CRDCIC

THE EFFECT OF ORGANIC TREATMENTS ON INSECT POPULATIONS IN COTTON GROWN AT 'ALCHERINGA' & 'WILBY'

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INTRODUCTION:

The recent pioneering attempts of several cotton growers to produce organic cotton presents an opportunity to monitor pest populations in the absence of synthetic insecticides. The study of alternative pest control practices has the potential to reduce our reliance on insecticides and thus help to overcome resistance problems. Therefore the insect populations of two organically grown cotton crops were monitored as part of a wider study funded by the Cotton Research and Development Corporation into the effects of organic treatments on beneficial and pest insects.

Three areas were involved in study: the Darling Downs (Queensland; J. Bidstrup), the Maquarie (N.S.W.; J. O'Brien) and the MacIntyre (N.S.W; D. & B. Coulton). This report covers the sites at Boggabilla and North Star in the MacIntyre district of northern N.S.W.

METHODS:

'Alcheringa'

240 hectares of **irrigated** organic cotton was grown by Dave Coulton on 'Alcheringa', 3km south of Boggabilla (N.S.W.). Siokra L23 was sown at a rate of 13 plants per meter on 26/10/93. This research project was carried out on the eastern half of the field.

'Wilby'

145 hectares of **raingrown** organic cotton was grown by Ben Coulton on 'Wilby', 2km north of North Star (N.S.W.). Siokra L23 was sown at a rate of 7 plants per meter on 29/11/93.

Trap Crops

Both sites had sorghum strips (16 rows wide) every 400 meters extending the length of the cotton field. The sorghum was expected to act as a trap crop so each strip was frequently slashed to maintain the plants in a stage attractive to *Helicoverpa.* Alternate halves of each sorghum strip were slashed each time.

Organic treatments

At 'Alcheringa' a total of 64 organic sprays were applied on 29 occasions (Appendix 1), but not all of these were applied over the entire area. For the eastern half of the field there were 48 sprays on 22 occasions (marked "East" in Appendix 1). At 'Wilby' 27 sprays were applied on 11 occasions (Appendix 2). For *Helicoverpa* control the most commonly used sprays were Bt (17 at 'Alcheringa' East and 9 at 'Wilby'), garlic (10 at 'Alcheringa' East, 9 at 'Wilby') and natural pyrethrum (3 at 'Alcheringa' East, 1 at 'Wilby').

There were two inundative releases of *Trichogramma* (*Trichogramma* sp. nr. *iverlae)* at 'Alcheringa', but none at 'Wilby'. *Helicoverpa* egg parasitism was determined before and after these releases by the growers' consultants (Appendix 5). There were two releases of lacewing larvae (*Mallada signata)* at both 'Wilby' and 'Alcheringa'. These were only released over the sorghum strips and were monitored by the predator sampling over the cotton.

Controls

A control plot of 20 cotton rows was set aside at the edge of the field at each site. This area did not receive any of the organic treatments directly but was along the side of the bordering sorghum strip in both cases.

Sampling and Records

Three sampling methods were used to monitor the pests and beneficials.

1) Visual sampling was carried out by the crop consultants according to the entomoLOGIC scouting guidelines. This method gives the best estimate of *Helicoverpa* pressure. Visual counts of predators and sucking pests were also recorded. Unfortunately, no entomoLOGIC samples were taken in the control areas.

2) A small petrol driven vac-blower (McCullock Super Airstream IV) was used to make suction samples. The sampling method was as determined by the CRDC Early Season Pest Management Working Group meeting at Toowoomba in May 1993. The intake was directed along the top of twenty row-meters of cotton in a single twenty second pass. Each week five samples were collected from the control plot and five from the organic plot at each farm. The samples were sorted and counted under a binocular microscope (12 x magnification). This method collects insects which are too mobile or too small for visual assessment. It provides an estimate of beneficials and sucking pests, however it is unreliable for *Helicoverpa*.

3) A larger 'D-vac' styled suction sampler (based on a Solo Port Model 423 70cc mist-blower, as used in the Ph.D. research of J. Stanley) was used fortnightly. This is essentially a more powerful version of the small-vac. It has a higher wind speed and a larger intake and was used in a different way. The intake was directed up the side, across the top and down the other side of each cotton plant along a ten meter section of row. There were 4 big-vac samples per plot, and each sample took about 4 minutes to perform. This additional sampling was carried out to give a better estimate of absolute insect populations because the big-vac method is known to be less affected by changes in plant size.

RESULTS

Suction Sample Data

The raw data of insect counts from the small and big-vac suction samples are presented on computer disc (Microsoft Excel ver.4 *Filename:* Small-vac data on **'bogorg93.xls'** & big-vac data on **'borg93bv.xls'**).

The most relevant species of pest, predator or insect group (eg. predatory bugs) are presented graphically in Appendix 6. With the exception of total predators, only the small-vac data are graphed. There is an index to the graphs at the end of this report. The treatment schedule (organic sprays and inundative releases of natural enemies) are listed in Appendix 1. The entomoLOGIC data are also given in the Appendices 3 ('Alcheringa' and 4 ('Wilby').

CONCLUSIONS: 'Alcheringa'

The amount of data is somewhat overwhelming, so we have chosen to consider the pattern of *Helicoverpa* abundance (Fig. 1) and attempt to outline the plausible explanations for these pest levels amongst the factors observed during the experiment. These factors were:

1) *Treatments*, including inundative biological control releases.
(The presence of a recent application)

2) *Predator abundance.*
(Total predator counts in visual or suction samples)

3) *Other considerations.*
(eg. weather and plant factors)

At 'Alcheringa', the *Helicoverpa* abundance pattern appears the be made up of four distinct periods (Fig. 1):

Period 1: (27/11/93 to 10/1/94)
low to moderate white egg pressure
moderate, fairly consistent very small to small larval pressure
very low medium to large larval pressure.
most larvae at this time were *H. punctigera*.

Period 2: (10/1/94 to 31/1/94)
increasing medium to large larval pressure

Period 3: (31/1/94 to 10/2/94
No larvae present, but a very high white egg input.

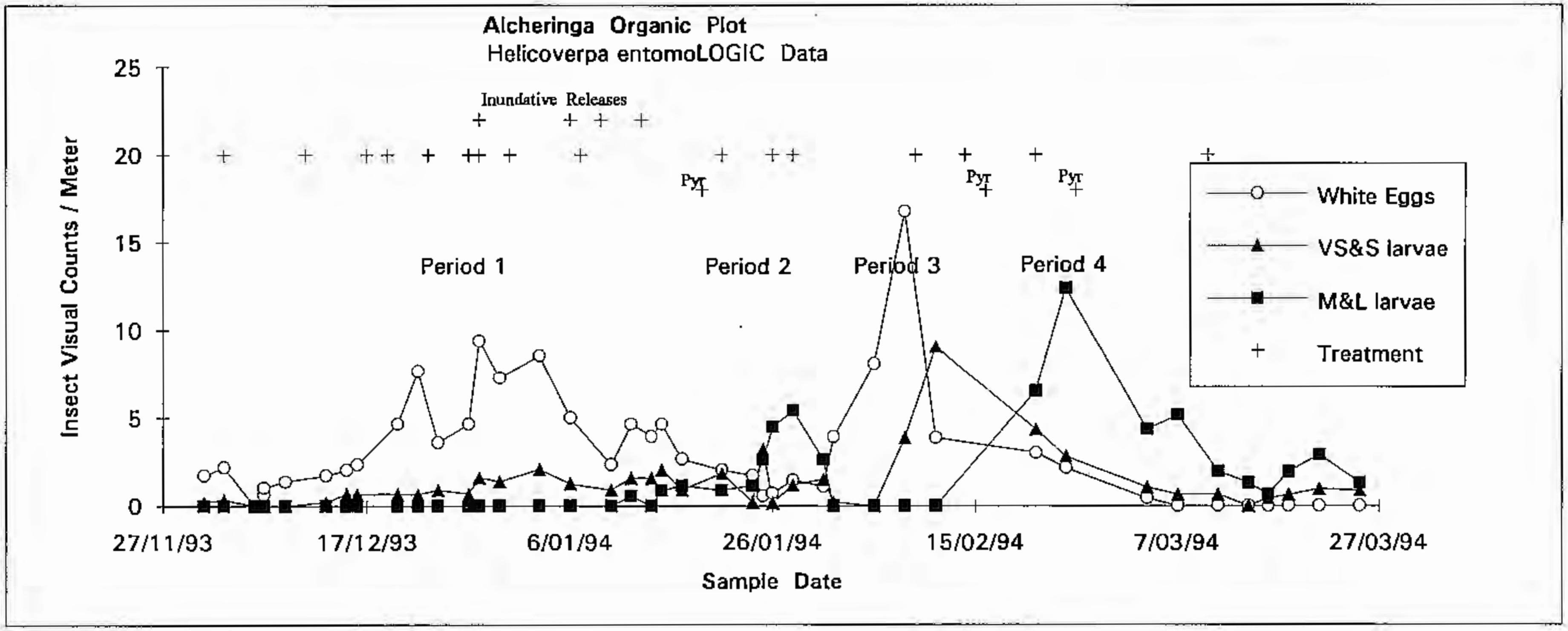
Period 4: (10/2/94 onwards)
Declining white egg input
Very high pressure from small to large larvae, mostly *H. armigera*

How do we explain these 4 periods?

Period 1. (27/11/93 to 10/1/94)
Here it is necessary to explain the relatively low numbers of larvae (especially medium and large ones) even though significant numbers of white eggs were present.

There are three possible explanations:

Figure 1
Helicoverpa abundance in the Organic Cotton Crop at 'Alcheringa'.
The entomoLOGIC data were collected and supplied by Coulton Farming.
The organic treatments are shown by crosses. Natural pyrethrum is maked by 'Pyr'
Inundative releases of natural enemies are also shown. Other spray treatments are listed in the Appendix.



a) The organic treatments reduced *Helicoverpa* survival. The prevailing treatments at this stage were garlic, Bt, and oils. Bt would be expected to reduce survival. The other sprays may also have contributed.

b) Beneficial insects reduced *Helicoverpa* survival. Consistently high levels of predators (figures 2 & 3) were present. Both *Trichogramma* and lacewing larvae were released during this period but neither had much effect. Parasitism was zero throughout this period (Appendix 5) and almost no lacewing larvae were recovered in suction samples (Fig. 15 in the Appendix 6).

c) Abiotic factors such as desiccation and wind dislodgment, which are more severe on these smaller, less protective young plants, reduced survival.

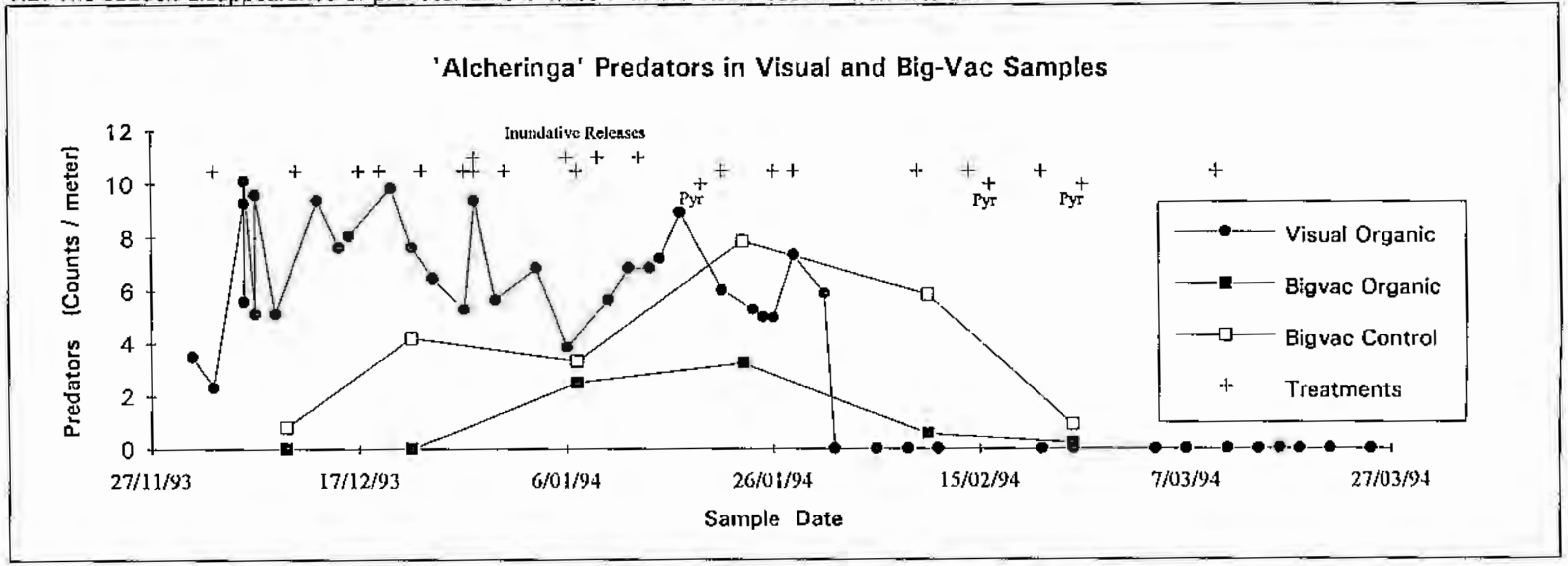
All these explanations are plausible, but we have no way of distinguishing between them. The absence of entomoLOGIC data for the control plot means that we are unable to assess the impact of the organic treatments. Though the method is not suited for sampling *Helicoverpa*, the small-vac samples did collect some larvae (Fig 30 of Appendix 6), and these data suggest that numbers were similar in the control and organic plots. Likewise, total predator counts in small-vac samples (Fig 3) were similar in both treatments. Taking these factors into consideration, our best guess is that most mortality of *Helicoverpa* resulted from some combination of predators and abiotic factors, with only limited effects from the organic treatments.

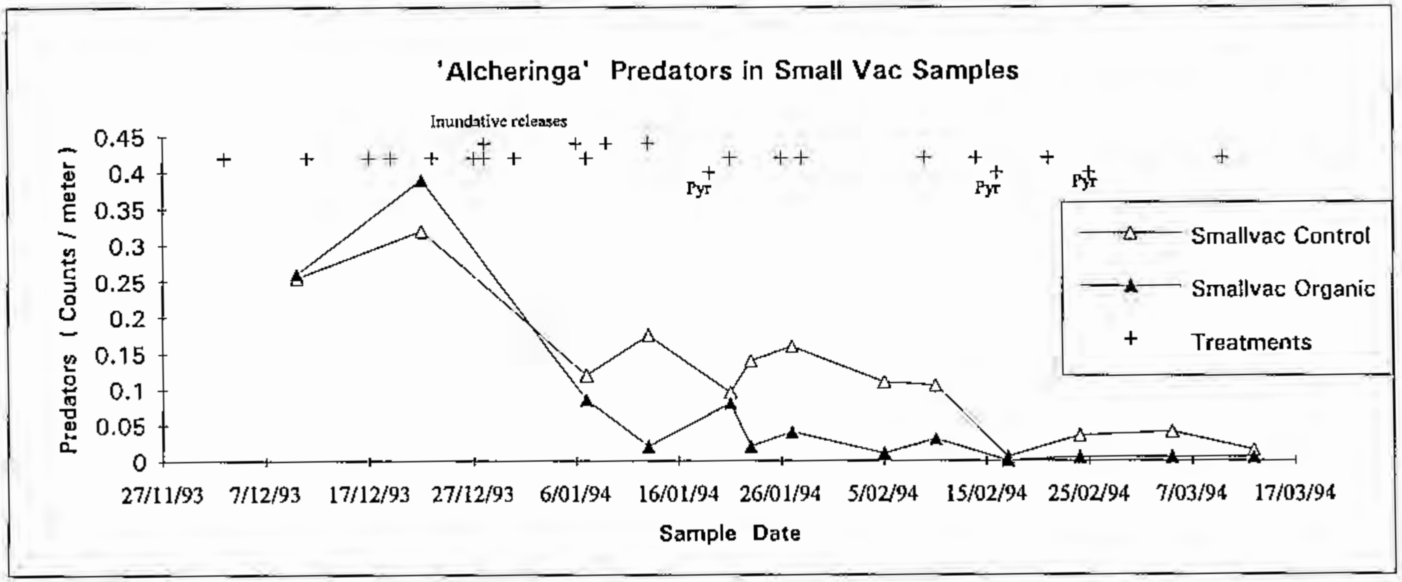
Period 2. (10/1/94 to 31/1/94)

Here it is necessary to explain the increase in survival of *Helicoverpa* (still mostly *H. punctigera* but with some *H. armigera*). Larval densities reached 5 medium to large larvae per meter. The white egg pressure did not increase, so the mortality which we have so far been explaining using our supporting measurements has somehow been relaxed. The Bt, garlic and oil treatments continued, but there was a natural pyrethrum applied (19/1/94). This spray did not appear to have a major inpact on predators, whether assessed visually (Fig. 2) or by suction sampling (Fig. 2 & 3) In fact the big-vac samples (which we consider the most reliable) suggest that predator numbers increased. Comparing the control plot to the organic area indicates that the natural pyrethrum may have stopped the predators from reaching the numbers that they might have in the absence of the spray. However it remains that predator levels were not below those which we were considering might be important in period 1. The pyrethrum also reduced the availability of alternative prey (eg. jassid adults and nymphs, refer to the species graphs in Appendix 6). The overall effect on predator impact cannot be quantified, but we feel it is unlikely that the outbreak in late January was due to predator destruction.

Another factor which may have relaxed the *Helicoverpa* mortality is the growth of the cotton. This can act in several ways; by offering a greater search area for predators and thus reducing their effectiveness, by offering a distraction to predators such as alternative food (eg. pollen) or by simply offering more protection to larvae from sprays or predators. 'Growth dilution' presents more untreated plant

Figures 2 & 3
Predator Counts: Visual, Big-Vac and Small-Vac.
NB. The sudden disappearance of predator on the 1/2/94 in the visual counts is an artefact





parts as food for pests. The impact of abiotic factors (desiccation and wind dislodgement) is reduced in denser canopies.

Trichogramma and lacewing larvae were also released during this period. The *Trichogramma* may have contributed a little to the heliothis mortality as parasitism rates in this period ranged from 1 to 5.5% (Appendix 5). Lacewing larvae were not recovered in sufficient numbers to expect a significant contribution.

Period 3. (31/1/94 to 10/2/94)

Here it is necessary to explain the reduction in virtually all insects except *Helicoverpa* eggs. The disappearance of predators from the visual counts (Fig. 2) is an artefact, due to the employment by the consultants of a new bug-checker, who simply stopped counting predators. However both small and big-vac samples showed that the predators over this period did decline considerably. No *Helicoverpa* larvae persisted (Fig. 1) so they must have all pupated or were killed somehow. As there were no treatments which could be considered likely major killers, the remaining factor appears to be the weather. There were several major rain events, totalling 185 mm, in the first half of February.

Period 4. (10/2/94 onwards)

Here it is necessary to explain the major outbreak of *Helicoverpa* (mostly *H. armigera).* The high levels at this stage were a direct result of considerably higher egg pressure during period 3. Considering that many eggs may have been washed off by the torrential rain, the moth activity must have been very high. Possible reasons for this include moth immigration (on the same weather systems that brought the rain) and a "herding effect" whereby moths were concentrated onto the organic field by widespread use of synthetic pyrethroids on nearby conventional cotton.

Predator numbers were quite low over this period (Figs 2 & 3). In part, this might be due to the application of two natural pyrethrum sprays (16 and 25/2/94), though the data suggest that the predator decline began before this. Thus, the large February-March outbreak may have been partly due to predator destruction, but there may also have been a relaxation of the effects of spray treatment brought about by growth dilution and the other plant effects mentioned before. However, the most important cause of the outbreak was simply increased egg pressure.

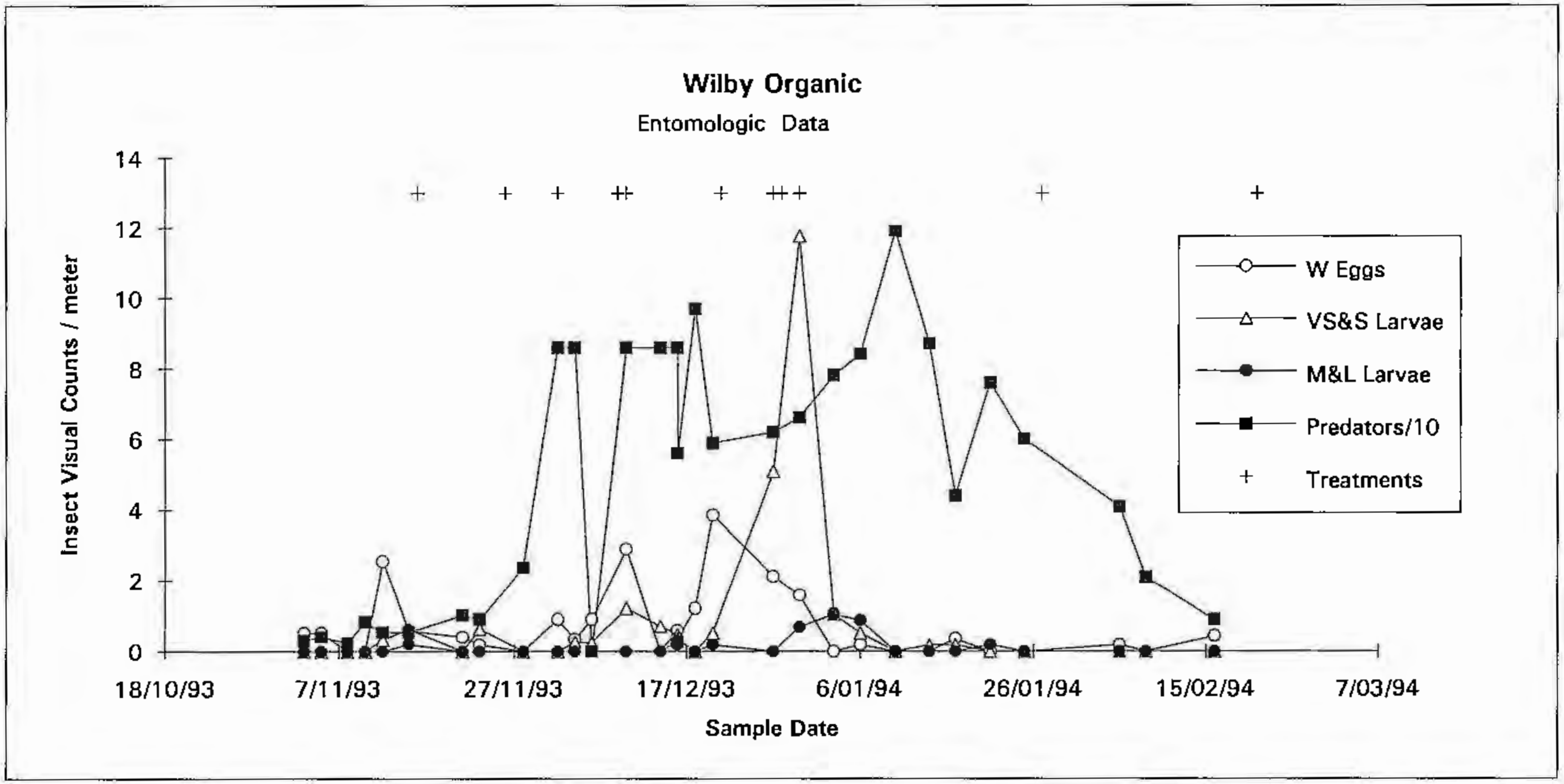
'Wilby'

At 'Wilby' there were three phases to the *Helicoverpa* season (Fig. 4):

Period 1: (3/11/94 to 20/12/94)

Low to moderate white egg pressure, with very low numbers of larvae, especially medium and large larvae. At this time, as at 'Alcheringa', control may have been maintained by the organic treatments, by beneficial insects, or by abiotic factors, and we do not have the data required to distinguish between these hypotheses. Total

Figure 4
'Wilby' Organic entomoLOGIC Data
NB. Predator counts have been divided by ten to allow the Helicoverpa variations to be seen
Organic treatments as for Figure 1



predator numbers were slightly higher in the control compared to the organic areas, but so were *Helicoverpa* larvae, at least as judged by suction sampling.

Period 2: (20/12/93 to 10/1/94)

At this time there was a *Helicoverpa* outbreak, reaching a peak of about 12 very small and small larvae per meter (Fig. 4). This occurred about 2 weeks before the first outbreak at 'Alcheringa'. Unlike that outbreak, this one appeared to be closely related to increased oviposition, which occurred around 20/12/94. Survival through to medium and large larvae remained fairly low, and the peak of these was only about 1/meter, much lower than in either the first or second 'Alcheringa' outbreaks. There was no evidence that the 'Wilby' outbreak was associated with reduced predator numbers (Fig. 4 and Figs 20 & 21 of Appendix 6). Thus, although *Helicoverpa* numbers in this period were well above threshold levels, we believe this was mostly due to increased egg pressure, rather than a breakdown in the factors which had previously controlled populations, as occurred at 'Alcheringa'.

Period 3: (10/1/94 onwards)

During this time there was a general decline in the numbers of *Helicoverpa*, predators and most other insects. This is in marked contrast to the events at 'Alcheringa' at the same time. It is probably not due to the organic treatments: there were fewer such treatments at 'Wilby' than at 'Alcheringa', and in any case the decline occurred in the control as well as the organic areas for most species. The most probable cause of the decline is the deterioration in plant quality in this dryland crop. Conditions were extremely dry, and the crop was essentially abandoned after mid-January.

Predators at 'Wilby'

In the entomoLOGIC checks, predator numbers at 'Wilby' were very much higher than at 'Alcheringa' for most of the season. There was no such major difference in the suction samples, though numbers of some predators were a bit higher. We believe the high entomoLOGIC numbers result from the bug-checkers recording as predators some common species which we would not normally consider predatory. As yet, we have not been able to ascertain exactly which species they counted.

Inundative Releases

Lacewings: Lacewing larvae (*Mallada signata*) were released at both sites over the sorghum at a rate of 1880 larvae/hectare. Neither the visual or the suction samples showed a significant presence of lacewing larvae in the cotton after these releases. This is consistent with general observations in soft-option trials that show that even with considerable adult and egg abundance, lacewing larvae do not become abundant. One plausible cause is the presence of a parasitic wasp (*Telenomus* sp.) Wasps in this family were counted in the vac samples (see results on the computer disc) however these may not be the lacewing parasite.

Trichogramma: The *Trichogramma* releases were followed by very low *Helicoverpa* egg parasitism rates (Appendix 5). These releases coincided with some unusually hot weather, conditions which have been linked to increased male production and reduced survival of *Trichogramma*. Trichogrammatidae were also counted in the suction samples (refer to the computer disk) however it was impossible to identify these to species while searching mass samples. Some samples which have been sent for expert identification are yet to be returned. Large numbers of Trichogrammatidae are commonly collected from Australian cotton fields. Many are egg parasites of insects other than *Helicoverpa*. There were no obvious periods of *Helicoverpa* decline following either *Trichogramma* or lacewing releases.

Effects of organic treatments on predators

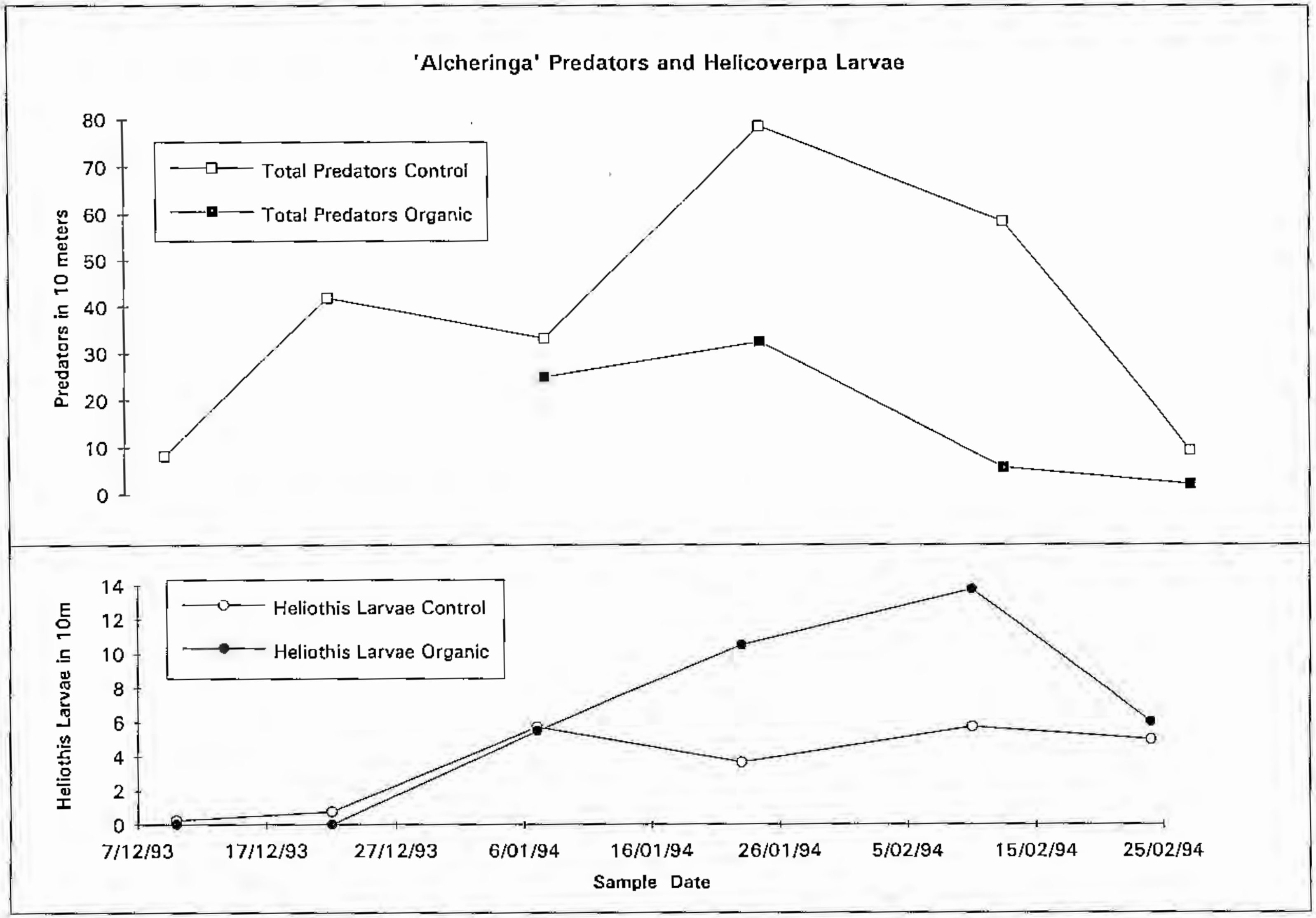
At 'Alcheringa' the numbers of many predatory species were higher in the untreated control than in the organic area, and/or the predator decline which commonly occurs from mid-season was delayed in the control. Examples of species for which one or both of these trends occurred were: Transverse ladybirds (Fig. 6), Pacific damselbugs (Fig. 11), Trichogrammatidae (Fig. 14), total predatory beetles (Fig. 16), total predatory bugs (Fig. 17) and spiders (Figs. 18 & 19). Similarly, the numbers of minor pests (flea beetles; Fig. 22, apple dimpling bugs; Fig. 23, green mirids; Fig. 24) and potential alternate prey (green and brown jassids; Figs 25-27) were higher in the control area. It is tempting to speculate that these trends were due to the impact of the organic treatments. Natural pyrethrum in particular would be expected to have broad-spectrum effects. However, caution is required. The control area was not replicated, and was located at the end of a field next to a sorghum strip. Furthermore, there was considerable variation in soil type within the field, being a newly developed field. It may be these positional effects rather than the treatments which affected insect numbers.

At Wilby, only Two-spotted ladybirds (Fig. 7) and total predatory beetles (Fig. 16) appeared to be higher in the control area. Small spiders (Fig. 18), juvenile jassids (Fig. 27) and thrips (Fig. 29) were actually higher in the treated areas. As these are groups which might be expected to be particularly sensitive to pesticides, this could be interpreted as evidence that the impact of the organic treatments on non-target insects was much less at 'Wilby', which is consistent with the lower number of applications made there. However, the same cautions regarding lack of replication and positioning of the control area apply as at 'Alcheringa'.

The Impact of Predators

The suction samples of *Helicoverpa* larvae and total predators over the organic and control plots at 'Alcheringa' (Fig. 5) suggest a substantial predator impact, especially from early January on. The higher total predator numbers in the control plot (roughly double the organic plot) coincide with a lower *Helicoverpa* density (roughly half the organic plot). Abiotic factors would be expected to be similar in both plots and the organic treatments would be expected to reduce *Helicoverpa* survival, if anything. The reduction in *Helicoverpa* is therefore most likely due to predation.

Figure 5
A comparison of predators and Helicoverpa larvae in the control and organic plots at 'Alcheringa'
Counts are from Big-vac samples so are counts per 10 meters



However, the absence of entomoLOGIC data from the control, and its positioning and lack of replication, prevent a definite conclusion. It is possible that the control site could have had less *Helicoverpa* oviposition, but more predators for some reason unrelated to the treaments. Moreover, the *Helicoverpa* numbers in both the control and organic areas were far in excess of normal economic thresholds for conventional cotton. These results tend to confirm our view that, though they may have a significant impact, predators alone (even in the very high numbers present in these studies) will not regulate *Helicoverpa* populations at economic levels in circumstances of high oviposition pressure.

Mirids

The three methods of sampling (visual, small-vac and big-vac) were in poor agreement for mirids. The big-vac caught 10-20 times the numbers caught in the small-vac on some occasions. Both vac methods revealed mirid peaks in early January at 'Wilby', as did the visual method. At 'Alcheringa' both vac methods showed peaks in late January, while the visual method indicated a steady decline from mid December.

Apart from these peaks, mirid numbers were low to moderate at both sites. They declined to very low levels after late January. Mirids appeared to be affected by the organic treatments at 'Alcheringa'. They were generally higher in the control area, and remained for approximately two weeks longer there than in the organic area during the time when natural pyrethrum was applied. However, it is difficult to isolate the effects of any particular treatments.

Aphids

Aphids were a significant late season pest at 'Alcheringa' but were virtually non-existent at 'Wilby' (see Fig. 28; note the difference in the scale of the graph). Aphids appeared earlier and were clearly more abundant in the organic area than the control at 'Alcheringa'. Aphids in general are a group for which resurgence following natural enemy destruction is commonly noted, and the data presented here strongly suggest that the organic treatments were responsible for the outbreak.

Thrips

Early season thrips numbers were below threshold at both sites, though somewhat higher at 'Wilby'. Suction samples revealed a late season peak, which seemed to be higher in the organic than the control areas at both sites (Fig. 29). This peak is absent from the visual counts, probably because the bug-checkers (in accord with entomoLOGIC guidelines) ignored thrips at this time.

Rough bollworms

Rough bollworms were abundant late in the season at 'Wilby', reaching levels up to 3 per meter. They were not included in the entomoLOGIC data, but were considered by the consultant to have caused major damage. Numbers of rough bollworms at 'Alcheringa' were very low.

Sampling methods for predators

Although we would require a truly absolute sampling method to make accurate conclusions, we are concerned about the differences between visual, small-vac and big-vac sampling methods. All methods began the season with similar estimates of overall predator numbers, but the big-vac showed an 8-fold increase between October and January at 'Alcheringa', while the small-vac showed a marked decline and the visual counts remained roughly constant.

Our previous experience with suction sampling suggests that the big-vac method is the most reliable which in turn suggests that visual counts, and especially the small-vac method, are seriously affected by canopy size. Comparisons across sampling dates using these methods must take account of this. Further complications arise because some insects (like red and blue beetles) often occupy the lower levels of the canopy. These may be under-represented in small-vac samples taken using the current standard method, which concentrates on the top of the canopy.

Yield

The average yield of cotton over the irrigated organically grown field at Alcheringa was about 1.5 bales/acre. The average for the eastern end of the field may have been somewhat lower. The raingrown yield at Wilby was 0.25 bales/acre. Unfortunately, we have no data on the yield of the control area compared with the organic area at either site. Our casual observations suggest that they would have been similar.

These yields are extremely low by conventional standards. At 'Wilby' this was due partly to lack of water, but pest damage also contributed. At 'Alcheringa', the low yield was probably due mostly to pest damage.

SUMMARY

The organic treatments used in this trial, *in these combinations and in this year,* did not produce the levels of pest control commonly expected in conventional cotton production. Early in the season, control was maintained at a reasonable level. Some combination of treatments, predators, plant resistance and abiotic factors limited *Helicoverpa* populations until late December ('Wilby') and early January ('Alcheringa'), but from then on control broke down, due to better survival and increased egg pressure from *Helicoverpa* spp.

Beneficial insects reached higher populations and persisted longer than we would have expected under conventional pest control, and in the control plots compared to the organically treated area. As the yield in both areas appeared similar, the pest control afforded by the organic treatments might have been comparable to that offered by the predators in the control. The predators appeared to have a noticeable effect on high *Helicoverpa* populations, but did not reduce them to

commonly accepted economic thresholds. Releases of *Trichogramma* and lacewings contributed little to the impact of beneficials. Rough bollworms were a problem late in the season at 'Wilby', but not at 'Alcheringa'. On the other hand, aphids were a problem late in the season at 'Alcheringa' but not at 'Wilby'. Reduction of predators by the organic treatments may have contributed to the aphid outbreak at 'Alcheringa'.

Future studies of this nature need to give more attention to aspects of experimental design, including the size, replication and placement of control areas, and the standardisation of data collection methods.

ACKNOWLEDGEMENTS

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APPENDICES

Appendix 6. Index to Graphs.

Predators and Parasites

Predator Combinations

Pests or Plant feeders

APPENDIX 1

PADDOCK	CAMPBELLS	CROP	ORGANIC COTTON	AREA	241.98	PROPERTY	ALCHERINGA

Windorah

Ha's SPRAYED	6Nov,93	GARLIC		CODACIDE OIL		AERIAL	100.00%	CHEM
EAST 142	RATEAPPLIED	0.50		0.25				APPLIC
Ha's SPRAYED	11Nov,93		DELFIN WDG	SYMSPRAY		CULTIVATOR	30.00%	CHEM
EAST 142	RATEAPPLIED		0.75	0.50				APPLIC
Ha's SPRAYED	22Nov,93	GARLIC		CODACIDE OIL		AERIAL	100.00%	CHEM
112	RATEAPPLIED	0.50		0.75				APPLIC
Ha's SPRAYED	24Nov,93	GARLIC	DIPEL FORTE	NATRAKELP		CONTRACTOR	30.00%	CHEM
EAST 142	RATEAPPLIED	0.50	0.75	0.50				APPLIC
Ha's SPRAYED	29Nov,93	GARLIC		NATRAKELP		CULTIVATOR	40.00%	CHEM
112	RATEAPPLIED	0.50		1.00				APPLIC
Ha's SPRAYED	3Dec,93	NATRASOAP	DIPEL LS	CODACIDE OIL		PICKERSPRAYER	40.00%	CHEM
EAST 85	RATEAPPLIED	0.80	2.00	0.25				APPLIC
Ha's SPRAYED	5Dec,93	GARLIC	DIPEL LS	CODACIDE OIL		PICKERSPRAYER	40.00%	CHEM
105	RATEAPPLIED	0.50	2.00	0.25				APPLIC
Ha's SPRAYED	5Dec,93	GARLIC	DIPEL LS	CODACIDE OIL		CONTRACTOR	40.00%	CHEM
61	RATEAPPLIED	0.50	2.00	0.25				APPLIC
Ha's SPRAYED	11Dec,93	GARLIC		CODACIDE OIL		AERIAL	100.00%	CHEM
EAST 251	RATEAPPLIED	0.50		0.25				APPLIC
Ha's SPRAYED	17Dec,93	GARLIC	DELFIN OF			AERIAL	100.00%	CHEM
EAST 251	RATEAPPLIED	0.50	2.00					APPLIC
Ha's SPRAYED	18Dec,93	NATRASOAP		SYMSPRAY		CULTIVATOR	40.00%	CHEM
40	RATEAPPLIED	0.80		0.50				APPLIC
Ha's SPRAYED	19Dec,93			SYMSPRAY		CULTIVATOR	40.00%	CHEM
EAST 211	RATEAPPLIED			0.40				APPLIC
Ha's SPRAYED	23Dec,93		DIPEL LS			AERIAL	100.00%	CHEM
EAST 242	RATEAPPLIED		3.00					APPLIC
Ha's SPRAYED	27Dec,93	GARLIC			PURE SUGAR	AERIAL	100.00%	CHEM
EAST 242	RATEAPPLIED	0.50			4.00			APPLIC
Ha's SPRAYED	28Dec,93				LACEWINGS	AERIAL	100.00%	CHEM
Sorghum 21	RATEAPPLIED				188000			APPLIC

PADDOCK	CAMPBELLS	CROP	ORGANIC COTTON	AREA	241.98	PROPERTY	ALCHERINGA

WINDMILL

	Ha's SPRAYED	28 Dec, 93		DELFIN OF		CONTRACTOR	75.00%	CHEM
EAST	142	RATE APPLIED		3.00				APPLIC
	Ha's SPRAYED	28 Dec, 93		DELFIN OF		CONTRACTOR	50.00%	CHEM
	100	RATE APPLIED		3.00				APPLIC
	Ha's SPRAYED	31 Dec, 93	GARLIC	DIPEL LS		AERIAL	100.00%	CHEM
EAST	242	RATE APPLIED	0.50	3.00				APPLIC
	Ha's SPRAYED	6 Jan, 94			TRICHOGRAMMA	AERIAL	100.00%	CHEM
EAST	142	RATE APPLIED			15900.00			APPLIC
	Ha's SPRAYED	7 Jan, 94		DELFIN OF		AERIAL	100.00%	CHEM
EAST	242	RATE APPLIED		3.00				APPLIC
	Ha's SPRAYED	9 Jan, 94			LACEWINGS	AERIAL	100.00%	CHEM
SORGHUM	21	RATE APPLIED			1880.00			APPLIC
	Ha's SPRAYED	13 Jan, 94			TRICHOGRAMMA	AERIAL	100.00%	CHEM
EAST	100	RATE APPLIED			15900.00			APPLIC
	Ha's SPRAYED	14 Jan, 94		DIPEL LS		AERIAL	100.00%	CHEM
	220	RATE APPLIED		3.00				APPLIC
	Ha's SPRAYED	14 Jan, 94	Natural Pyrethrum	DIPEL LS		AERIAL	100.00%	CHEM
EAST	18 TRIAL	RATE APPLIED	0.10	3.00				APPLIC
	Ha's SPRAYED	19 Jan, 94	Natural Pyrethrum	DIPEL LS	DC TRON	AERIAL	100.00%	CHEM
EAST	242	RATE APPLIED	0.20	3.00	2.00			APPLIC
	Ha's SPRAYED	21 Jan, 94		DELFIN OF	PURE SUGAR	AERIAL	100.00%	CHEM
EAST	242	RATE APPLIED		2.00	2.00			APPLIC
	Ha's SPRAYED	25 Jan, 94		DIPEL LS	PURE SUGAR	AERIAL	100.00%	CHEM
	100	RATE APPLIED		2.00	6.00			APPLIC
	Ha's SPRAYED	26 Jan, 94		DIPEL LS	PURE SUGAR	AERIAL	100.00%	CHEM
EAST	142	RATE APPLIED		2.00	6.00			APPLIC
	Ha's SPRAYED	28 Jan, 94	GARLIC			AERIAL		CHEM
EAST	242	RATE APPLIED						APPLIC
	Ha's SPRAYED	9 Feb, 94		DIPEL LS	PURE SUGAR	AERIAL	100.00%	CHEM
EAST	242	RATE APPLIED		2.50	5.50			APPLIC

PADDOCK	CAMPBELLS	CROP	ORGANIC COTTON	AREA	241.98	PROPERTY	ALCHERINGA

WindDumilla

Ha's SPRAYED	14 Feb,94			DIPEL LS		PURE SUGAR	AERIAL	100.00%	CHEM
EAST 242	RATE APPLIED			2.50		6.00			APPLIC
Ha's SPRAYED	16 Feb,94	GARLIC	NATURAL PYRETHRUM	DIPEL LS			AERIAL	100.00%	CHEM
EAST 242	RATE APPLIED	1.20	0.10	2.00					APPLIC
Ha's SPRAYED	21 Feb,94			DELFIN OF		PURE SUGAR	AERIAL	100.00%	CHEM
EAST 242	RATE APPLIED			3.00		4.00			APPLIC
Ha's SPRAYED	25 Feb,94	GARLIC	Natural Pyrethrum		NATRAKELP		AERIAL	100.00%	CHEM
EAST 242	RATE APPLIED	1.00	0.13		1.00				APPLIC
Ha's SPRAYED	10 Mar,94	NATRASOAP				DC TRON	AERIAL	100.00%	CHEM
EAST 142	RATE APPLIED	2.00				2.00			APPLIC
Ha's SPRAYED	13 Mar,94	NATRASOAP					AERIAL	100.00%	CHEM
70	RATE APPLIED	4.00							APPLIC
Ha's SPRAYED	17 Mar,94					DC TRON	AERIAL	100.00%	CHEM
20	RATE APPLIED					10.00			APPLIC

16 LTS

PADDOCK	FOUR 75	CROP	ORGANIC COTTON	AREA	145.10	PROPERTY	GETTA WILBY

APPENDIX 2

Ha's SPRAYED	29 Oct,93	GARLIC	CODACIDE OIL				CONTRACTOR	33.00%	CHEM
97	RATE APPLIED	033	025						APPLIC
Ha's SPRAYED	7 Nov,93	GARLIC			CODACIDE OIL		CONTRACTOR	30.00%	CHEM
97	RATE APPLIED	033			025				APPLIC
Ha's SPRAYED	16 Nov,93	GARLIC		DELFIN WDG	NATRAKELP		CULTIVATOR	20.00%	CHEM
97	RATE APPLIED	033		075	050				APPLIC
Ha's SPRAYED	26 Nov,93	GARLIC		DIPEL FORTE	CODACIDE OIL		CONTRACTOR	40.00%	CHEM
97	RATE APPLIED	050		100	025				APPLIC
Ha's SPRAYED	2 Dec,93	GARLIC		DELFIN WDG	CODACIDE OIL		CONTRACTOR	40.00%	CHEM
97	RATE APPLIED	050		100	025				APPLIC
Ha's SPRAYED	10 Dec,93	GARLIC		DIPEL LS	CODACIDE OIL		CONTRACTOR	40.00%	CHEM
97	RATE APPLIED	075		300	025				APPLIC
Ha's SPRAYED	21 Dec,93	GARLIC		DELFIN OF	NATRAKELP		GROUND RIG	60.00%	CHEM
97	RATE APPLIED	050		300	050				APPLIC
Ha's SPRAYED	27 Dec,93	GARLIC		DELFIN OF	CODACIDE OIL		GROUND RIG	100.00%	CHEM
97	RATE APPLIED	020		300	025				APPLIC
Ha's SPRAYED	28 Dec,93					LACEWINGS	AERIAL	100.00%	CHEM
11	RATE APPLIED					1880.00			APPLIC
Ha's SPRAYED	30 Dec,93	Natural Pyrethrum		DIPEL LS	CODACIDE OIL		AERIAL	100.00%	CHEM
145	RATE APPLIED	010		150	050				APPLIC
Ha's SPRAYED	9 Jan,94					LACEWINGS	AERIAL	100.00%	CHEM
11	RATE APPLIED					1880.00			APPLIC
Ha's SPRAYED	27 Jan,94	GARLIC		DELFIN OF	CODACIDE OIL		AERIAL	100.00%	CHEM
145	RATE APPLIED	050		300	025				APPLIC
Ha's SPRAYED	21 Feb,94			DIPEL LS			AERIAL	100.00%	CHEM
145	RATE APPLIED			200					APPLIC

APPENDIX 3

entomoLOGIC data PRESENCE ABSENCE

WINDMILL EAST							
	Variety	Progress	Plants/m	Sow date	1st square	1st boll	1st open
WINDMILL EAST	Siokra L23	average	13	10/26/93	11/26/93	12/27/93	

30

	Date	W.Eggs	B.Eggs	VS.Larvae	S.Larvae	M.Larvae	L.Larvae	Mites	Mirids	Aphids	Predators	Thrips
WINDMILL EAST	12/1/93	1.73	1.14	0.23	0	0	0	0	0.58	0	3.5	0.24
WINDMILL EAST	12/3/93	2.18	0.85	0.34	0	0	0	0	2	0	2.33	0.36
WINDMILL EAST	12/6/93	0	0	0	0	0	0	0	0.82	9	9.3	0.12
WINDMILL EAST	12/6/93	0	0	0	0	0	0	0	0.75	0	5.58	0.29
WINDMILL EAST	12/6/93	0	0	0	0	0	0	0	0.55	13	10.13	0
WINDMILL EAST	12/7/93	0.67	1.37	0	0	0	0	0	1.2	0	5.11	0.16
WINDMILL EAST	12/7/93	1.02	0.33	0	0	0	0	0	1.05	32	9.57	0.08
WINDMILL EAST	12/9/93	1.37	0.33	0	0	0	0	0	0.8	0	5.11	0.61
WINDMILL EAST	12/13/93	1.73	0.85	0.23	0	0	0	0	1.25	5	9.39	0.2
WINDMILL EAST	12/15/93	2.03	0.85	0.45	0.23	0	0	0	0.58	0	7.62	0
WINDMILL EAST	12/16/93	2.34	1.73	0.67	0	0	0	0	1	0	8.06	0
WINDMILL EAST	12/20/93	4.64	3.28	0.45	0.23	0	0	0	1.38	0	9.05	0
WINDMILL EAST	12/22/93	7.66	10.34	0.67	0	0	0	0	0.96	0	7.62	0
WINDMILL EAST	12/24/93	3.61	2.97	0.92	0	0	0	0	0.75	0	0 *	0
WINDMILL EAST	12/27/93	4.64	5	0.45	0.23	0	0	0	1.33	0	5.27	0
WINDMILL EAST	12/28/93	9.39	5.72	1.63	0	0	0	0	1.38	0	9.39	0
WINDMILL EAST	12/30/93	7.26	5.72	1.14	0.23	0	0	0	0.5	1.67	5.65	0
WINDMILL EAST	1/3/94	8.52	5	1.63	0.45	0	0	0	0.38	18.33	6.82	0
WINDMILL EAST	1/6/94	5	3.61	0.8	0.45	0	0	0	0.46	0	3.83	0
WINDMILL EAST	1/10/94	2.34	0.57	0.67	0.23	0	0	0	0.67	0	5.65	0
WINDMILL EAST	1/12/94	4.64	5.72	0.45	1.14	0.58	0	0	0.25	0	6.82	0
WINDMILL EAST	1/14/94	3.95	4.64	0.67	0.92	0	0	0	0.25	0	6.82	0
WINDMILL EAST	1/15/94	4.64	0.85	0.67	1.39	0.87	0	0	0.12	0	7.22	0
WINDMILL EAST	1/17/94	2.65	1.14	0	0.92	0.87	0.29	0	0.33	0	8.93	0
WINDMILL EAST	1/21/94	2.03	1.43	0.45	1.39	0.87	0	0	0.33	0	6.04	0
WINDMILL EAST	1/24/94	1.73	0.85	0	0.23	0.87	0.29	0	0.33	0	5.27	0
WINDMILL EAST	1/25/94	0.56	0.84	0	3.21	1.76	0.86	0	0	0	0 *	0
WINDMILL EAST	1/26/94	0.74	0.24	0	0.2	2.64	1.81	16.67	0	0	4.97	0
WINDMILL EAST	1/28/94	1.48	1.48	0	1.19	3.49	1.9	0	0.22	0	7.34	0
WINDMILL EAST	1/31/94	1.1	0.74	0.3	1.19	1.51	1.13	0	2.17	0	5.9	0

* Considered errors

entomoLOGIC data ACTUAL NUMBERS

WINDMILL EAST

	Variety	Progress	Plants/m	Sow date	1st square	1st boll	1st open
WINDMILL EAST	Siokra L23	average	13	10/26/93	11/20/93	12/26/93	2/10/94

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	Date	W.Eggs	B.Eggs	VG.Larvae	S.Larvae	M.Larvae	L.Larvae	TipSLarvae	Mites	Mirids	Aphids	Honeydew	Predators	S.Army	Roughies	Thrips
WINDMILL EAST	1-Dec-93	1.73	1.14	0.23	0	0	0	0	0	0.58	0	0	3.5	0	0	0.24
WINDMILL EAST	3-Dec-93	2.18	0.65	0.34	0	0	0	0	0	2	0	0	2.33	0	0	0.36
WINDMILL EAST	6-Dec-93	0	0	0	0	0	0	0	0	0.82	9	0	9.3	0	0	0.12
WINDMILL EAST	6-Dec-93	0	0	0	0	0	0	0	0	0.75	0	0	5.53	0	0	0.29
WINDMILL EAST	6-Dec-93	0	0	0	0	0	0	0	0	0.55	18	0	10.13	0	0	0
WINDMILL EAST	7-Dec-93	0.67	1.37	0	0	0	0	0	0	1.2	0	0	5.11	0	0	0.16
WINDMILL EAST	7-Dec-93	1.02	0.33	0	0	0	0	0	0	1.05	32	0	9.57	0	0	0.08
WINDMILL EAST	9-Dec-93	1.37	0.33	0	0	0	0	0	0	0.8	0	0	5.11	0	0	0.61
WINDMILL EAST	13-Dec-93	1.73	0.65	0.23	0	0	0	0	0	1.25	5	0	9.39	0	0	0.2
WINDMILL EAST	15-Dec-93	2.03	0.85	0.45	0.23	0	0	0	0	0.58	0	0	7.62	0	0	0
WINDMILL EAST	16-Dec-93	2.34	1.73	0.67	0	0	0	0	0	1	0	0	8.06	0	0	0
WINDMILL EAST	25-Jan-94	0.33	0.67	0	2.67	1.17	0.5	0	0	0	0	0	0	0	0	0
WINDMILL EAST	28-Jan-94	0.26	0	1.03	0.51	1.54	1.03	0	0	21.15 +	7.69	0	15 *	0	0	0
WINDMILL EAST	1-Feb-94	3.91	1.96	0.22	0	0	0	0	0	0	10.03	0	0	0	0	0
WINDMILL EAST	5-Feb-94	8.06	5	0	0	0	0	0	0	0	11.17	0	0	0	0	0
WINDMILL EAST	8-Feb-94	16.77	18.27	3.67	0	0	0	0	0	0	53.35	0	0	0	0	0
WINDMILL EAST	11-Feb-94	3.87	16.13	5.48	3.55	0	0	0	0	0	0	0	25 *	0	0	0
WINDMILL EAST	21-Feb-94	3.04	3.04	0.65	3.7	4.35	2.17	0	0	0	16.72	0	0	0	0	0
WINDMILL EAST	24-Feb-94	2.17	1.03	0.22	2.61	6.3	6.09	0	0	0	8.36	6.69	0	0	0	0
WINDMILL EAST	4-Mar-94	0.43	0.43	0.43	0.65	1.52	2.83	0	0	0	18.39	13.38	0	0	0	0
WINDMILL EAST	7-Mar-94	0	0	0	0.65	1.94	3.23	0	0	0	9.93	7.44	0	0	0	0
WINDMILL EAST	11-Mar-94	0	0	0.22	0.43	1.09	0.87	0	0	0	18.39	13.38	0	0	0	0
WINDMILL EAST	14-Mar-94	0	0	0	0	0.43	0.87	0	0	0	20.07	18.39	0	0	0	0
WINDMILL EAST	16-Mar-94	0	0	0	0.43	0.43	0.22	0	0	0	16.72	16.72	0	0	0	0
WINDMILL EAST	18-Mar-94	0	0	0.32	0.32	1.29	0.65	0	0	0	19.85	17.37	0	0	0	0
WINDMILL EAST	21-Mar-94	0	0	0	0.97	2.26	0.65	0	0	0	19.85	17.37	0	0	0	0
WINDMILL EAST	25-Mar-94	0	0	0.22	0.65	0.65	0.65	0	0	0	13.39	16.72	0	0	0	0

* considered as errors

\+ some reservations

Printout of OCIO data ACTUALS **APPENDIX 4**

FOUR 75

	Variety	Region	Progress	Plants/m	Sow date	1st square	1st boll	1st open
FOUR 75	Sickra L23	Macintyre	average	7	29-Sep-93	5-Nov-93	14-Dec-93	26-Jan-94

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	Date	No.Cards	W.Eggs	B.Eggs	VS.Larvae	S.Larvae	M.Larvae	L.Larvae	Mirids	Aphids	Predators	S.Army	L.Army	Thrips
FOUR 75	3-Nov-93	1	0.51	0.17	0	0	0	0	0.12	0	3.11	0	0.12	0.56
FOUR 75	5-Nov-93	1	0.51	0	0	0	0	0	0	0	4.02	0	0	0.59
FOUR 75	8-Nov-93	1	0	0	0	0	0	0	0	0	2.28	0	0	1.6
FOUR 75	10-Nov-93	1	0	0.34	0	0	0	0	0.41	0	8.17	0.12	0	2.1
FOUR 75	12-Nov-93	1	2.53	0.4	0.16	0.16	0	0	0	3.33	5.34	0.12	0	1.87
FOUR 75	15-Nov-93	1	0.59	0.4	0.47	0.16	0.21	0	0	0	5.34	0	0	1.64
FOUR 75	21-Nov-93	1	0.4	0.4	0	0	0	0	0.15	1.67	10.24	0	0	1.04
FOUR 75	23-Nov-93	1	0.19	0.4	0.64	0	0	0	0.2	0	9.02	0	0	1.04
FOUR 75	29-Nov-93	1	0	0.19	0	0	0	0	0.29	0	23.58	0	0	0.6
FOUR 75	2-Dec-93	1	0.9	2.53	0	0	0	0	3.24	0	85.96	0	0	1.87
FOUR 75	4-Dec-93	1	0.34	0.68	0.27	0	0	0	6.3	0	85.96	0	0	0.86
FOUR 75	6-Dec-93	1	0.9	0.9	0.24	0	0	0	3.15	0	0	0	0	0.31
FOUR 75	10-Dec-93	1	2.89	4.01	1.23	0	0	0	1.92	0	85.96	0	0	0.2
FOUR 75	14-Dec-93	1	0	0.59	0.24	0.47	0	0	2.71	0	85.96	0	0	0.25
FOUR 75	16-Dec-93	1	0.59	2.53	0.24	0.24	0.29	0	2.8	0	85.96	0	0	0.36
FOUR 75	16-Dec-93	1	0.35	1.4	0.16	0.18	0.18	0	2.81	0	56	0	0	0.16
FOUR 75	19-Dec-93	1	1.23	2.26	0	0	0	0	2.02	0	97	0	0	0
FOUR 75	20-Dec-93	1	3.86	5.61	0.53	0	0.18	0	6.93	0	59	0	0	0
FOUR 75	27-Dec-93	1	2.11	5.96	4.39	0.7	0	0	4.91	0	62	0	0	0.23
FOUR 75	30-Dec-93	1	1.58	2.28	4.39	7.37	0.7	0	11.05	0	66	0	0	0.6
FOUR 75	3-Jan-94	1	0	0.18	0	1.05	1.05	0	9.52	0	78	0	0	0.33
FOUR 75	6-Jan-94	1	0.18	0	0	0.53	0.88	0	6.62	0	84	0	0	0
FOUR 75	10-Jan-94	1	0	0	0	0	0	0	0.26	0	119	0	0	0.28
FOUR 75	14-Jan-94	1	0	0.7	0.18	0	0	0	1.8	0	87	0	0	0.25
FOUR 75	17-Jan-94	1	0.35	0.53	0.18	0	0	0	1.36	0	44	0	0	0.23
FOUR 75	21-Jan-94	1	0	0	0	0	0.18	0	0.39	0	76	0	0	0.18
FOUR 75	25-Jan-94	1	0	0	0	0	0	0	0.75	0	60	0	0	0.13
FOUR 75	5-Feb-94	1	0.18	0	0	0	0	0	0.26	0	41	0	0	0.23
FOUR 75	8-Feb-94	1	0	0	0	0	0	0	0.18	0	21	0	0	0.08
FOUR 75	16-Feb-94	1	0.43	0.64	0	0	0	0	0.16	0	9	0	0	0.15

Appendix 5

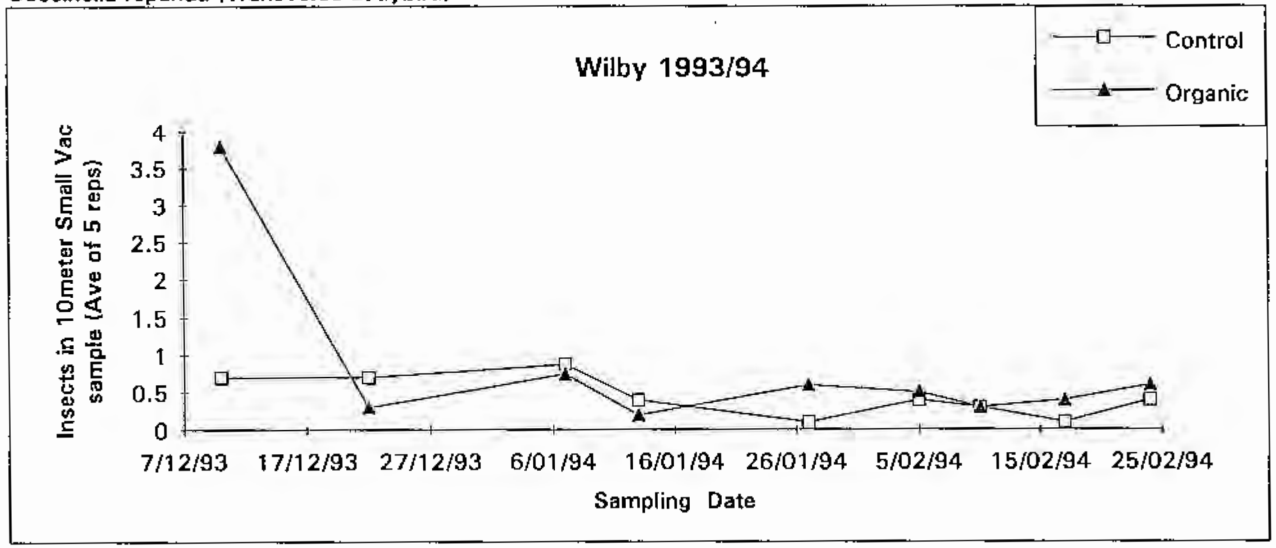
Trichogramma Parasitism of *Helicoverpa* Eggs at 'Alcheringa'

Sample Date	Test Date	Total Eggs	Number Parasites	% Parasitism
4/01/94	9/01/94	96	0	0.0
7/01/94	11/01/94	192	0	0.0
11/01/94	14/01/94	72	4	5.6
14/01/94	17/01/94	96	3	3.1
15/01/94	19/01/94	96	0	0.0
18/01/94	21/01/94	96	1	1.0
24/01/94	27/01/94	96	1	1.0
28/01/94	31/0194	96	0	0.0
5/02/94	8/02/94	96	0	0.0
8/02/94	11/02/94	96	0	0.0

APPENDIX 6 - SPECIES GRAPHS

Figure 6

Wilby 1993/94 Small Vaccuum Samples
Coccinella repanda (Transverse Ladybird)



Alcheringa 1993/94 Small Vaccuum Samples
Coccinella repanda (Transverse Ladybird)

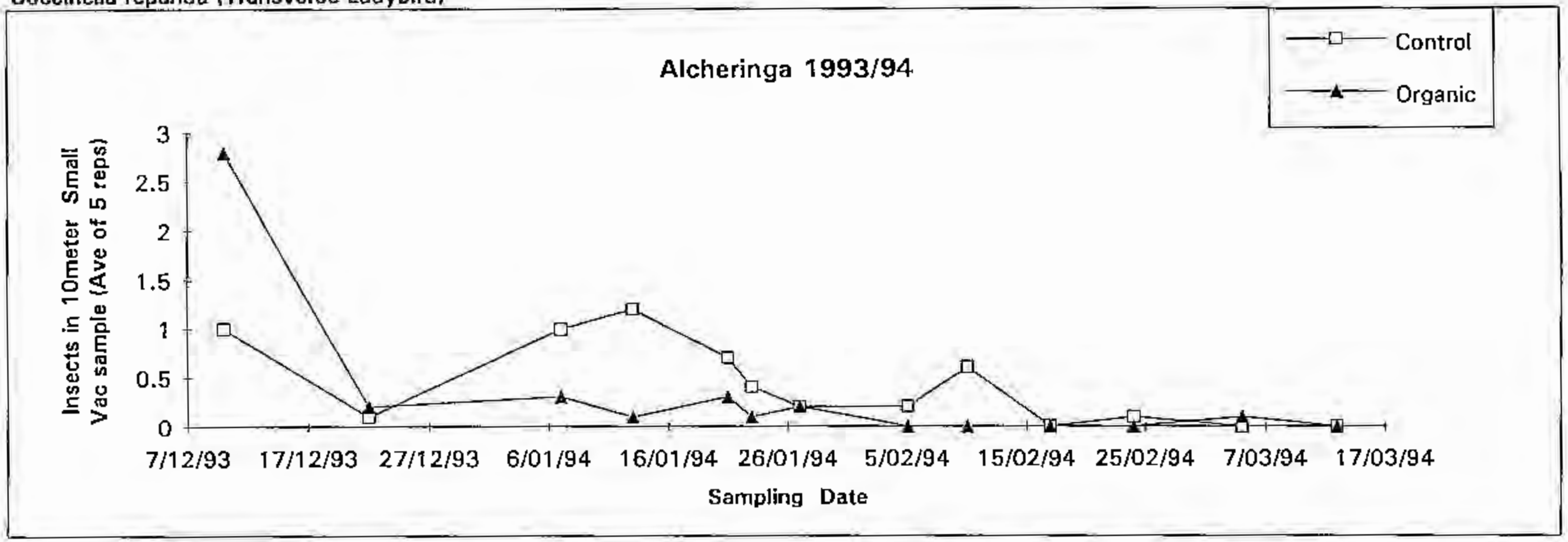
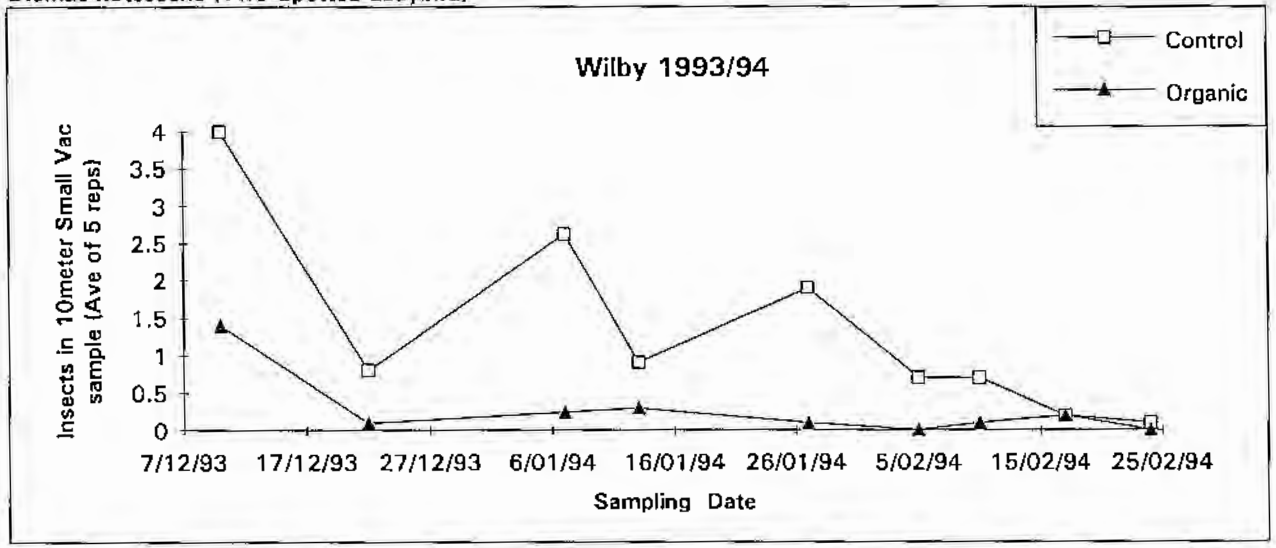


Figure 7

Wilby 1993/94 Small Vaccuum Samples
Diomus notescens (Two Spotted Ladybird)



Alcheringa 1993/94 Small Vaccuum Samples
Diomus notescens (Two Spotted Ladybird)

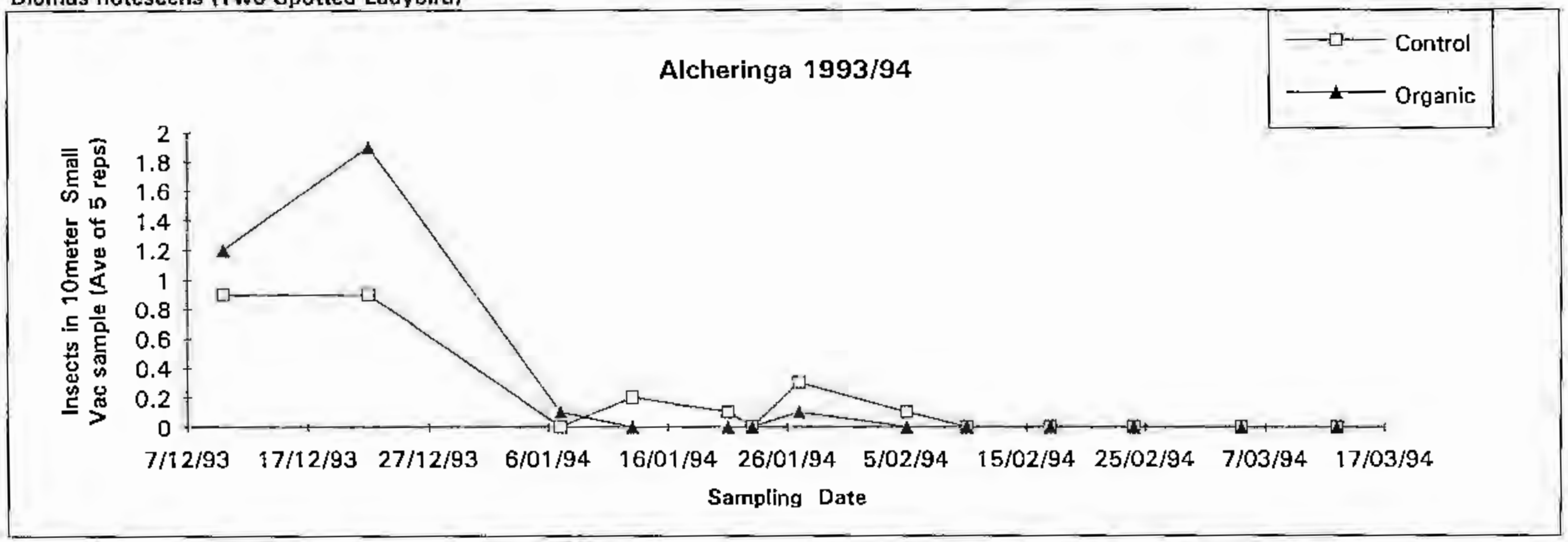
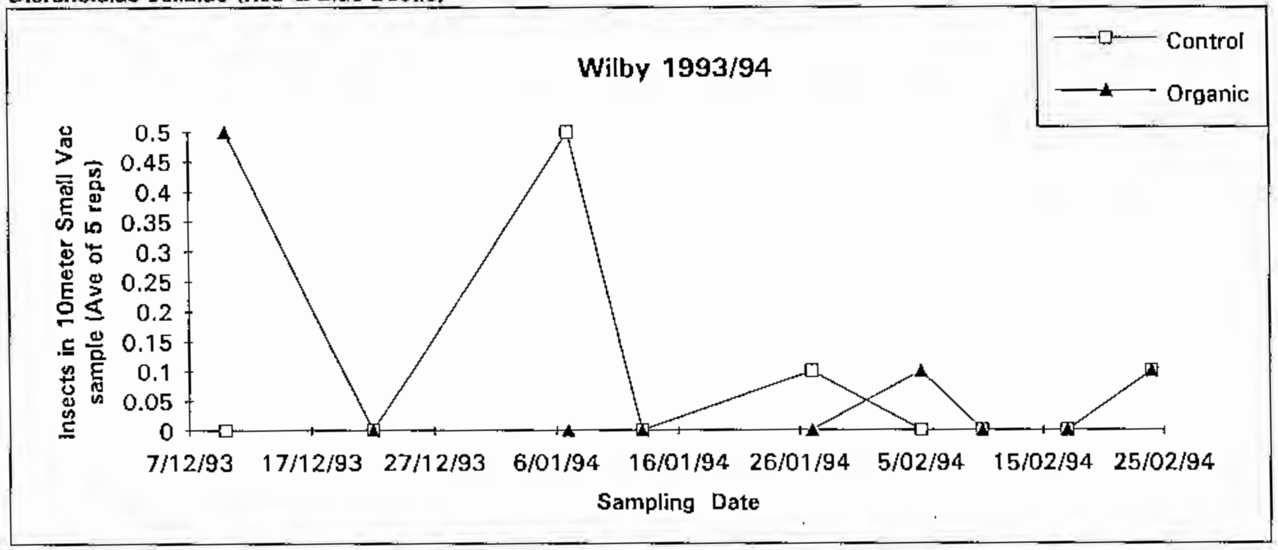


Figure 8

Wilby 1993/94 Small Vaccuum Samples
Dicranolaius bellulus (Red & Blue Beetle)



Alcheringa 1993/94 Small Vaccuum Samples
Dicranolaius bellulus (Red & Blue Beetle)

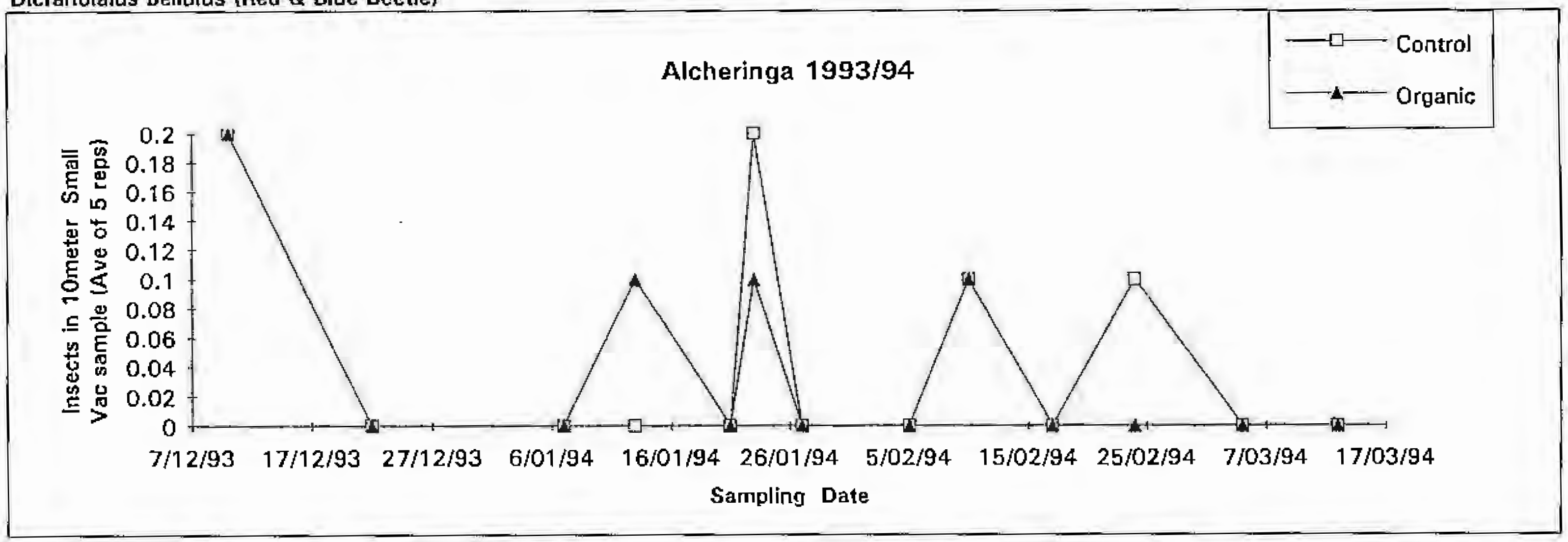
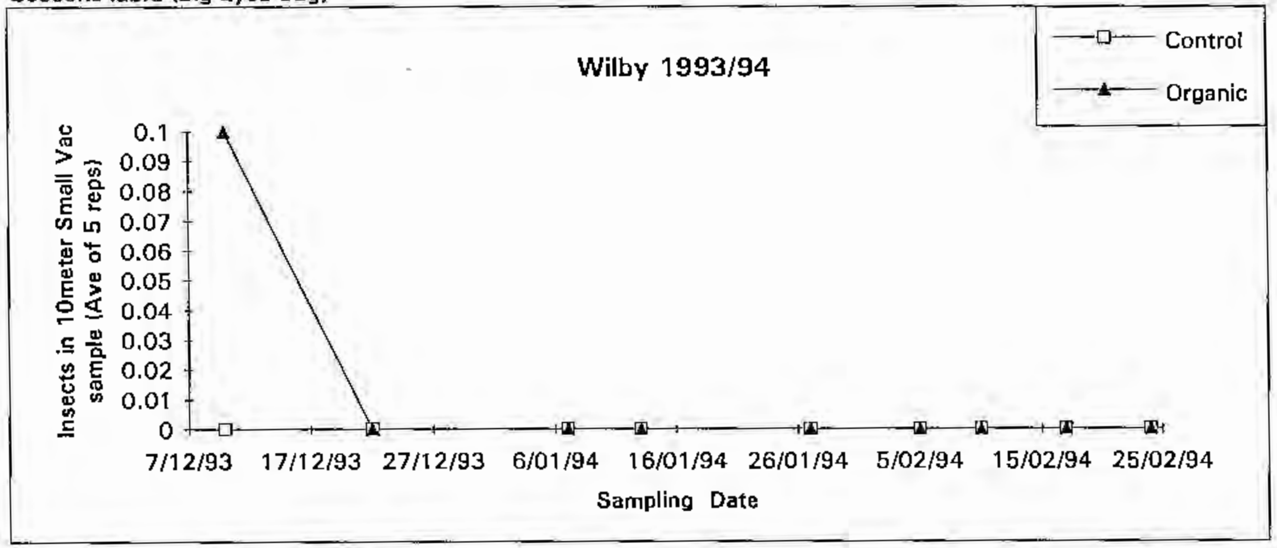


Figure 9

Wilby 1993/94 Small Vaccuum Samples
Geocoris lubra (Big-Eyed Bug)



Alcheringa 1993/94 Small Vaccuum Samples
Geocoris lubra (Big-Eyed Bug)

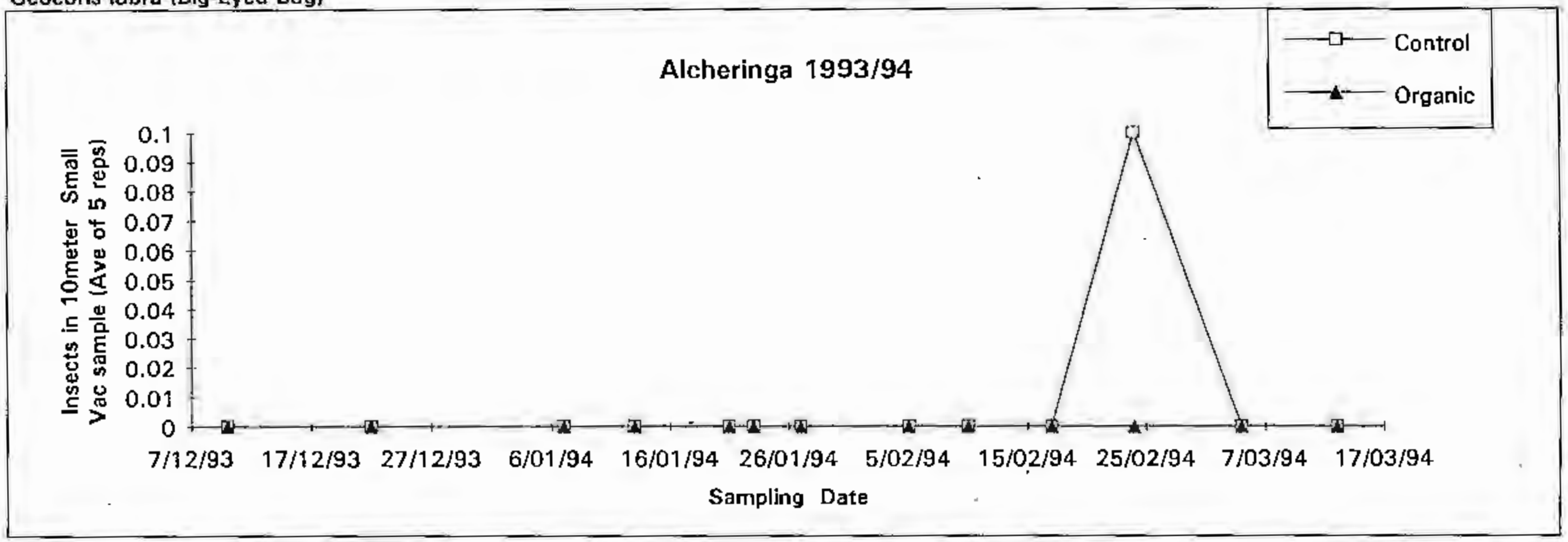
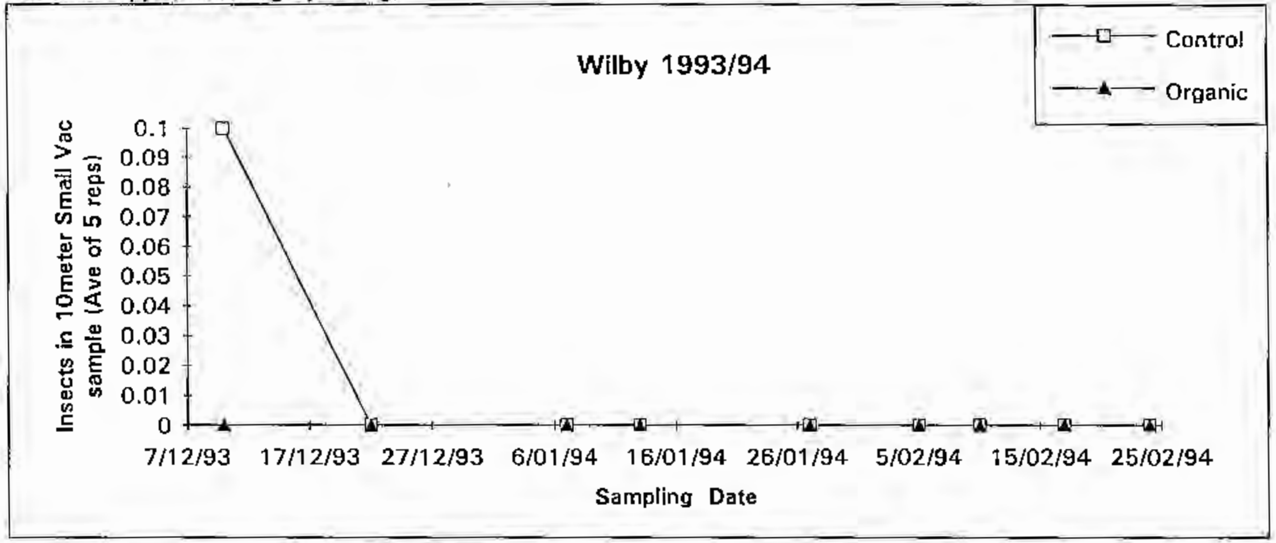


Figure 10

Wilby 1993/94 Small Vaccuum Samples
Germalus spp. (Green Big-Eyed Bug)



Alcheringa 1993/94 Small Vaccuum Samples
Germalus spp. (Green Big-Eyed Bug)

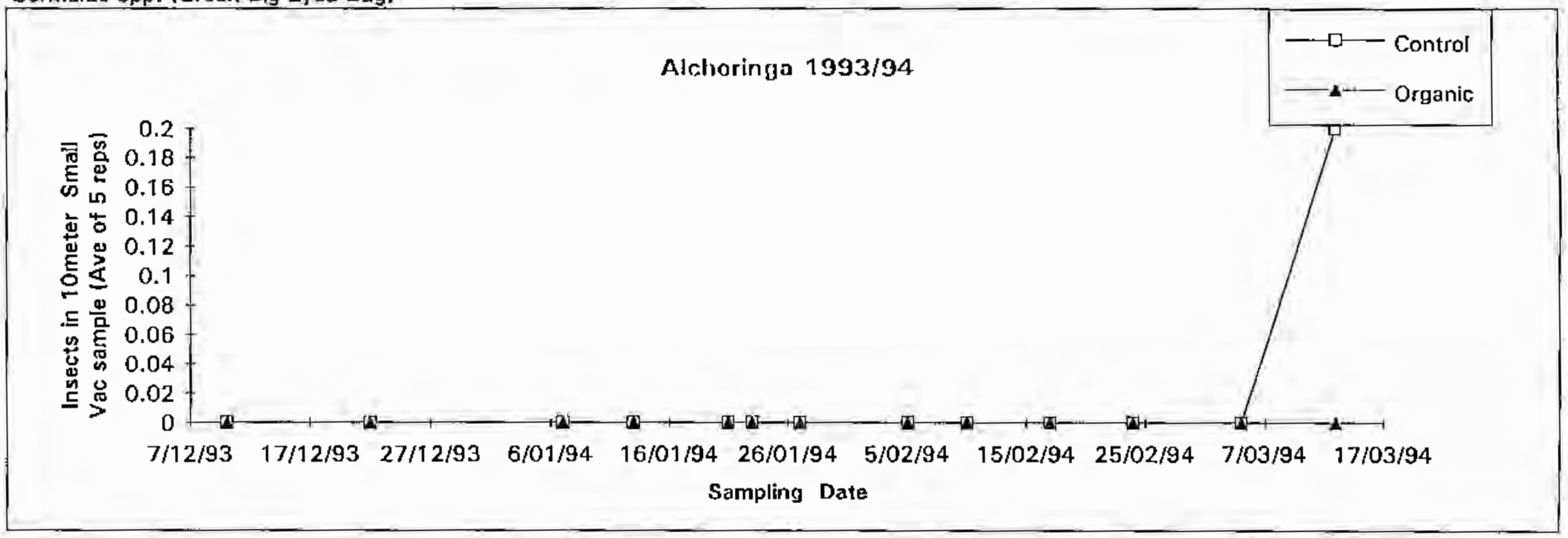
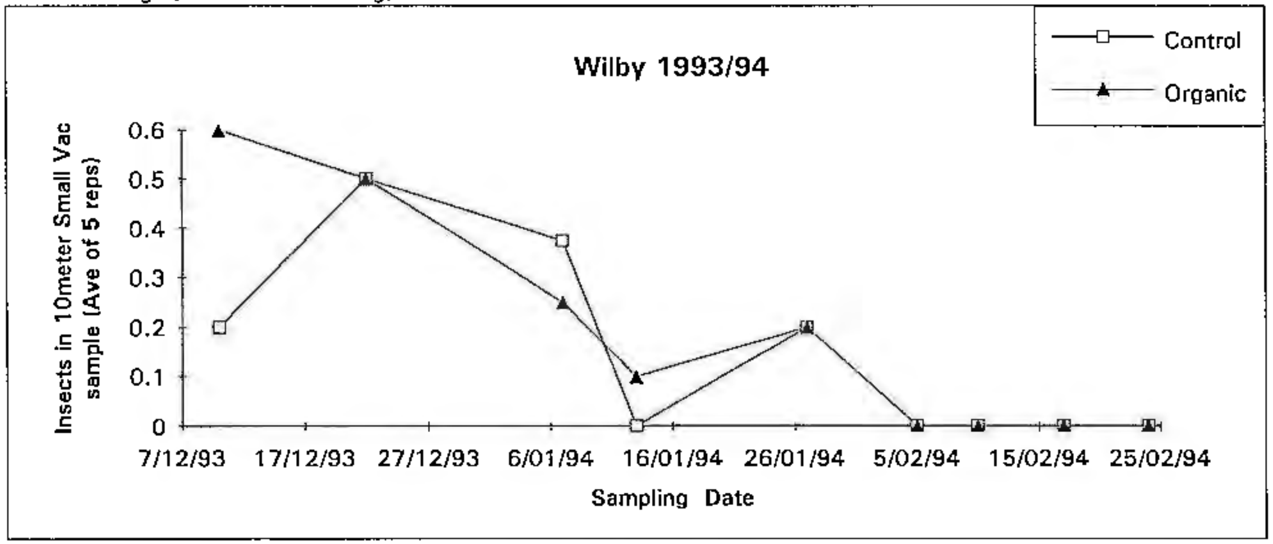


Figure 11

Wilby 1993/94 Small Vaccuum Samples
Nabis kinbergii (Pacific Damsel Bug)



Alcheringa 1993/94 Small Vaccuum Samples
Nabis kinbergii (Pacific Damsel Bug)

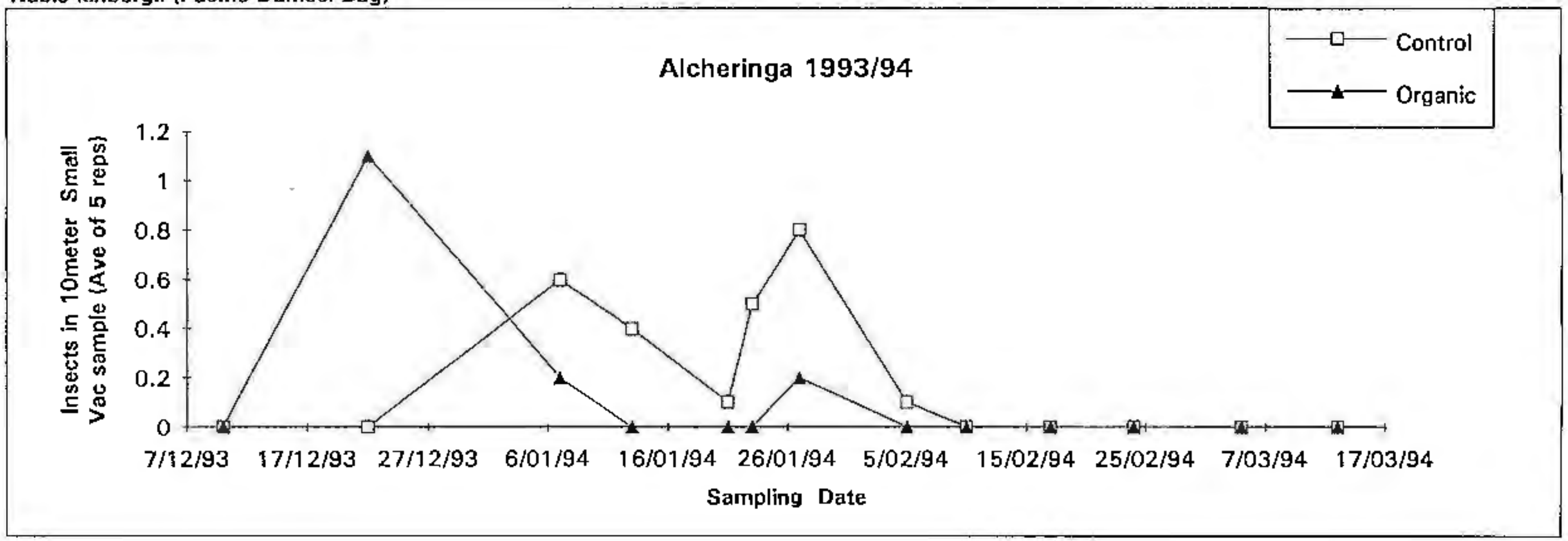
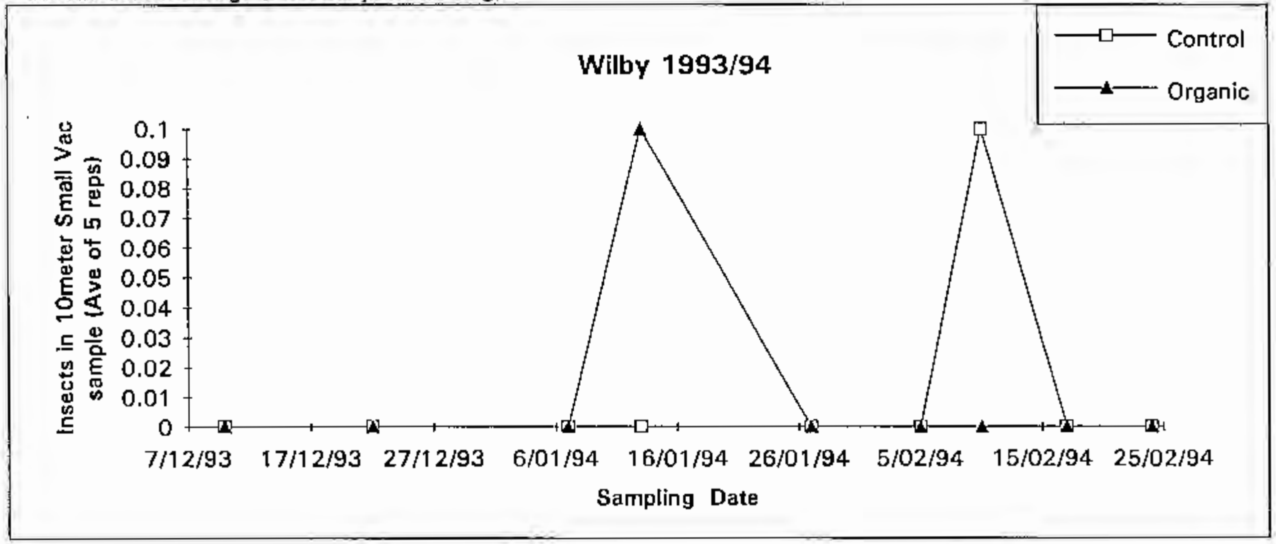


Figure 12

Wilby 1993/94 Small Vaccuum Samples
Oechalia schellenbergii (Predatory Shield Bug)



Alcheringa 1993/94 Small Vaccuum Samples
Oechalia schellenbergii (Predatory Shield Bug)

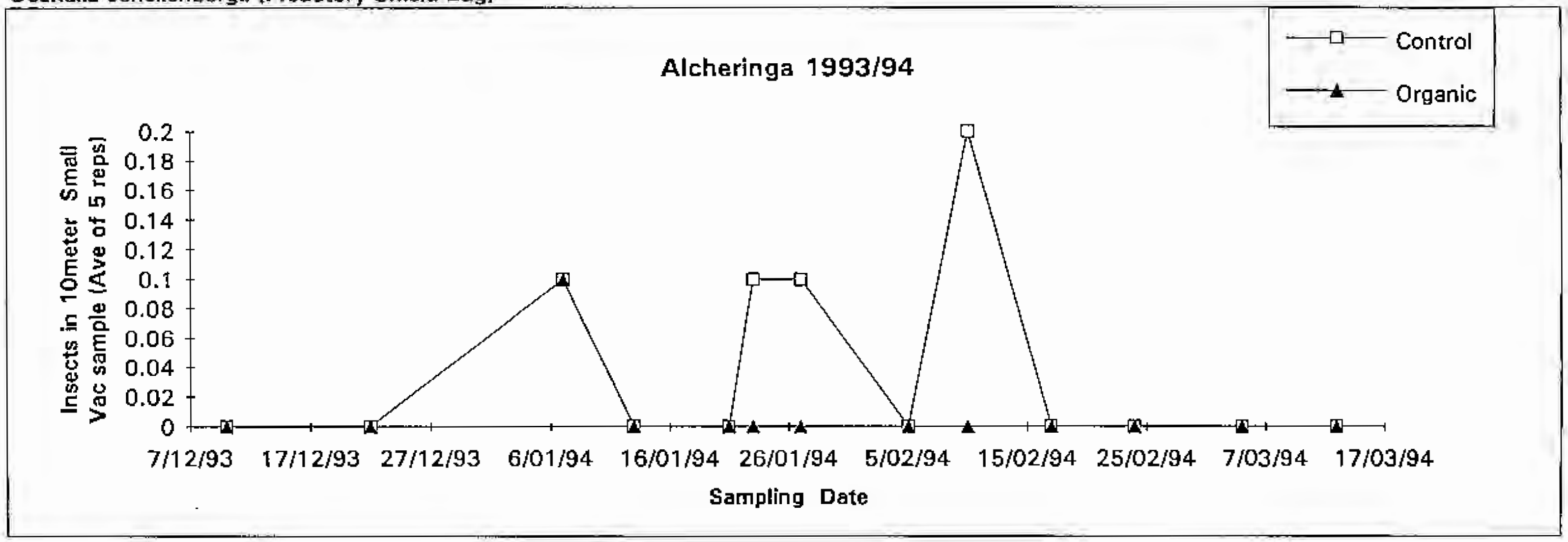
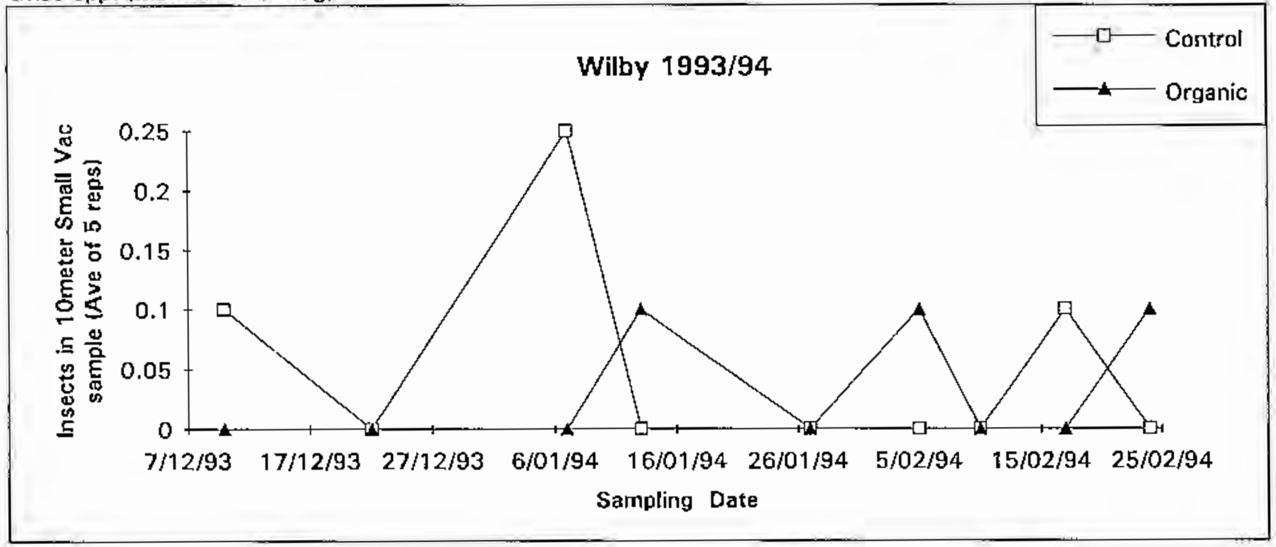


Figure 13

Wilby 1993/94 Small Vaccuum Samples
Orius spp. (Minute Pirate Bug)



Alcheringa 1993/94 Small Vaccuum Samples
Orius spp. (Minute Pirate Bug)

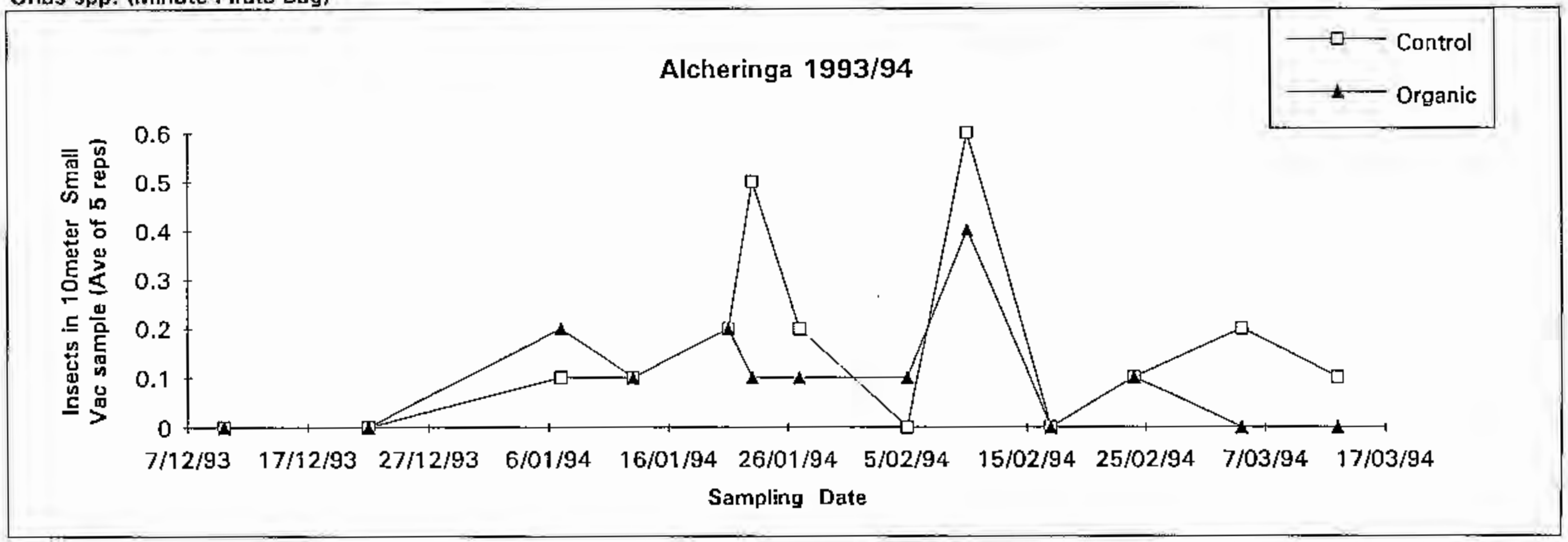
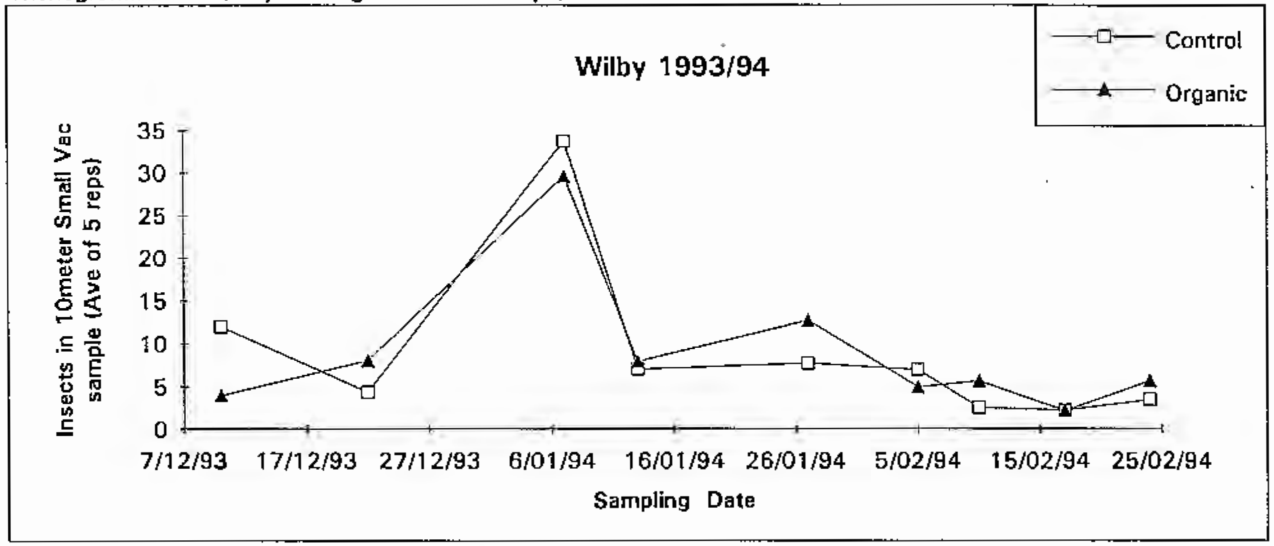
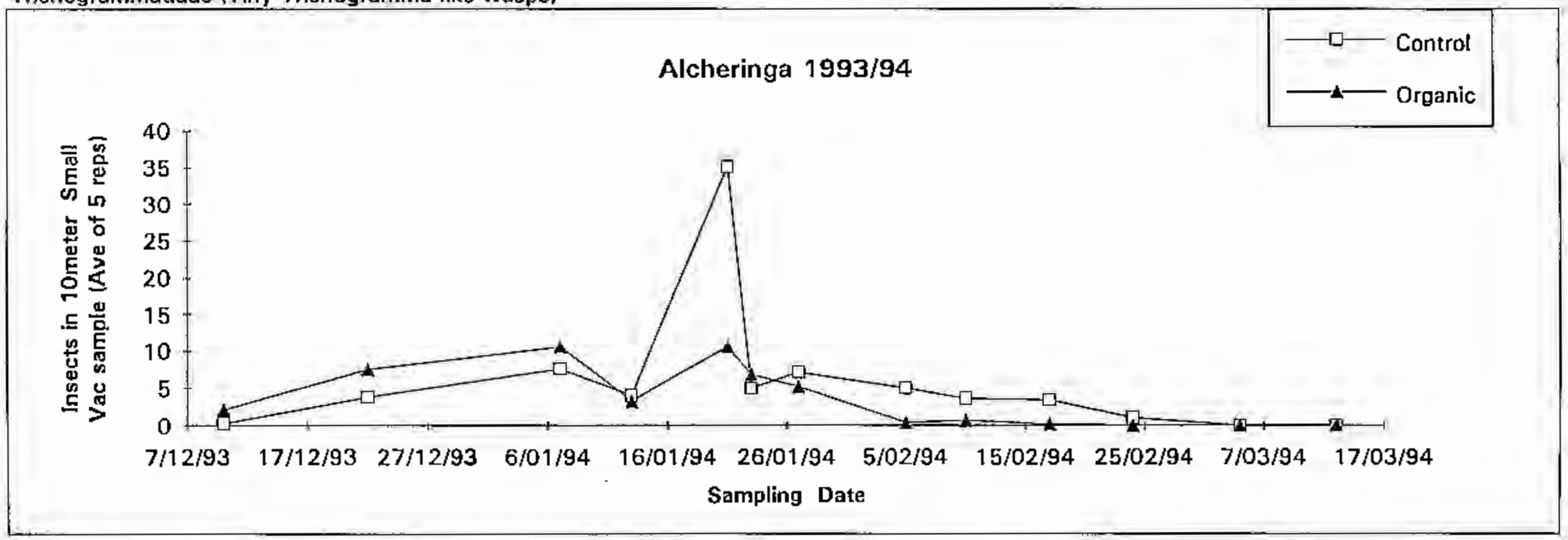


Figure 14

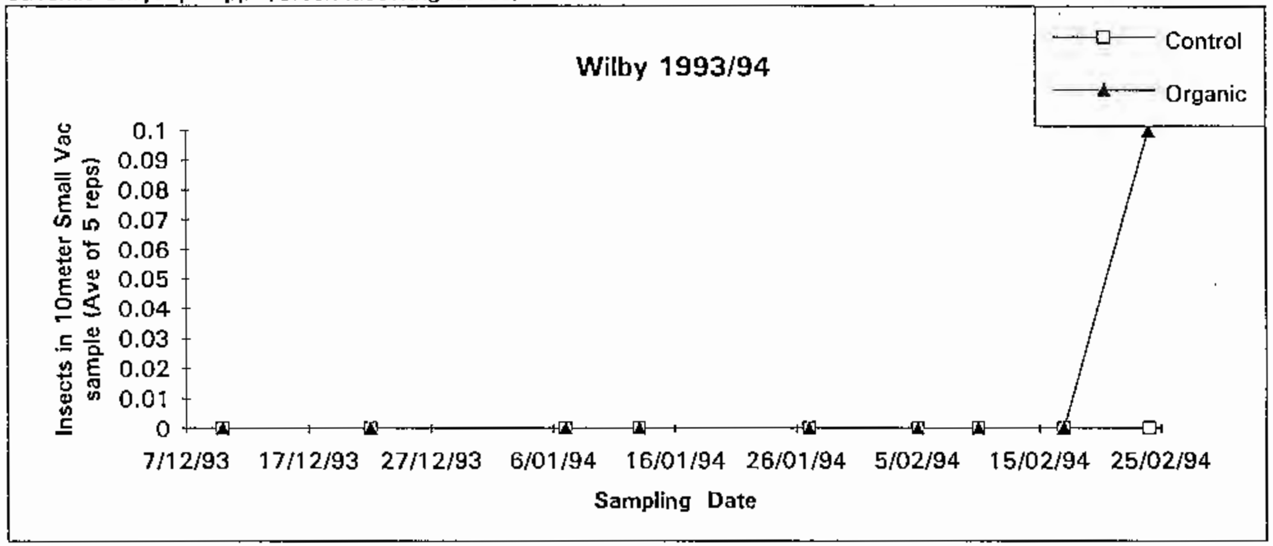
Wilby 1993/94 Small Vaccuum Samples
Trichogrammatidae (Tiny Trichogramma-like wasps)



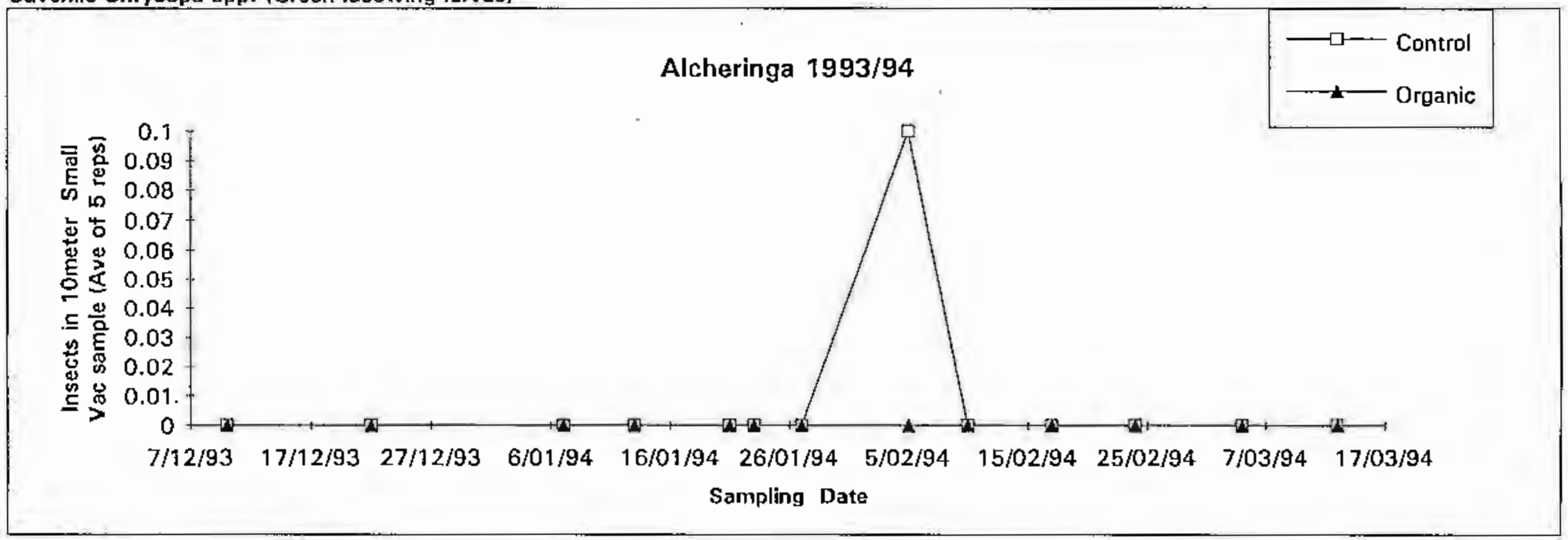
Alcheringa 1993/94 Small Vaccuum Samples
Trichogrammatidae (Tiny Trichogramma-like wasps)



Wilby 1993/94 Small Vaccuum Samples
Juvenile Chrysopa spp. (Green lacewing larvae)

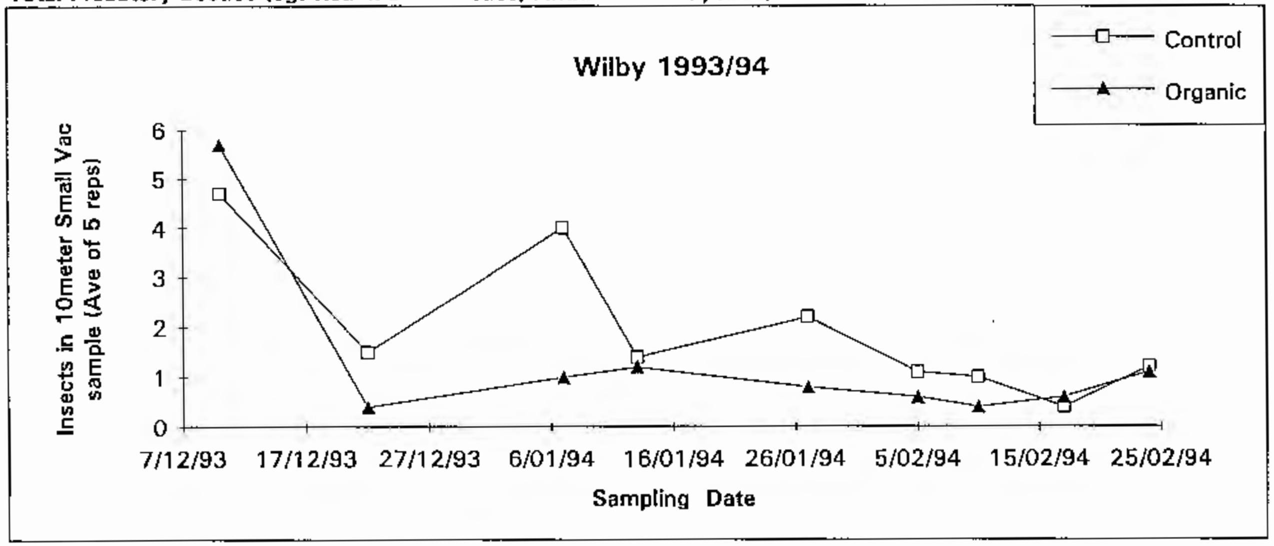


Alcheringa 1993/94 Small Vaccuum Samples
Juvenile Chrysopa spp. (Green lacewing larvae)



Wilby 1993/94 Small Vaccuum Samples
Total Predatory Beetles (eg. Red & Blue Beetles, Anthicus & Ladybirds)

Figure 16



Alcheringa 1993/94 Small Vaccuum Samples
Total Predatory Beetles (eg. Red & Blue Beetles, Anthicus & Ladybirds)

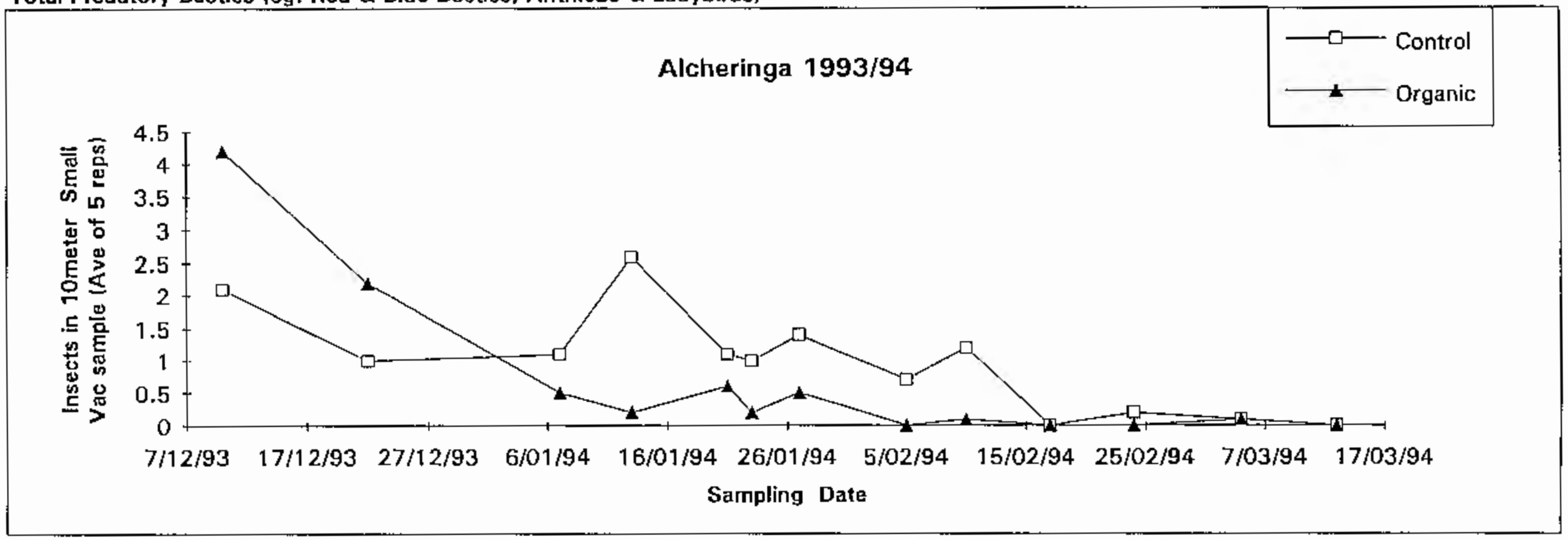
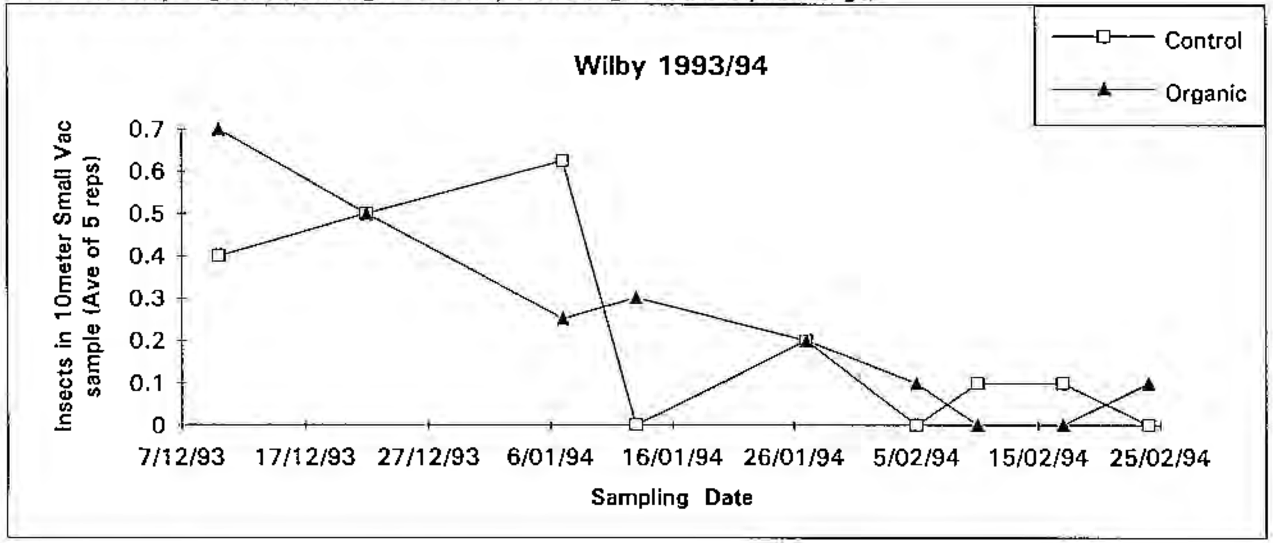


Figure 17

Wilby 1993/94 Small Vaccuum Samples
Total Predatory Bugs (Damsel bugs, Predatory shield bugs & Minute pirate bugs)



Alcheringa 1993/94 Small Vaccuum Samples
Total Predatory Bugs (Damsel bugs, Predatory shield bugs & Minute pirate bugs)

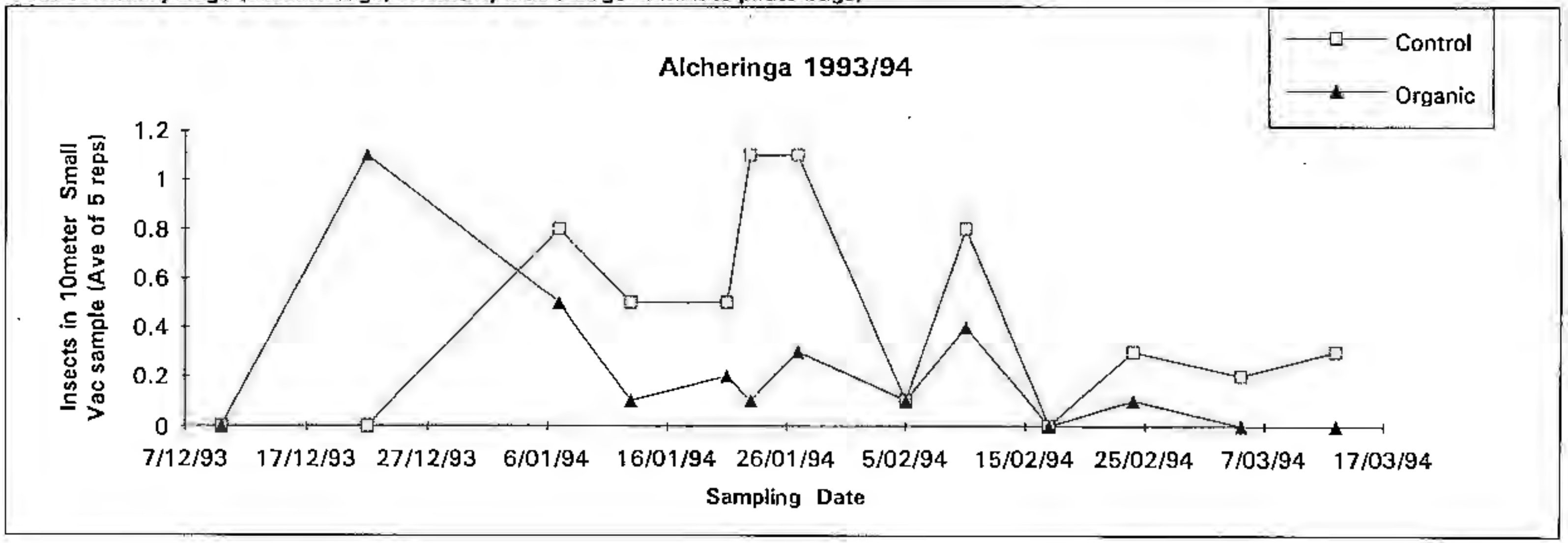
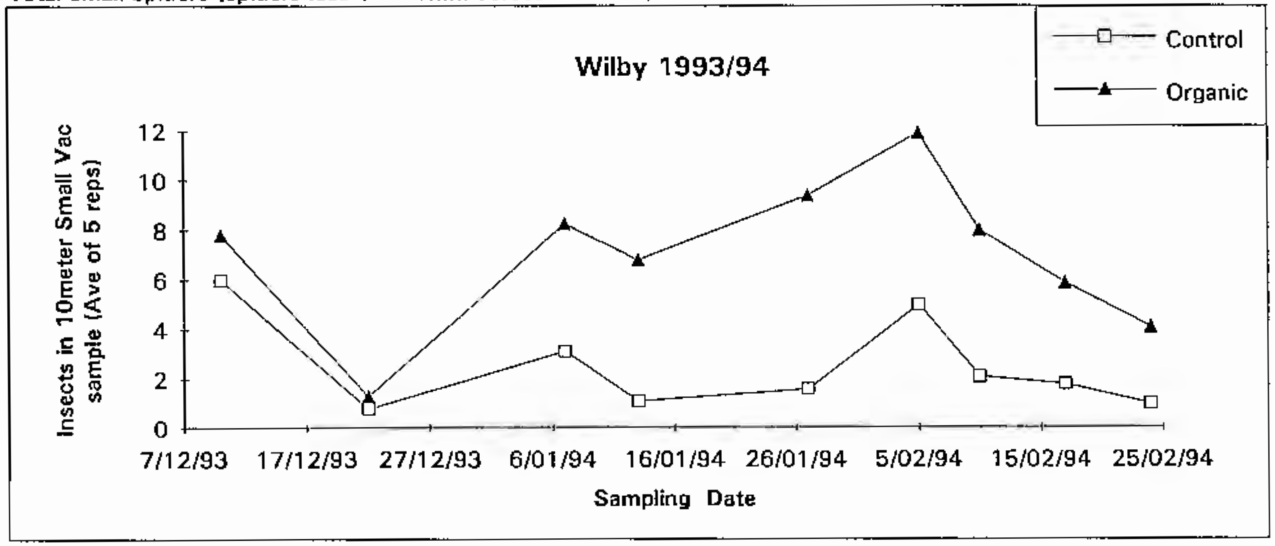


Figure 18

Wilby 1993/94 Small Vaccuum Samples
Total small spiders (spiders less than 1mm across the head)



Alcheringa 1993/94 Small Vaccuum Samples
Total small spiders (spiders less than 1mm across the head)

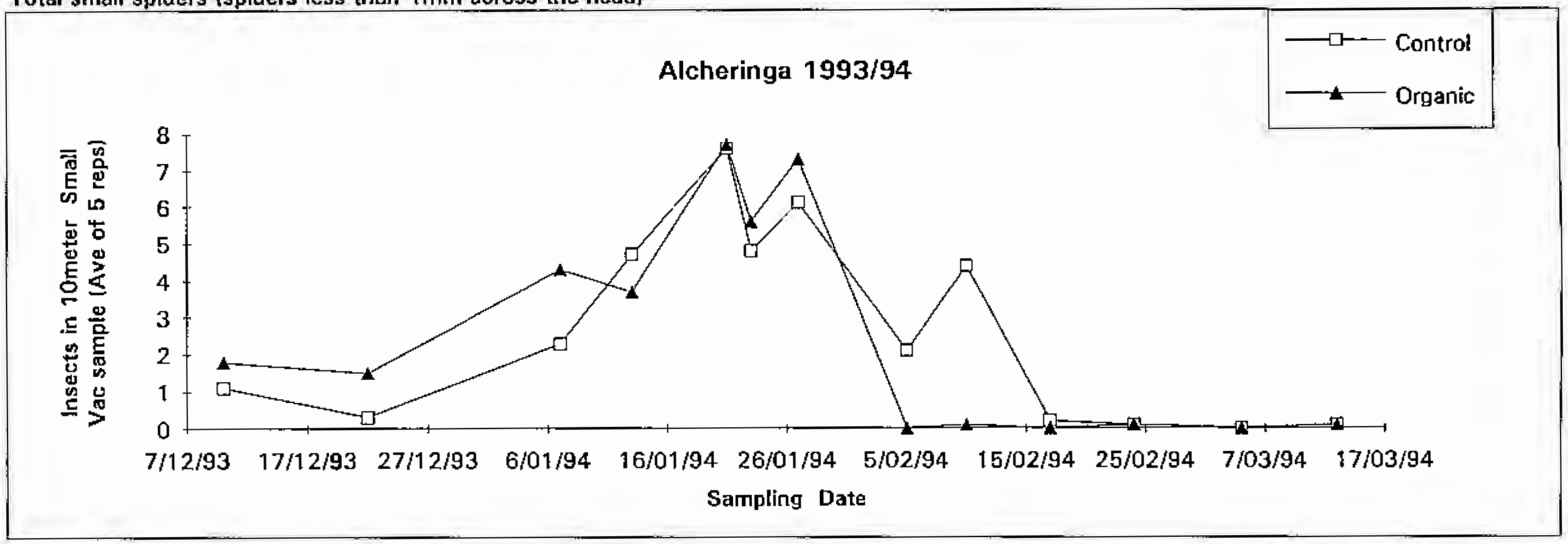
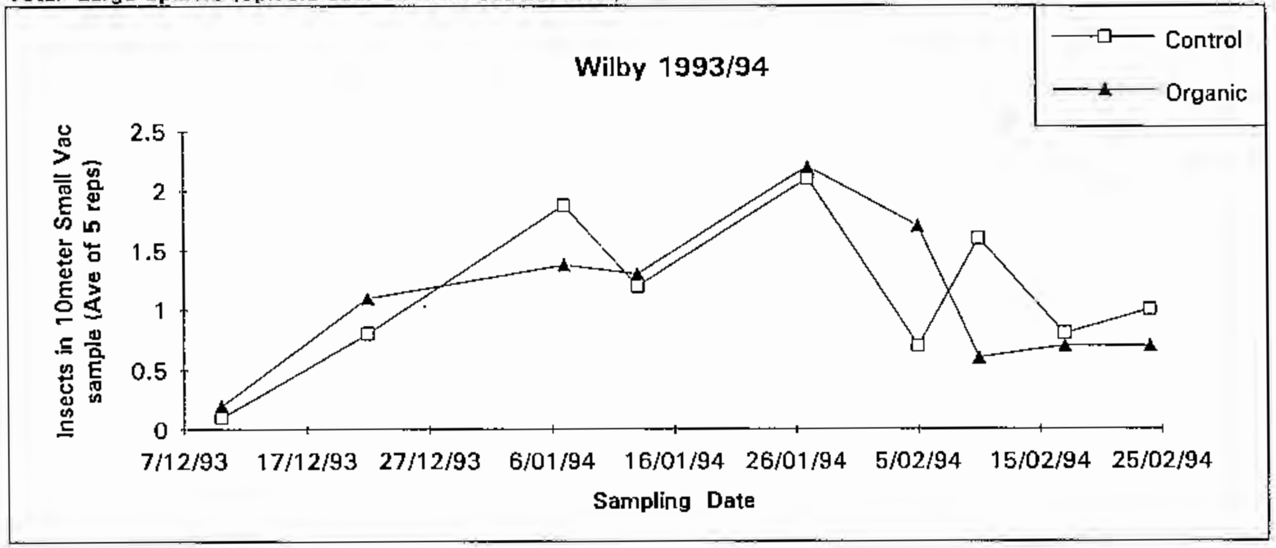
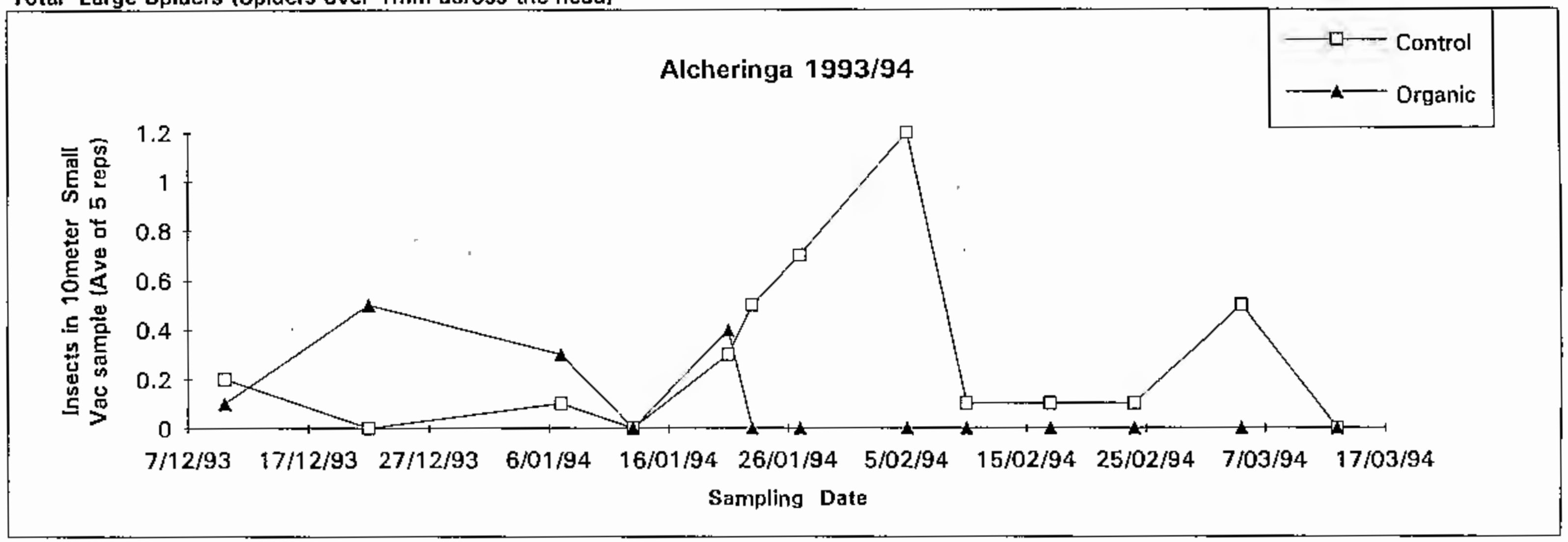


Figure 19

Wilby 1993/94 Small Vaccuum Samples
Total Large Spiders (Spiders over 1mm across the head)



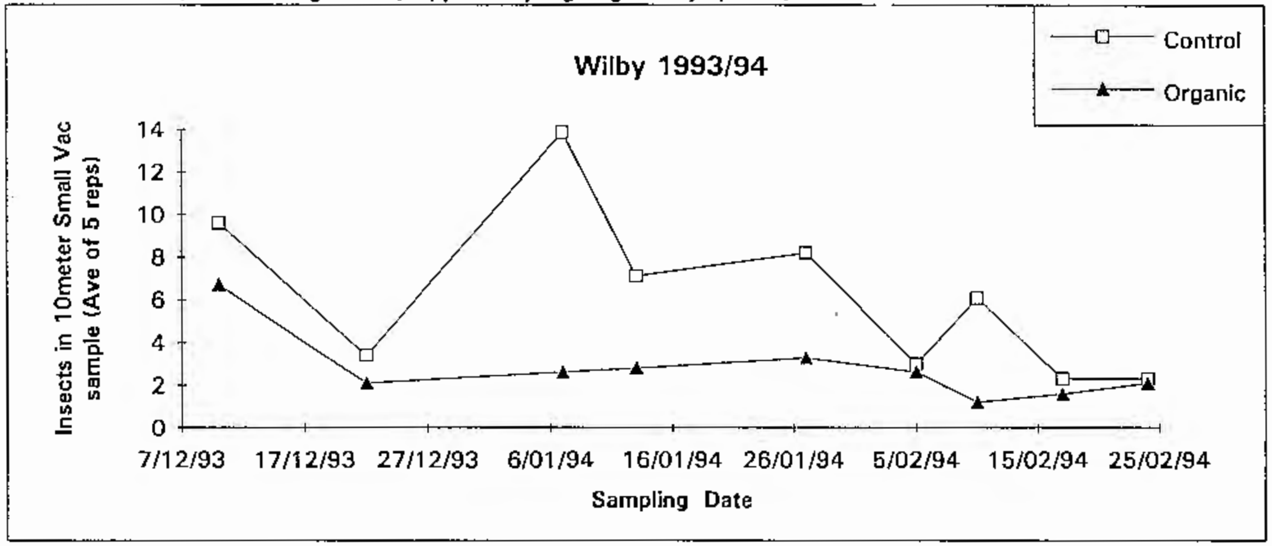
Alcheringa 1993/94 Small Vaccuum Samples
Total Large Spiders (Spiders over 1mm across the head)



Wilby 1993/94 Small Vaccuum Samples

Figure 20

Total Predators (not counting Mirids, Apple Dimpling bug or tiny spiders)



Alcheringa 1993/94 Small Vaccuum Samples

Total Predators (not counting Mirids, Apple Dimpling bug or tiny spiders)

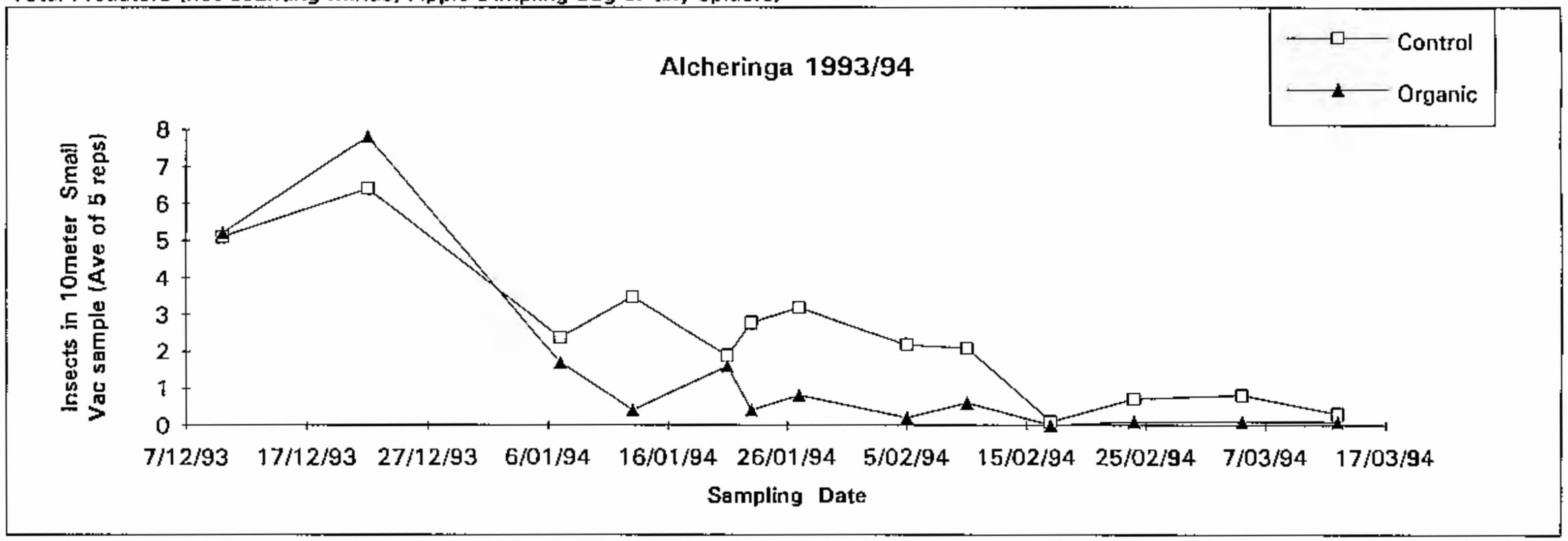
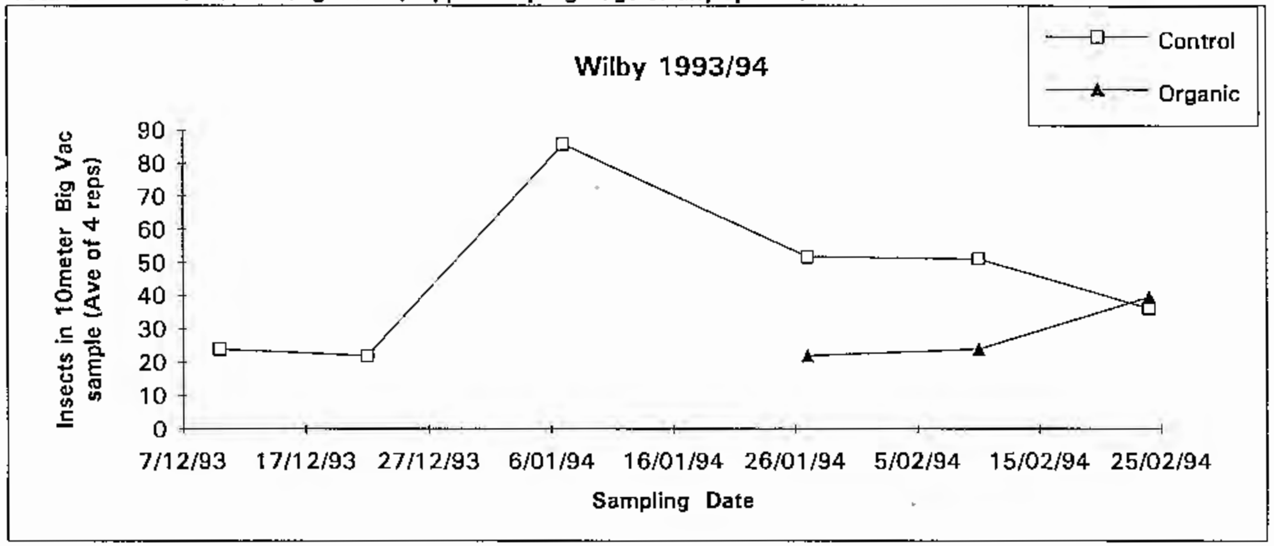


Figure 21

Wilby 1993/94 Big Vac Samples
Total Predators (not counting Mirids, Apple Dimpling Bugs or tiny spiders)



Alcheringa1993/94 Big Vac Samples
Total Predators (not counting Mirids, Apple Dimpling Bugs or tiny spiders)

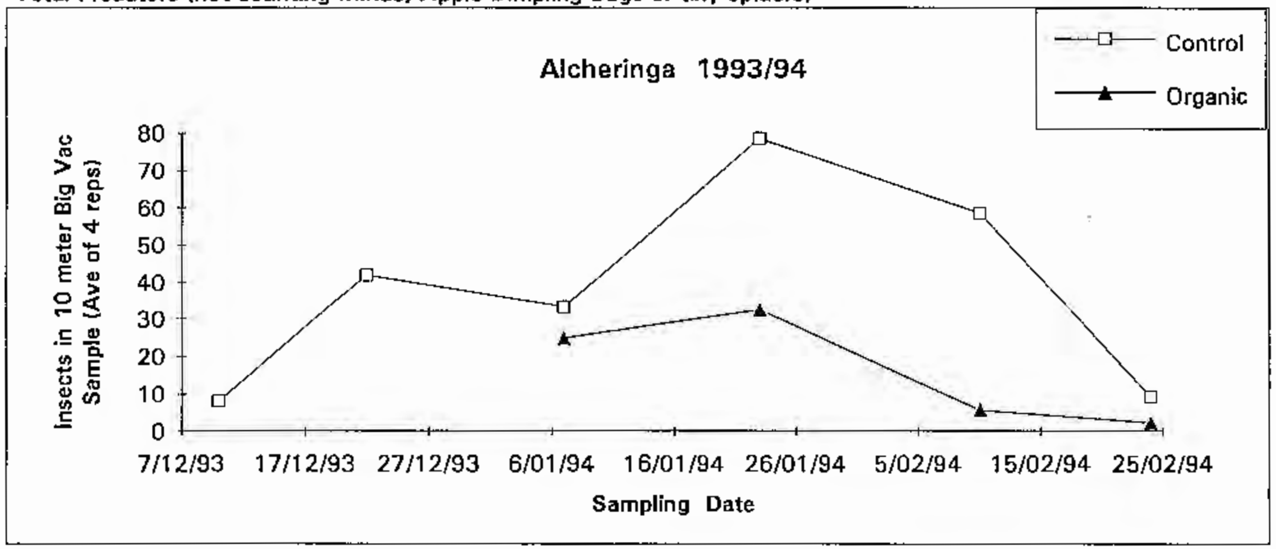
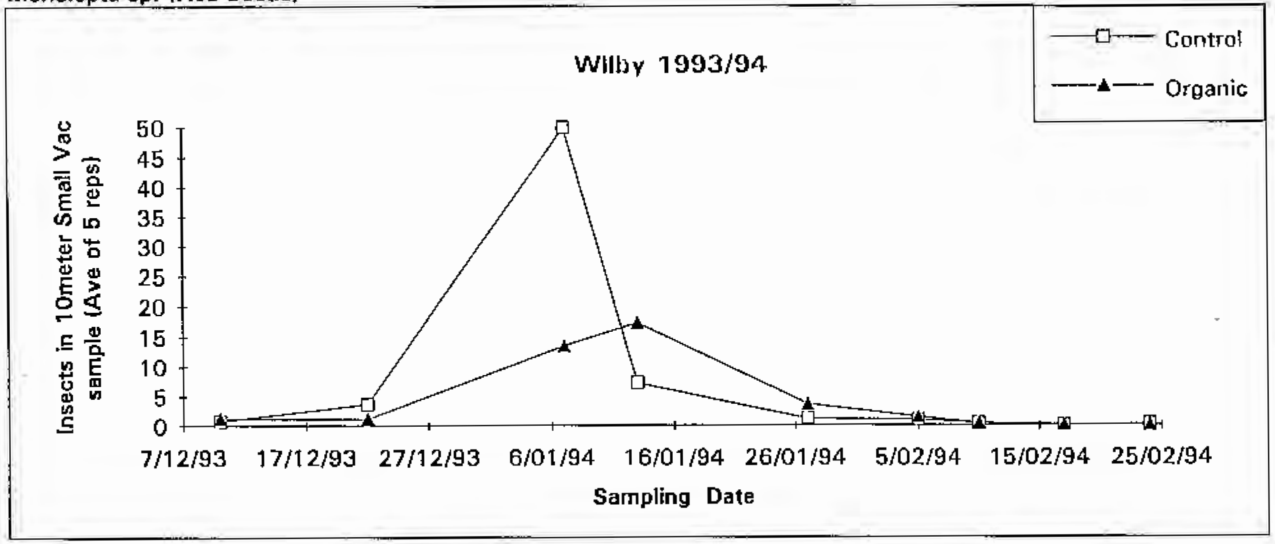


Figure 22

Wilby 1993/94 Small Vaccuum Samples
Monolepta sp. (Flea Beetle)



Alcheringa 1993/94 Small Vaccuum Samples
Monolepta sp. (Flea Beetle)

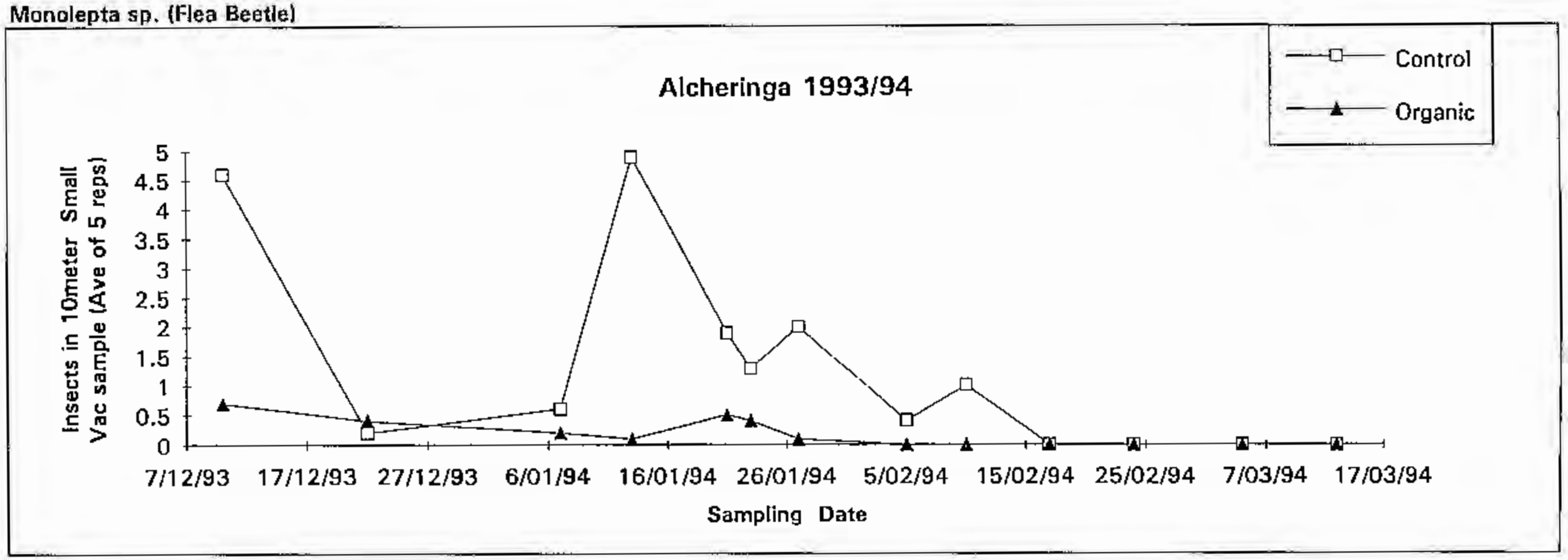
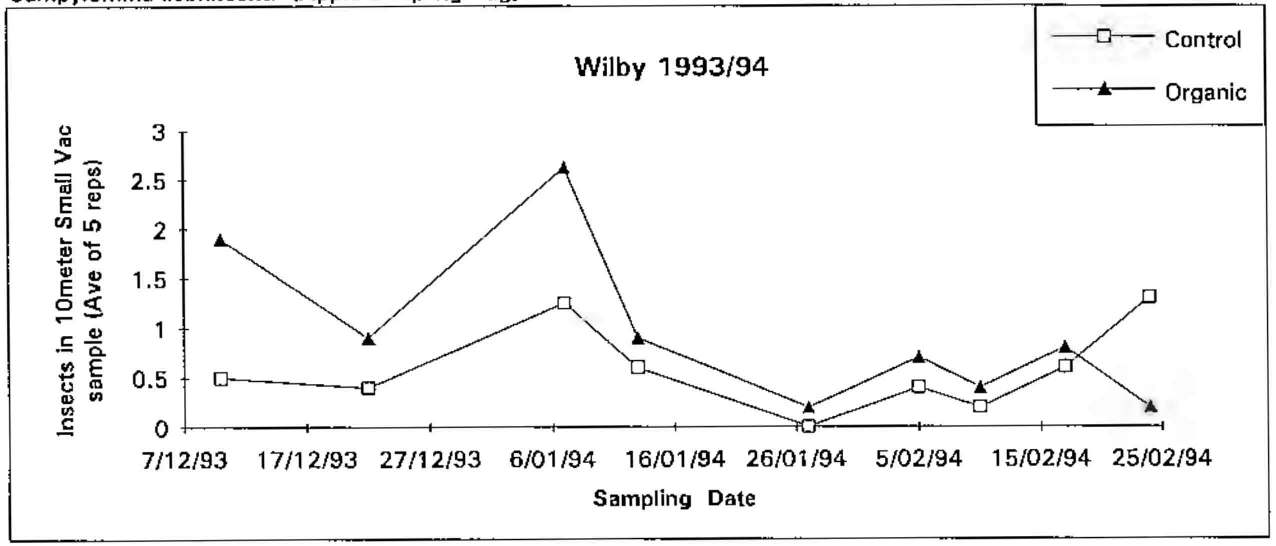


Figure 23

Wilby 1993/94 Small Vaccuum Samples
Campylomma liebknechti (Apple Dimpling Bug)



Alcheringa 1993/94 Small Vaccuum Samples
Campylomma liebknechti (Apple Dimpling Bug)

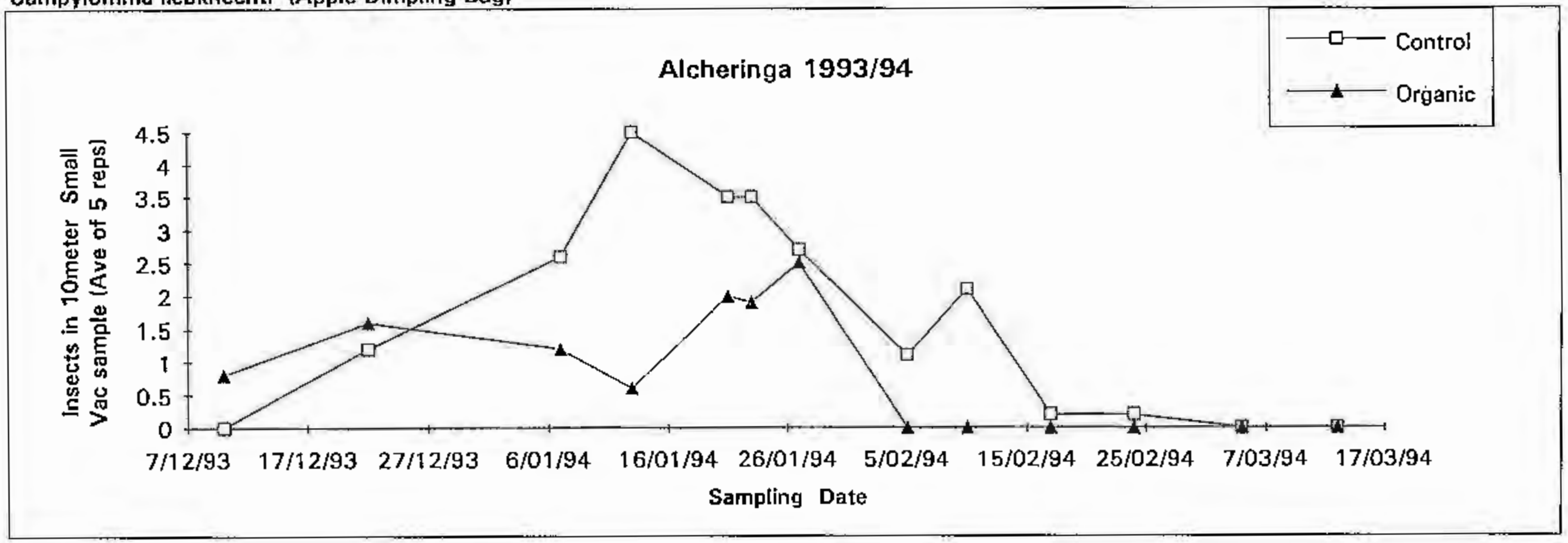
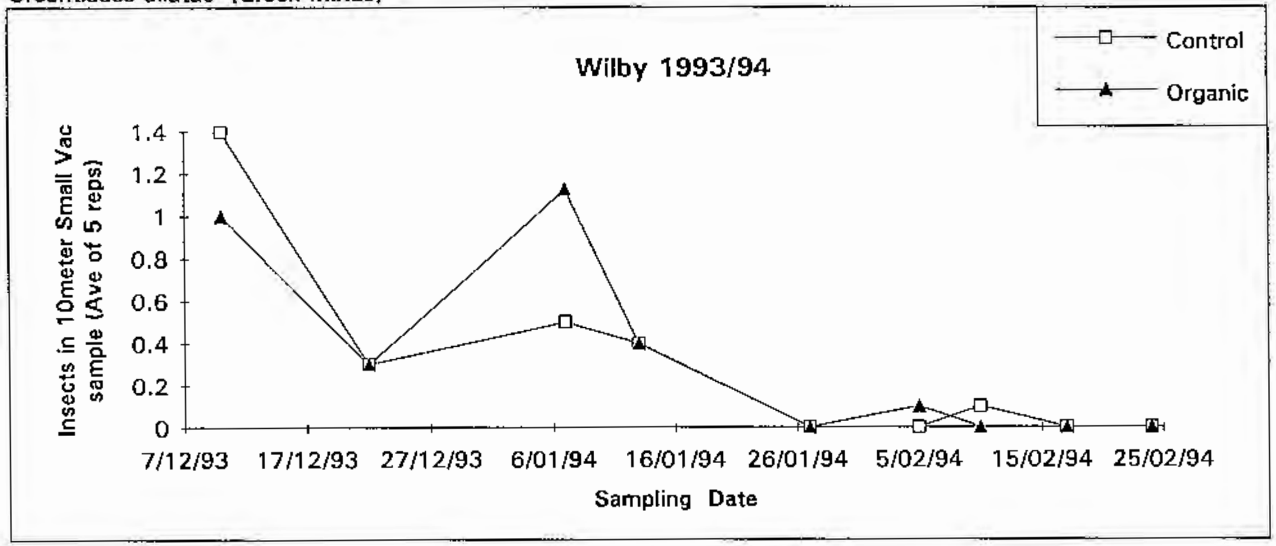


Figure 24

Wilby 1993/94 Small Vaccuum Samples
Creontiades dilutus (Green Mirids)



Alcheringa 1993/94 Small Vaccuum Samples
Creontiades dilutus (Green Mirids)

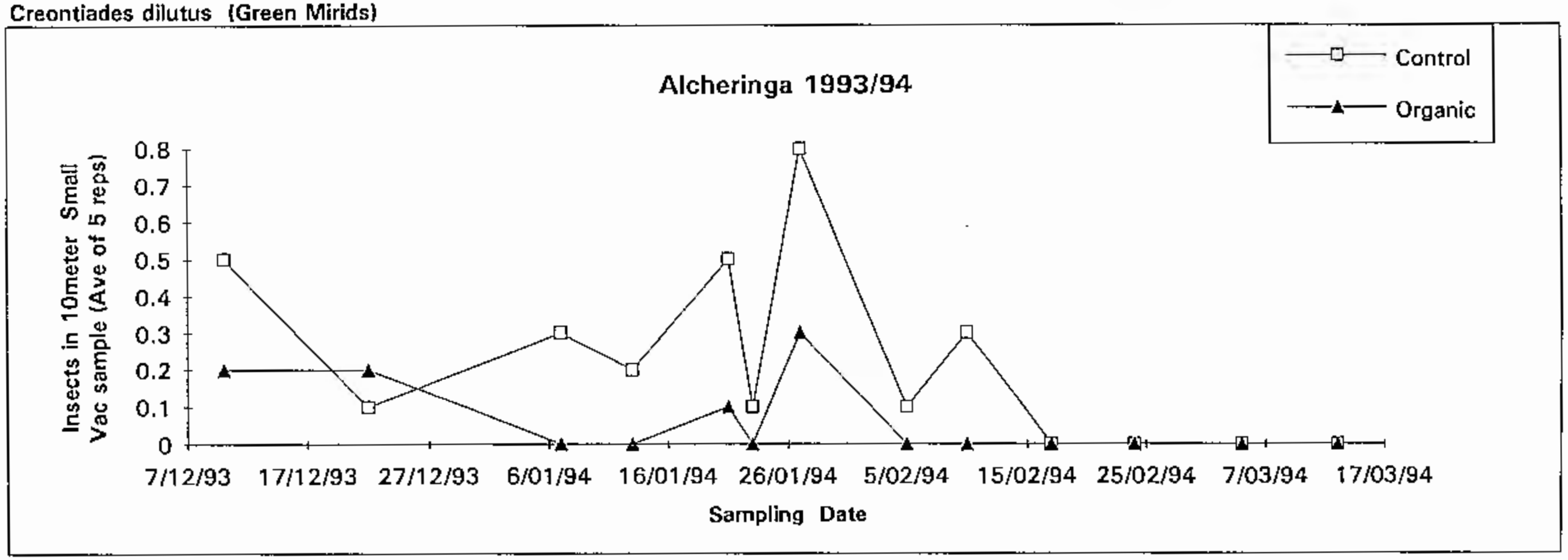
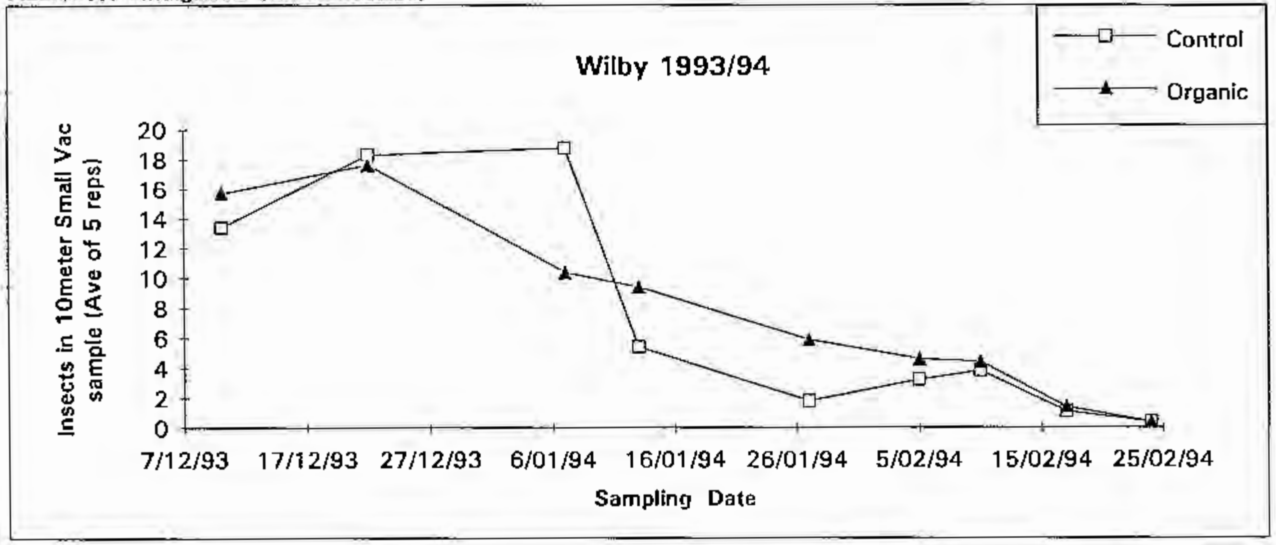


Figure 25

Wilby 1993/94 Small Vaccuum Samples
Ausroasca viridigrisea (Green Jassids)



Alcheringa 1993/94 Small Vaccuum Samples
Ausroasca viridigrisea (Green Jassids)

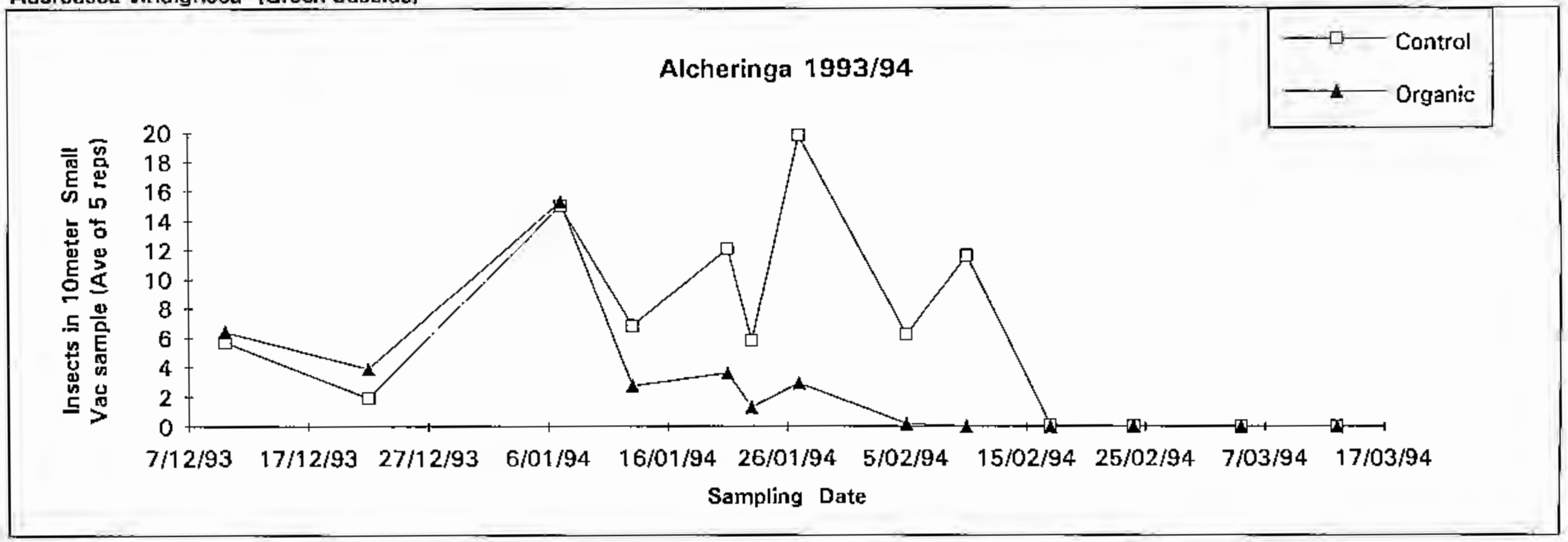
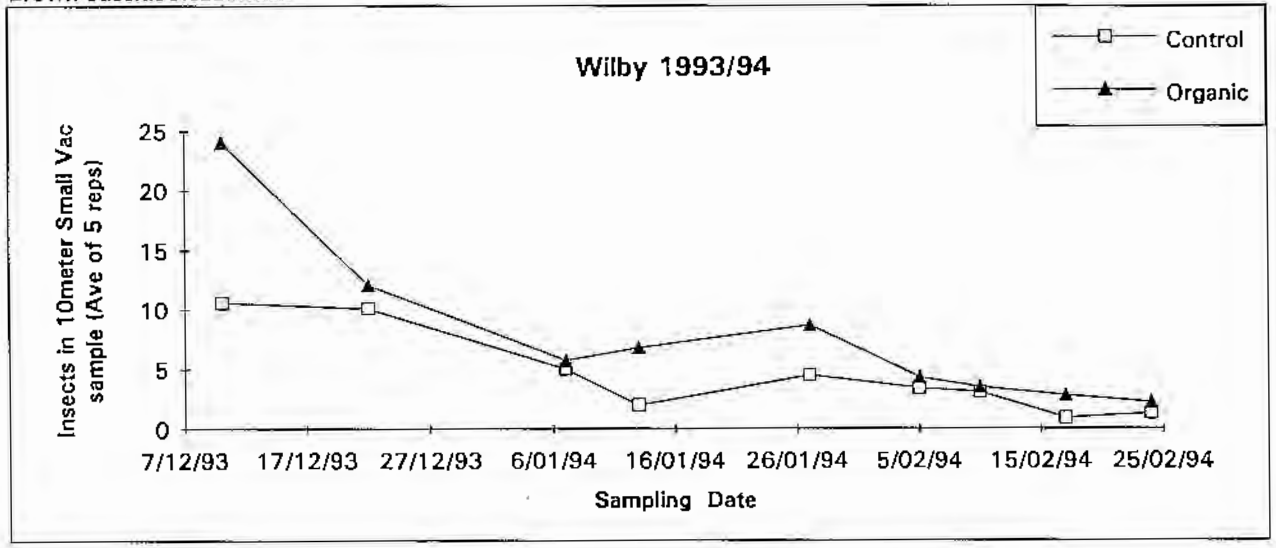


Figure 26

Wilby 1993/94 Small Vaccuum Samples
Brown JassidsCicadellidae



Alcheringa 1993/94 Small Vaccuum Samples
Brown JassidsCicadellidae

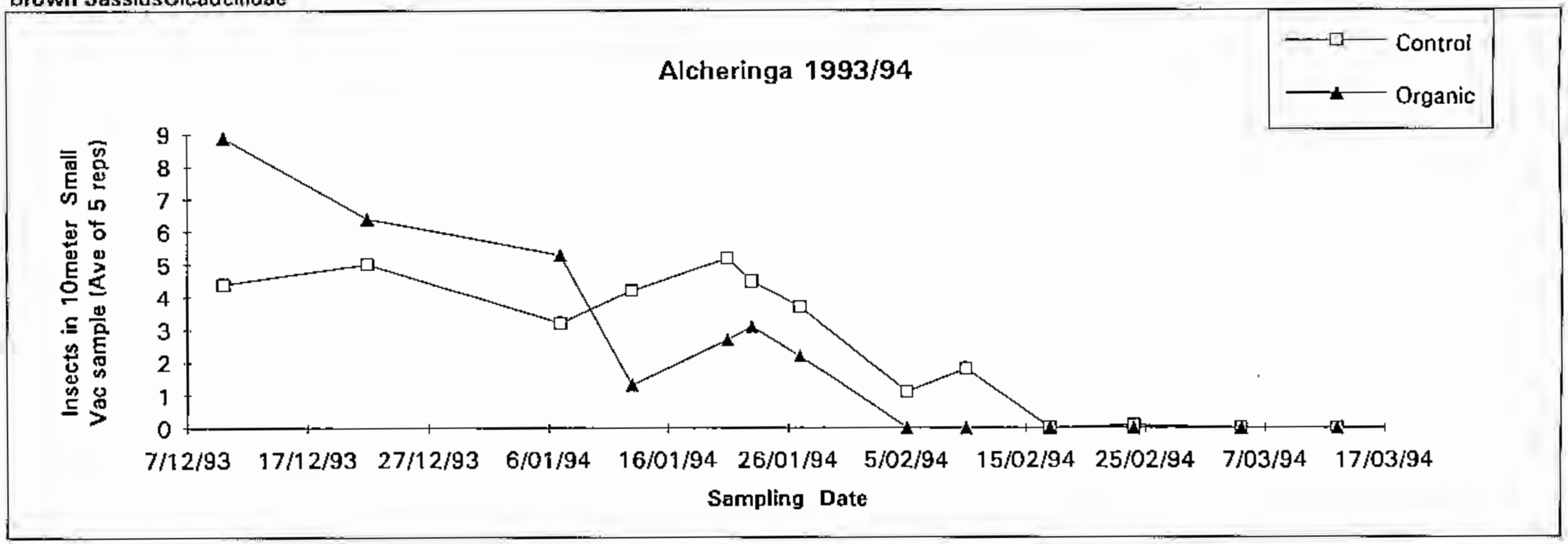
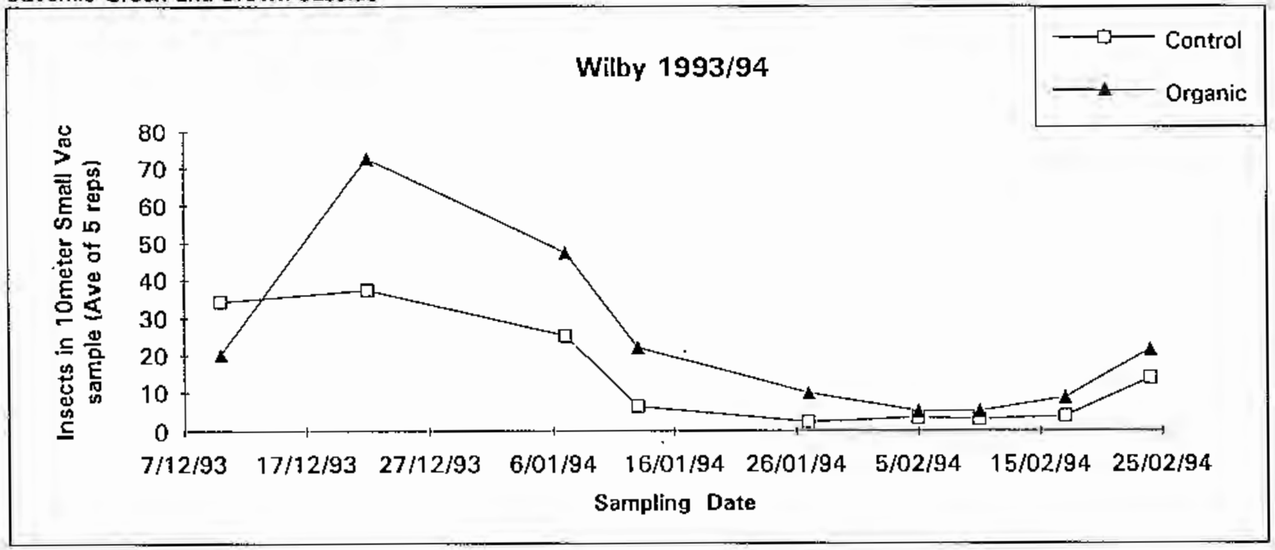


Figure 27

Wilby 1993/94 Small Vaccuum Samples
Juvenile Green and Brown Jassids



Alcheringa 1993/94 Small Vaccuum Samples
Juvenile Green and Brown Jassids

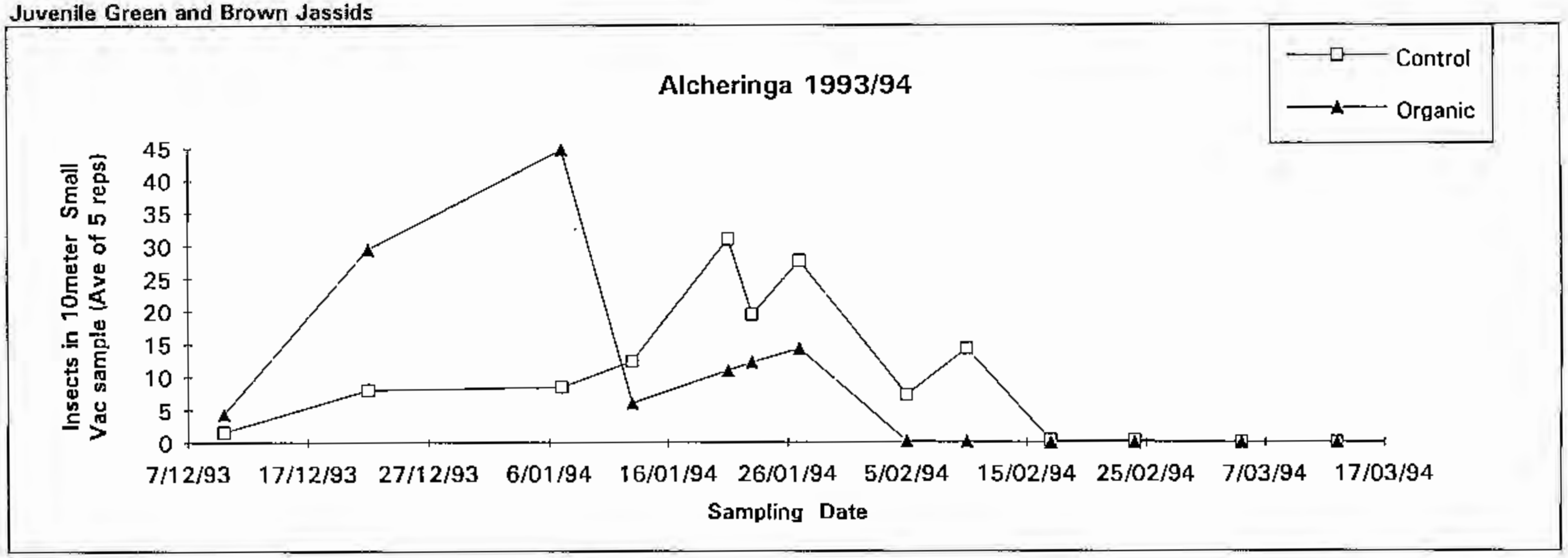
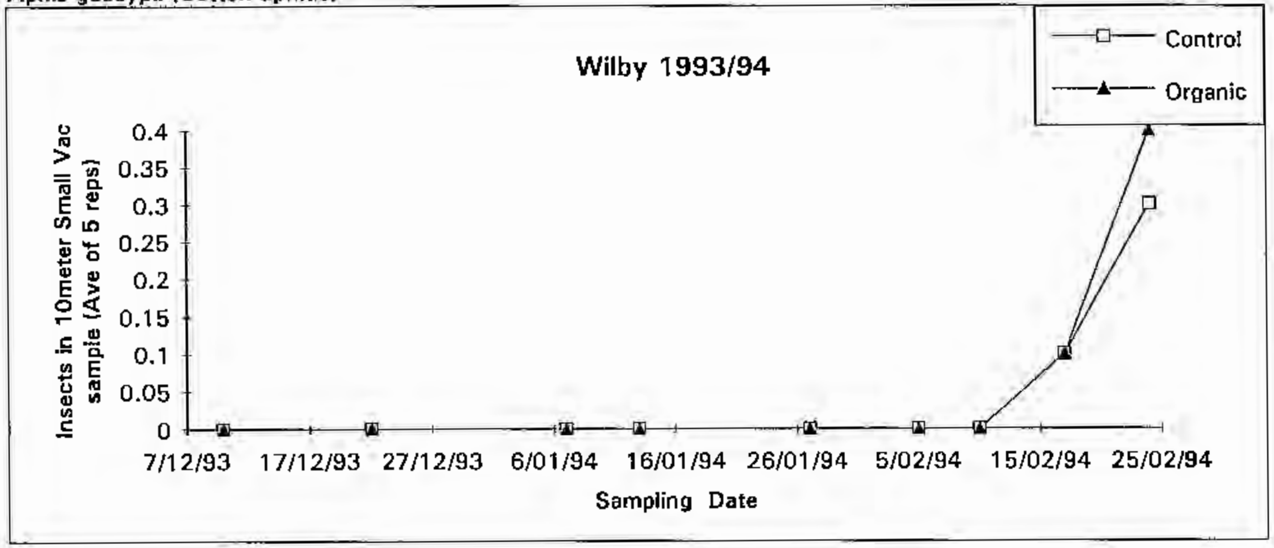


Figure 28

Wilby 1993/94 Small Vaccuum Samples
Aphis gossypii (Cotton aphids)



Alcheringa 1993/94 Small Vaccuum Samples
Aphis gossypii (Cotton aphids)

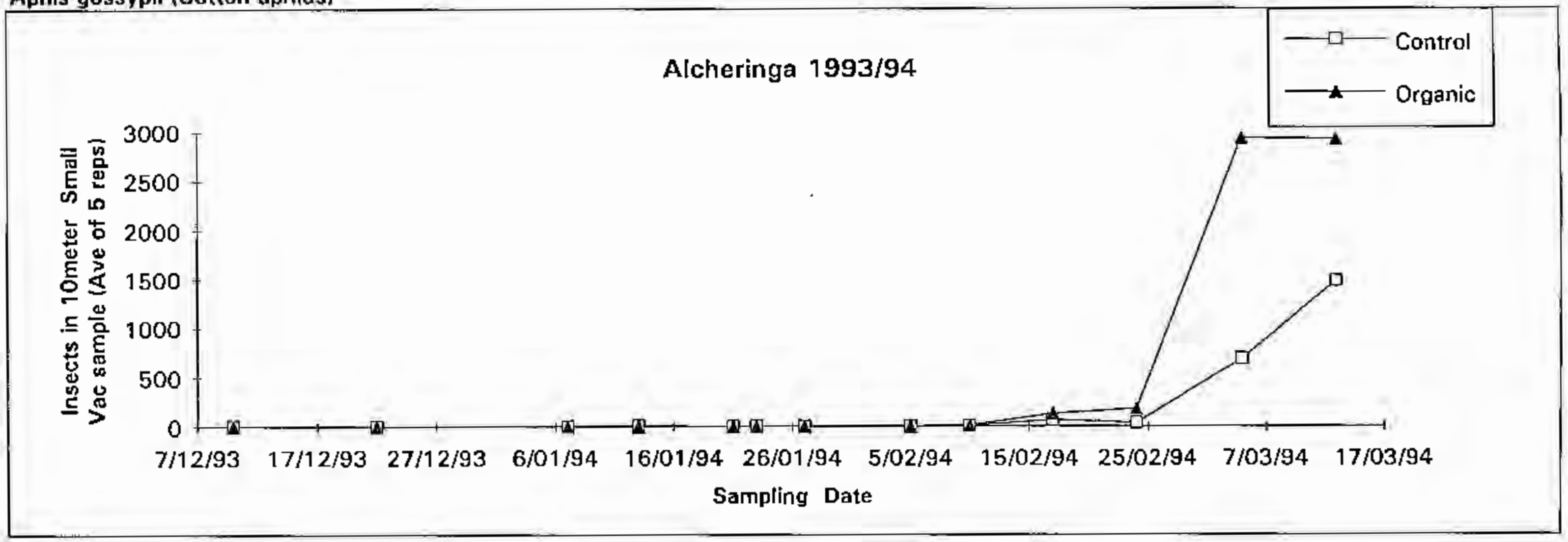
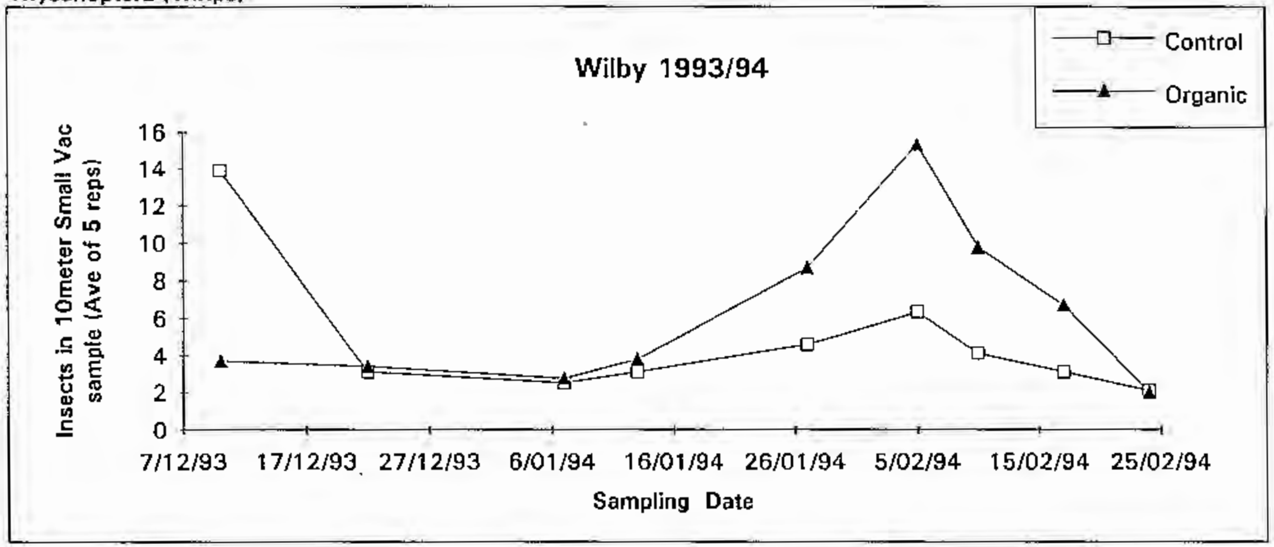


Figure 29

Wilby 1993/94 Small Vaccuum Samples
Thysanoptera (Thrips)



Alcheringa 1993/94 Small Vaccuum Samples
Thysanoptera (Thrips)

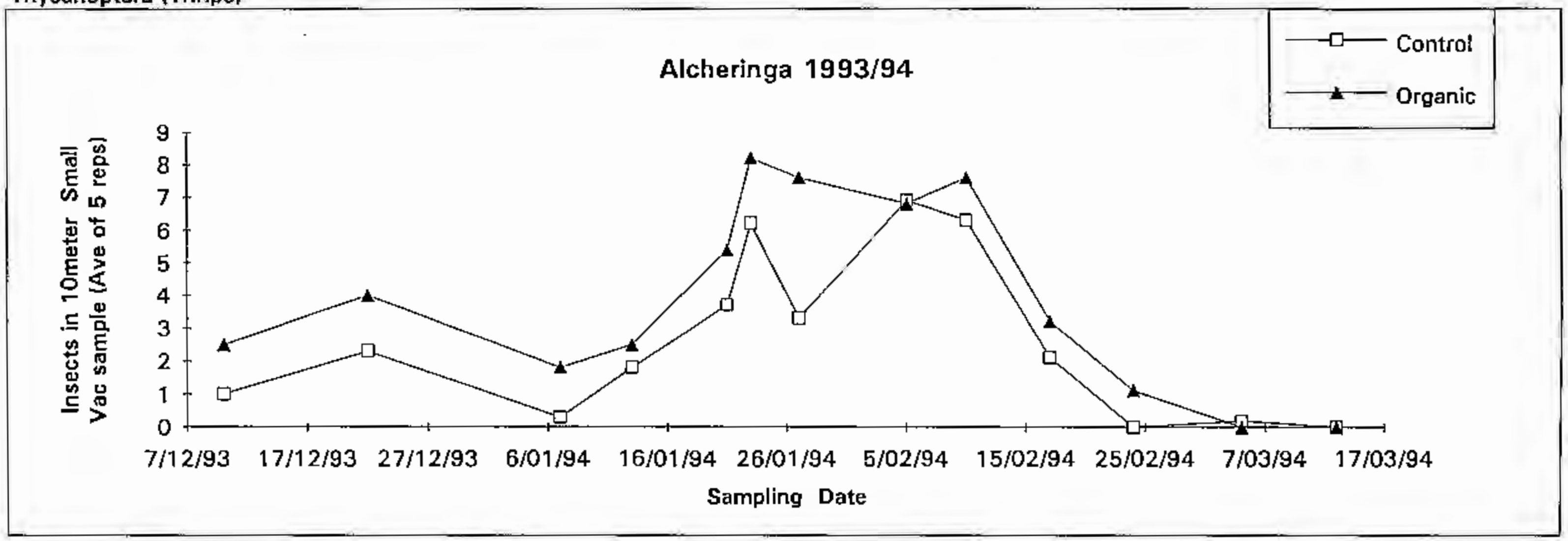
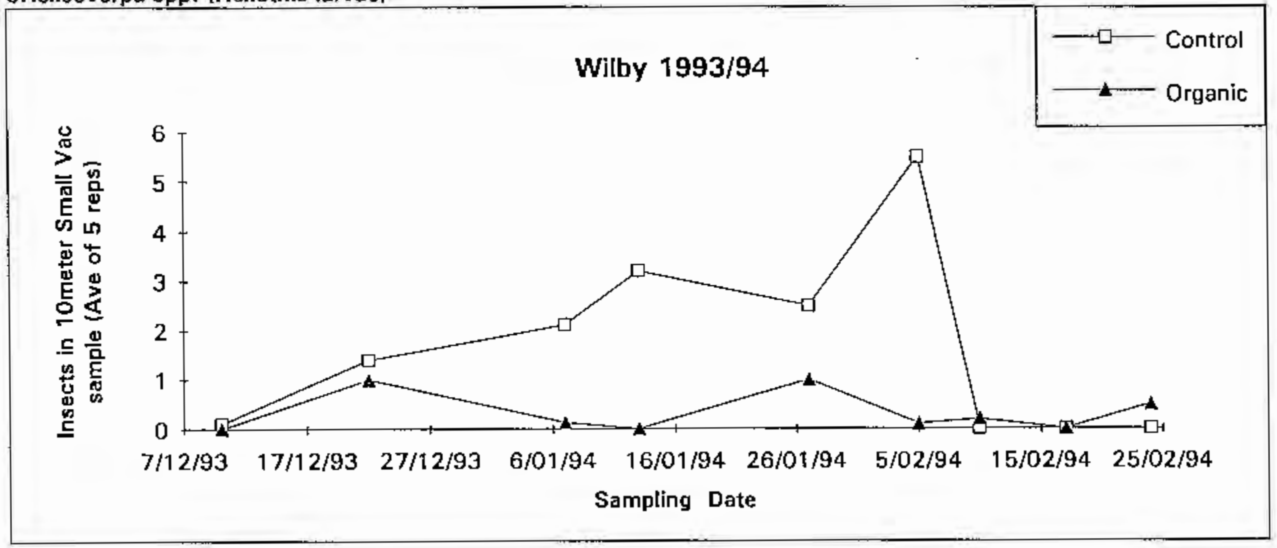


Figure 30

Wilby 1993/94 Small Vaccuum Samples
JHelicoverpa spp. (Heliothis larvae)



Alcheringa 1993/94 Small Vaccuum Samples
JHelicoverpa spp. (Heliothis larvae)