Field disinfestation trials against *Culicoides* in north-west Sardinia

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Summary

Bluetongue (BT) first affected Sardinia in August 2000, spreading rapidly across the island causing more than 6 000 outbreaks and significant economic damage. *Culicoides imicola* Kieffer (Diptera: Ceratopogonidae) was the main vector of the disease and was also found to be the most abundant *Culicoides* species on Sardinia. During 2002, a field trial was conducted to evaluate the efficacy of an insecticide on local *Culicoides* populations in north-western Sardinia. A synthetic pyrethroid derivative (Mycrocip, ICF, Cremona, Italy) was used on two farms where outbreaks of BT had been reported; a third farm was used as control. The same treatment was repeated after 15 days. For the collection of *Culicoides*, two blacklight traps were placed on each farm and operated every second day for two weeks before and after insecticide treatment. Insect collections and data analyses were performed in accordance with the protocols of the Italian National Reference Centre for Exotic Diseases (CESME: *Centro Studi Malattie Esotiche*). For each collection, the total number of insects, *Culicoides* spp. and *C. imicola* was determined. A slight decrease in the number of *Culicoides* collected on treated farms was recorded for only a few days after treatment. Mycrocip played a secondary role in suppressing insect numbers, but did not reduce the number of *Culicoides*. Indeed, periodic variations of *Culicoides* population sizes correlated with significant changes in weather conditions that prevailed, including oscillating temperatures, winds and relative humidity.

Keywords

Bluetongue – *Culicoides* – *Culicoides imicola* – Cypermethrin – Disinfestation – Italy – Sardinia.

Introduction

The appearance of bluetongue (BT) in Sardinia in August 2000 drastically reduced sheep populations and incurred extensive economic losses. *Culicoides imicola* Kieffer, the principal vector of the disease, was discovered to be abundant on the island in 2000 (3) and thus it would be of benefit if its numbers (adult and/or larval) could be reduced. The scientific literature on the insecticidal control of *Culicoides* is scarce and, furthermore, the synthetic derivatives of pyrethrum utilised to date have not given encouraging results (1, 2, 6). The micro-encapsulated pyrethroid-based product, Mycrocip, produced by ICF (Industria Chimica Fine, Cremona, Italy), is of low toxicity and is long acting. The efficacy of Mycrocip against *Culicoides* was evaluated in the field, through treatment trials conducted on two farms in the north-west of Sardinia.

Material and methods

Study sites

The sites investigated were as follows:

1) Station 1 (Olmedo): north-west Sardinia, half way between Sassari and Alghero; an area of vegetable gardens and vineyards, 60 m above sea level (asl) (Fig. 1)
2) Station 2 (Bortigiadas): north-west Sardinia, between Sassari and Tempio Pausania, an agricultural area, with several cork oak plantations, 400 m asl (Fig. 2)

   Stations 1 and 2 are family-managed sheep and cattle farms
3) Control Station (Bonassai): a livestock reproduction institute, 700-800 m from Station 1 (Fig. 3).

Figure 1
Station 1 (Olmedo)

Figure 2
Station 2 (Bortigiadas)

Figure 3
Control station (Bonassai)

Insecticidal treatment

Two treatment trials using Mycrocip were conducted at Stations 1 and 2 fifteen days apart, the first on 27 June and the second on 12 July. The composition of 100 g Mycrocip was as follows: cypermethrin (11 g), a synthetic pyrethroid that acts by contact/ingestion, displaying rapid action and having prolonged effect; esbiothrin (1 g), with rapid neurotoxic action; piperonyl butoxide (11 g), a synergist of pyrethrins; and coformulants (77 g). Mycrocip was distributed over one hectare around each station at 1% concentration at 20 atmospheric pressures using a vaporiser mounted on a vehicle (Fig. 4). Meteorological data (temperature, humidity and wind) were provided by the regional meteorological office of Sardinia (SAR: *Servizio Agrometeorologico Regionale per la Sardegna*) for Stations 1 and 3. For Station 2, the data were obtained from the nearest meteorological station located in Luras.

Figure 4
Mycrocip spraying

Stations 1 and 2 were sampled weekly from September 2000 to July 2003 (Figs 5 and 6).

Insect collection

Onderstepoort blacklight suction traps of the type described by Venter and Meiswinkel (7) were used to collect insects. Blacklight is 8-10 times more attractive for *Culicoides* than white light (8).

Collections and the analysis thereof were performed in accordance with the protocols of National Reference Centre for Exotic Diseases (CESME: *Centro Studi Malattie Esotiche*) (4). Two blacklight traps (lettered A and B) were placed on each farm; they were operated every 2 or 3 days, commencing about two weeks before, and ending about two weeks after, disinfestation. The number of total insects, total *Culicoides* and total *C. imicola* was recorded for each collection. For the analysis of results, we considered three time frames: the first from 9-14 June to 27 June, the second from 28 June to 12 July and the third from 13 to 29-30 July. The average total number of insects, *Culicoides* and *C. imicola* collected in the second and in the third periods, were compared to the average of those collected during the first period.

Results and discussion

Station 1

After the first disinfestation a reduction in total insect numbers was recorded in Trap A (–7.3%) and in Trap B (–51.7%). However, the number of *Culicoides* spp. increased by 23.1% in Trap A while a decrease of –16.7% was noted in Trap B. After the second disinfestation, total insects decreased in Trap A (–38.5%) and B (–42.9%), while *Culicoides* increased in Trap A (1.5%) and B (0.2%) (Figs 7 and 8). In addition, *C. imicola* gradually increased from 21.5% to 34.8% in Trap A and from 48 to 629% in Trap B in the second and third periods, respectively (Table I).

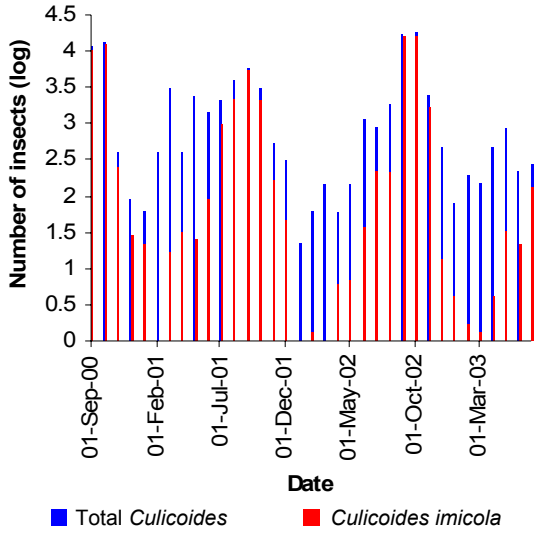

Figure 5
Station 1 (Olmedo): Seasonal abundance of insects (September 2000-July 2003)

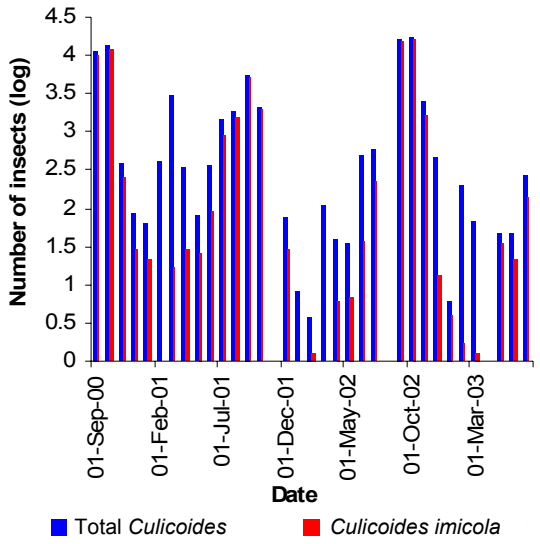

Figure 6
Station 2 (Bortigiadas): Seasonal abundance of insects (September 2000-July 2003)

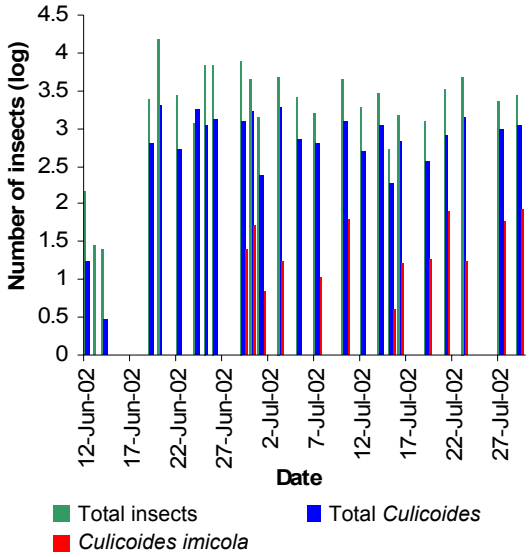

Figure 7
Station 1 (Olmedo): Trap A

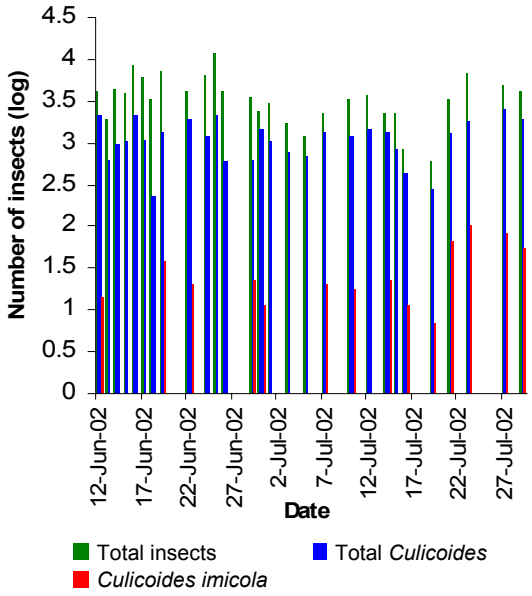

Figure 8
Station 1 (Olmedo): Trap B

Table I
Station 1: Traps A and B

Trap	Period	Total insects	Mean	Δ	Total *Culicoides*	Mean	Δ	*C. imicola*	Mean	Δ
A	First	35 080	3 897.8	–	7 452	828.0	–	0	0.0	–
	Second	28 919	3 614.9	–7.3%	8 155	1 019.4	23.1%	172	21.5	21.5%
	Third	19 190	2 398.8	–38.5%	6 724	840.5	1.5%	278	34.8	34.8%
B	First	65 525	5 460.4	–	15 514	1 292.8	–	69	5.8	–
	Second	21 111	2 638.9	–15.7%	8 621	1 077.6	–16.7%	69	8.6	48.3%
	Third	24 960	3 120.0	–42.9%	10 358	1 294.8	0.2%	338	42.3	629.3%

Station 2

After the first disinfestation, an increase in total insect numbers was found in Trap A (11.5%) and a reduction in Trap B (–22.3%). *Culicoides* increased by 37.7% and 18.9% in the two traps, respectively. After the second disinfestation, total insect numbers increased in Trap A (10.0%) but were reduced in Trap B (–30.3%); *Culicoides* increased by 185.0% and 161.7%, respectively (Figs 9 and 10). *Culicoides imicola* sharply increased in numbers from 301.5% to 1 098.8% in Trap A and from 89.0% to 1 194.7% in Trap B, in the second and third periods, respectively (Table II).

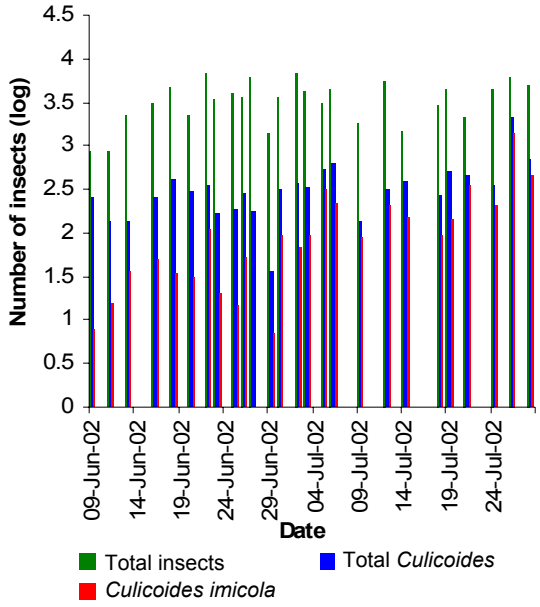

Figure 9
Station 2 (Bortigiadas): Trap A

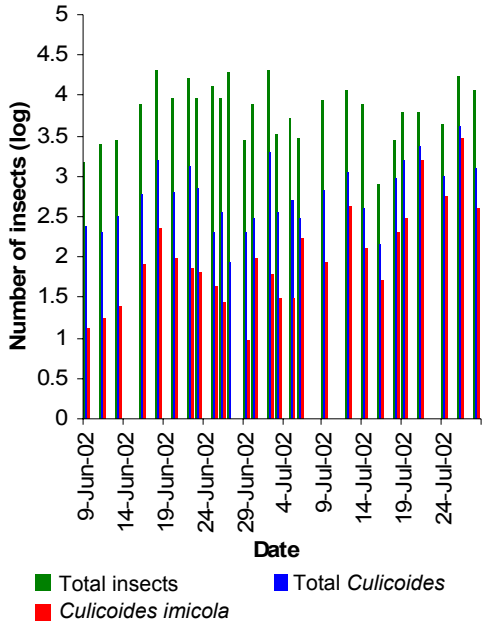

Figure 10
Station 2 (Bortigiadas): Trap B

Control station

Total insect numbers in Trap A decreased by 26.1% in the second period, but increased by 4.5% in the third period. *Culicoides* increased from 78.4% to 166.7% and *C. imicola* from 143.5% to 517.4% in the two periods, respectively (Figs 11 and 12). Total insect numbers in Trap B decreased by 50.9% in the second period and by 73.1% in the third period, whereas both *Culicoides* and *C. imicola* increased by 108% and 460%, and by 0.6% and 8.3%, in the two periods, respectively (Table III).

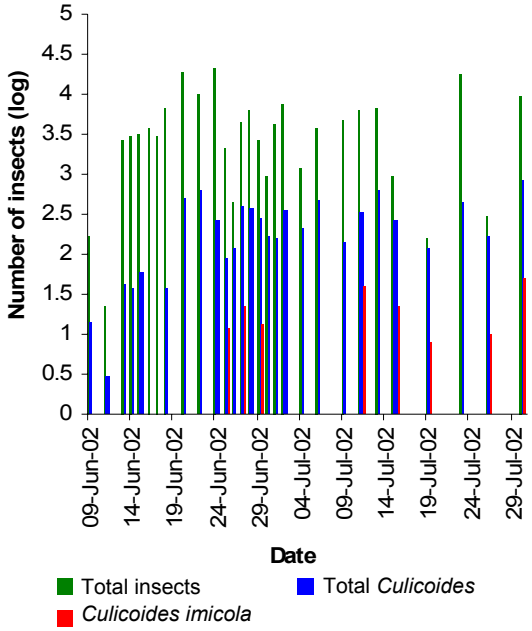

Figure 11
Control station (Bonassai): Trap A

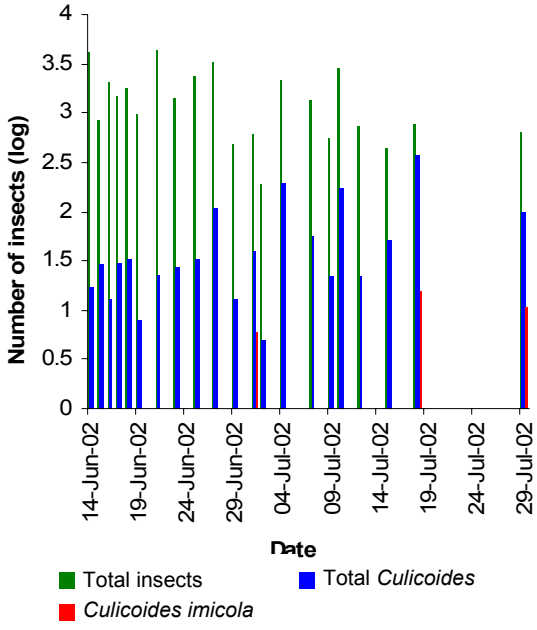

Figure 12
Control station (Bonassai): Trap B

Table II
Station 2: Traps A and B

Trap	Period	Total insects	Mean	Δ	Total *Culicoides*	Mean	Δ	*C. imicola*	Mean	Δ
A	First	38 078	3 461.6	–	2 666	242.4	–	369	33.5	–
	Second	31 046	3 880.8	11.5%	2 670	333.8	37.7%	1 076	134.5	301.5%
	Third	26 659	3 808.4	10.0%	4 836	690.9	185.0%	2 811	401.6	1 098.8%
B	First	111 044	1 0094.9	–	6 174	561.3	–	648	58.9	–
	Second	62 772	7 846.5	–22.3%	5 341	667.6	18.9%	890	111.3	89.0%
	Third	56 302	7 037.8	–30.3%	11 750	1 468.8	161.7%	6 101	762.6	1 194.7%

Table III
Station 3: Traps A and B

Trap	Period	Total insects	Mean	Δ	Total *Culicoides*	Mean	Δ	*C. imicola*	Mean	Δ
A	First	78 766	5 626.1	–	2 186	156.1	–	32	2.3	–
	Second	37 428	4 158.7	–26.1%	2 506	278.4	78.4%	50	5.6	143.5%
	Third	35 267	5 877.8	4.5%	2 498	416.3	166.7%	85	14.2	517.4%
B	First	22 606	2 260.6	–	312	31.2	–	0	0.0	–
	Second	8 873	1 109.1	–50.9%	519	64.9	108.0%	5	0.6	0.6%
	Third	1 825	608.3	–73.1%	525	175.0	460.9%	25	8.3	8.3%

No significant differences were detected when the data from Traps A and B for each station were compared, nor were differences noted when the data from the two disinfestation sites were compared against those from the control station (Fig. 13). The variation in insect and *Culicoides* numbers observed correlate with marked oscillations in local climatic conditions and so are not the result of insecticidal disinfestation (Figs 14 and 15). Generally, an increase in minimum temperatures and a decrease in windspeed corresponded to an increase in the number of insects collected; conversely, a sudden decrease in minimum temperatures, associated with an increase in windspeed, led to a decrease in the total number of insects collected. For example, at Station 1 on 5 July, the temperature dropped to 10.7°C and resulted in a marked decrease in insect numbers. At Station 2, a slackening in the windspeed

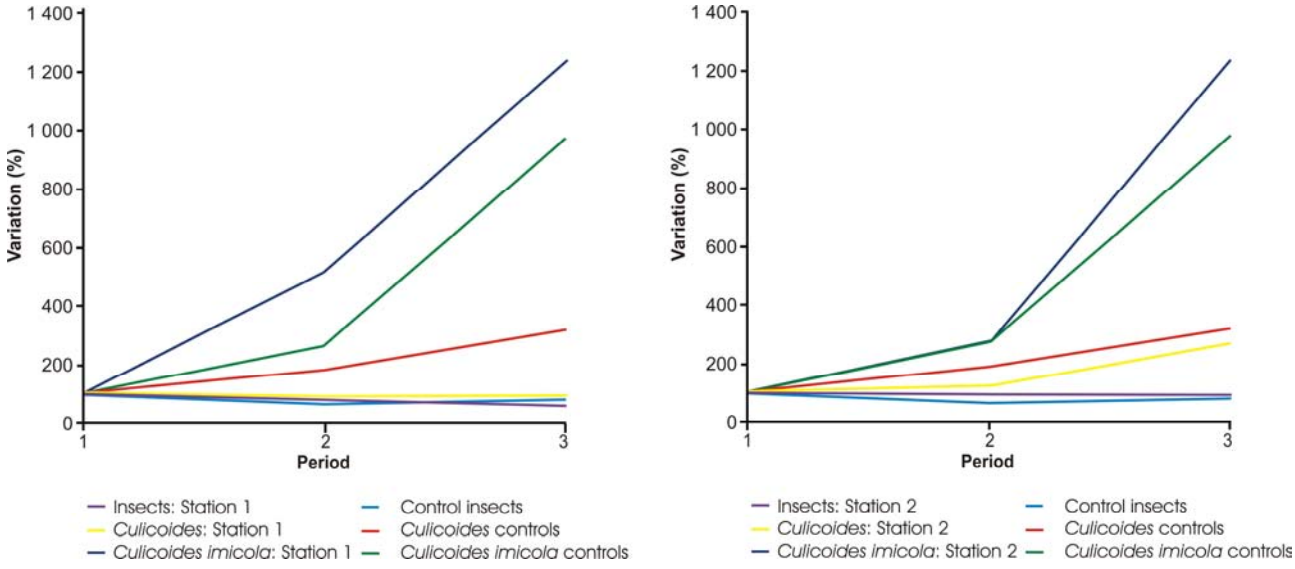

Figure 13
Variations observed at study stations 1 and 2 compared to control station for each of the three-period time-frames (1 = 9-27 June; 2 = 28 June-12 July; 3 = 13-30 July)
The mean number of midges captured per day refers to the first period assumed equal to 100%; disinfestations were applied on 27 June (period 1) and on 12 July (period 2)

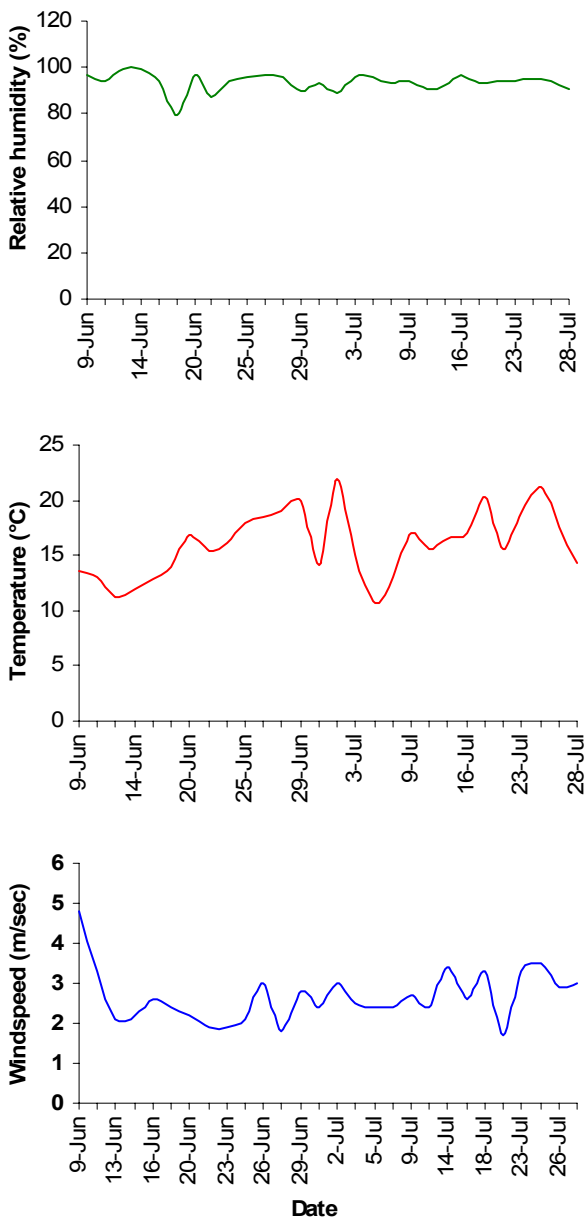

Figure 14
Station 1 (Olmedo): meteorological data collected during the field trials

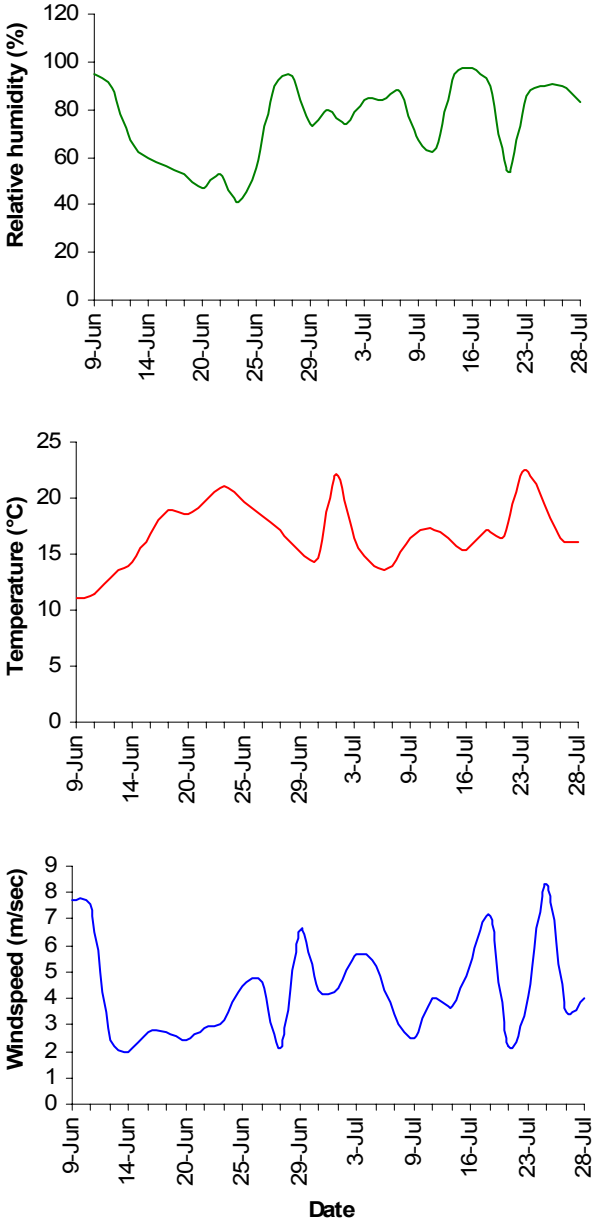

Figure 15
Station 2 (Luras): meteorological data collected during the field trials

on 2 July accompanied by a sudden increase in temperature (22.2°C), and an increase in relative humidity (74%), was associated with a peak in insect numbers (20 822) collected in Trap B.

Conclusions

Mycrocip plays a secondary role in the environmental control of insects. Collection results for farms treated with this product were not significantly different from those of the control station. Variations in total insect numbers appeared to be associated with prevailing weather conditions rather than with the efficacy of the insecticide used.

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