	0.6 a
Methomyl	8.0 b	1.05a	0.6a	0.3 a	0.15	0.85	0.4	0.4	0.05a	0.65c	0.15ab	0.5 bc
Decis	8.7 b	0.95a	0.35a	0.15a	0.05	1.5	0.05	0.8	0.6 a	2.2 b	0.05a	0.7 a
Tracer	7.75b	0.95a	0.25a	0.45a	0.5	0.1	0.45	0.7	0.15	0.2	0.2	0.75
DPX-MP062 30	8.4 b	0.95a	0.25a	0.3 a	0.1	0.3	0.25	0.45	0.1	0.3	0.4	0.4
DPX-MP062 60	7.75b	0.35a	0.75a	0.55a	0.1	0.1	0.4	1.0	0.25	0.4	0.75	0.6
DPX-MP062 127.5	7.15a	0.55a	0.65a	0.35a	0.0	0.1	0.4	0.8	0.0	0.15	0.5	0.75
Bt 1.0	7.75b	0.5 a	0.3a	0.35a	1.1	0.55	0.8	0.45	0.75	0.95	0.9	0.55
Bt 1.5	8.25b	0.6 a	0.45a	0.65a	0.3	0.7	0.4	0.35	0.65	1.05	0.7	0.65
Bt 2.0	9.35b	0.9 a	0.45a	0.6 a	0.1	0.2	0.5	0.6	0.3ab	0.05a	0.7b	0.8b
Bt 1.5 + CP	8.95b	1.25a	0.3a	.04	0.51	0.46	0.62	0.69	0.55	0.65	0.3	1.0

Means followed by the same letter do not significantly differ (P > 0.05).

Table 3. Mean numbers for 5 1m beat cloth samples for 0, 3 and 7 DAT for 4 blocks Trial 2 Adlem's Feb 2000. Heli= heliothis

Treatment	**0 DAT**				**3 DAT**				***7 DAT***			
	Looper	**Heli**	Nabis	**Spider**	**Looper**	**Heli**	***Nabis***	**Spider**	**Looper**	**Heli**	***Nabis***	**Spider**
Control	52.88b	0.63a	0.5 a	0.19a	23.94b	0.38a	0.38a	0.38a	11.88b	0.31a	0.25a	0.44a
Decis	60.38b	0.56a	0.31a	0.5 a	1.06b	0.31a	0.0 a	0.44a	0.31	0.56	0.0	0.63
Tracer 24	55.69b	0.25a	0.44a	0.38a	4.81	0.125	0.25	0.44	3.06	0.63	0.19	.081
Tracer 48	58.88b	0.38a	0.31a	0.19a	1.38b	0.0 a	0.63a	0.44a	3.88b	0.06a	0.44a	0.81a
DPX-MP062 30	55.81b	0.56a	0.19a	0.25a	2.93	0.18	0.69	0.38	0.44	0.13	0.75	0.94
DPX-MP062 60	53.94b	0.19a	0.06a	0.44a	0.31	0.13	0.13	0.63	0.63	0.0	0.25	0.75
DPX-MP062 127.5	53.44b	0.31a	0.44a	0.31a	0.06a	0.13a	0.06a	0.37b	0.0	0.06	0.25	0.88
Bt 0.5	62.31b	0.56a	0.19a	0.13a	17.06b	0.38a	0.13a	0.5 a	6.0b	0.5 a	0.19a	0.81a
Bt 0.75	56.63b	0.75a	0.31a	0.44a	10.5 b	0.38a	0.31a	0.19a	1.56	0.13	0.38	0.88
Bt 1.0	64.0 b	0.63a	0.13a	0.25a	7.93b	0.38a	0.38a	0.5 a	2.5b	0.38a	0.56a	1.0 a

Bt 1.5	47.5 b	0.25a	0.31a	0.63a	7.13b	0.38a	0.13a	0.38a	2.81b	0.38a	0.06a	0.75a
Bt 0.5 + CP	58.44b	0.75a	0.06a	0.31a	8.94b	0.75a	0.19a	0.56a	2.19b	0.19a	0.5 a	1.19ab

Means followed by the same letter do not significantly differ (P > 0.05).

Table 4. Mean numbers for 5 1m beat cloth samples for 0, 2 and 5 DAT for 4 blocks Trial 3 Truss's Mar 2000.

Treatment	**0 DAT**	**2 DAT**	**5 DAT**
	Loopers	**Loopers**	**Loopers**
Control	33.75	31.50cde	21.06e
Decis	31.69	11.00a	1.00a
Bt 0.5	37.75	32.94de	19.00de
Bt 0.75	38.0	36.06e	16.42cde
Bt 1.0	37.56	34.88e	14.06bcde
Bt 1.5	40.81	32.44de	12.19bcd
Bt 0.5 + amino	35.81	26.30bcd	10.27bc
Bt 0.75 + amino	40.63	33.50e	13.69bcde
Bt 1.0 + amino	39.56	30.00bcde	14.81bcde
Bt 1.5 + amino	32.06	25.19bc	7.88ab
Bt 1.5 + amino + TTO	42.31	31.50cde	9.44bc
TTO	31.56	24.05b	14.03bcde

Means followed by the same letter do not significantly differ (P > 0.05).

Table 5. Mean numbers for 5 1m beat cloth samples for 0, 3 and 5 DAT for 4 blocks Trial 4 Truss's Mar 2000. BSB= Brown smudge bug.

Treatment	0 DAT				3 DAT				*5 DAT*			
	Looper	***Nabis***	**Spider**	**BSB**	**Looper**	***Nabis***	**Spider**	**BSB**	**Looper**	***Nabis***	**Spider**	**BSB**
Control	28.93b	0.5 a	2.0 a	0.5 a	12.44b	0.38a	2.06a	0.63a	6.63c	0.25a	2.63b	1.63ab
Decis	36.13b	0.44a	2.56a	0.69a	1.88b	0.0 a	2.13b	0.56a	0.94	0.19	1.06	1.38
DPX-MP062 7.5	32.06b	0.38a	2.75a	1.5 a	2.56b	0.19a	2.0 b	0.31a	0.88	0.38	2.13	1.81
DPX-MP062 15	36.06b	0.13a	2.5 a	1.0 a	0.75a	0.38a	1.94b	0.75a	0.69a	0.31a	2.19b	2.5b
DPX-MP062 30	41.81b	0.56a	1.56a	0.44a	0.69a	0.44a	2.38b	0.88a	0.25a	0.56ab	2.69c	1.63bc
DPX-MP062 60	33.81b	0.69a	2.69a	0.69a	0.25a	0.38a	2.06b	0.94ab	0.0 a	0.25a	2.38b	2.44b
DPX-MP062 7.5+amino	34.31b	0.56a	1.56a	0.63a	2.25c	0.31a	1.63bc	0.75ab	0.88ab	0.38a	1.94bc	2.44c
DPX-MP062 15+amino	36.25b	0.56a	2.19a	0.5 a	1.25b	0.19a	2.56c	0.56ab	0.31a	0.25a	2.88b	2.94b
DPX-MP062 30+amino	36.44b	0.25a	2.25a	0.69a	0.63a	0.19a	1.81b	0.63a	0.13a	0.56a	1.94b	2.13b
RH 2485 100	35.06b	0.63a	2.63a	0.44a	2.38b	0.25a	2.31b	0.5 a	0.5	0.81	2.0	2.0
RH 2485 200	36.56b	0.81a	1.5 a	0.38a	3.25c	0.5 a	2.38bc	0.75ab	0.25a	0.63a	2.63b	2.75b
RH 2485 100+amino	32.19b	1.06a	2.19a	0.56a	1.94	0.5	1.75	1.0	0.56a	0.38a	2.19b	2.31b

Means followed by the same letter do not significantly