CONTRACT REPORT
PC 77

Control of thrips and aphids on chrysanthemums and sweet peppers by the predatory bugs *Anthocoris nemorum* and *Orius laevigatus*

ADAS

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Authentication

I declare that this work was done under my supervision according to the procedures described herein and that this report represents a true and accurate record of the results obtained.

Signed ....[signature].......

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SUMMARY

In order to see their effect upon thrips and aphids, the predatory bugs *Orius laevigatus* and *Anthrocoris nemorum* were introduced weekly to sweet peppers from late May until late July and on one occasion at three weeks old to each planting in crops of year-round pot chrysanthemum and cut-flower chrysanthemum during the same period.

In sweet peppers, an aphid infestation was continually present at a low level with good parasitism by *Aphidius* spp, but there were hardly any thrips throughout the observations. *Anthocoris* did not establish at all but *Orius* (in spite of a lack of prey) established well, reproduced and spread throughout the glasshouse. *Orius* were found mainly in the flowers and may have fed on *Amblyseius* as well as pollen.

In chrysanthemums, both pots and cut-flowers, neither predator could be found easily although infestation of thrips (mainly *Thrips tabaci*) migrated into glasshouse from outdoors and increased to cause extensive damage. Aphids were also continually present but were mainly controlled by *Aphidius* spp in pots and *Verticillium lecanii* in cut flowers. It is suspected that larger and more frequent introductions of the predatory bugs will be required and the possibility of regenerating them in open blooms will have to be considered. Some cultivars of chrysanthemum were highly attractive to migrant thrips but this did not result in any preference by the bugs. Any IPM programme for chrysanthemum must include integratable insecticides for the control of these migrations and other migrants such as capsids.

INTRODUCTION

Although integrated pest management (IPM) programmes have been designed for use in pot chrysanthemums, cut flower chrysanthemums and sweet peppers the threat of western flower thrips and aphids is a constant restraint because of the limitations of *Verticillium lecanii* and *Amblyseius* spp. The predatory bugs *Orius* spp and *Anthocoris* spp could enhance the reliability of IPM programmes by improving the control of these pests.

Although *Orius* spp are now commercialised and proving successful against thrips in sweet peppers, aphid control may not be adequate. In chrysanthemums, *Orius* spp is basically untested but is thought to have good potential. *Anthocoris* spp are not yet fully commercialised but it is likely to produce better aphid control than *Orius* in sweet peppers and is known to work well in chrysanthemums under the right conditions.

The experiments described here were instigated to compare the efficacy of both *Orius laevigatus* and *Anthocoris nemorum* in the three crop cultures. Success could result in the expansion of *Anthocoris* production and an increase in the area of chrysanthemums using IPM.

OBJECTIVE

To assess the efficacy of *Orius laevigatus* and *Anthocoris nemorum* against aphids and thrips in sweet peppers and AYR chrysanthemums.

MATERIALS AND METHODS

There were three experiments conducted as follows:-

(i) Sweet peppers

By kind permission of Mr D Elliott, 124 Batchmere Estate, Sidlesham, West Sussex a 0.3 ha glasshouse of 9500 sweet peppers cv Mazurka was used. The crop was planted in January in rockwool 90 cm slabs. There were two leaders per plant grown to the high wire giving 6.3 stems/m^2.

Predatory bugs were introduced weekly at the rate of one bug per 10 plants from late May until late July. Anthocoris larvae and adults were introduced to four bays (2923 plants) in the south of the glasshouse and *Orius* adults were introduced to four bays in the north of the glasshouse. There were 5 bays that did not receive the bugs between the two treated areas.

Every 14 days 25 flowers from each of the four bays for each insect were examined in situ for the presence of aphids, thrips and natural enemies. In addition, from each bay a sample of 50 upper, middle and lower leaves was collected for examination under a binocular microscope in the laboratory at ADAS, Wye. The presence of any animals on these leaves was recorded.

Amblyseius cucumeris and *Aphidius matricariae* had already been established on the crop prior to the experiment.

(ii) Pot chrysanthemums

By kind permission of Mr J Duijf, Adviserate Limited, Yapton Road, Walberton, Arundel, West Sussex the observation was done in a 0.8 ha glasshouse in which a year-round programme of 2100 pots of mixed cultivars/week were produced on 0.15 ha of mobile benches.

round programme of 2100 pots of mixed cultivars/week were produced on 0.15 ha of mobile benches.

Pots of five plants were received at 3 weeks old from a separate propagation unit and placed at 24 pots/m² for two weeks. Predatory bugs were introduced in the first week, *Anthocoris* to half the bench area and *Orius* to the other half at the rate of one bug per 10 plants beginning in late May 1993 and weekly thereafter to each planting until late July. Each planting also received a weekly spray of Vertalec/Mycotal mix, *Amblyseius cucumeris* at 50/m² for six weeks and *Phytoseiulus persimilis* at 1 per 10 plants in the first week. Plants were fully spaced after 2 weeks.

Every 14 days, 50 growing points from the *Anthocorid* area and 50 from the *Orius* area of each planting were examined for thrips, aphids and bugs up to emerged bud stage. Records of visible thrips distortion to foliage were also kept. In addition, 50 upper, middle and lower leaves were collected from each area and examined under a binocular microscope in the ADAS Laboratory at Wye.

Over each planting, one blue and one yellow sticky trap was placed at the time each planting was received and these were assessed every 14 days.

Sample of 50 closed buds from each planting were also collected.from each planting and thrips were extracted by a heating apparatus in the laboratory at ADAS Wye.

Open flowers on some benches were examined for any thrips damage.

(iii) **Cut-flower chrysanthemums**

By kind permission of Mr P Liverman, Norman's Nursery, Courtwick Lane, Rustington, Littlehampton, West Sussex two glasshouses comprising 0.17 ha were used for the experiment. A year-round crop of mixed cultivars was split between the two houses. Cuttings in blocks were grown in steam-sterilized soil and received a weekly spray of Vertalec/Mycotal mix. *Amblyseius cucumeris* was added to the programme at 50/m²/week from mid June. Production was 6500 flowers/week in the earlier house and 5550/week in the later unit. From late May, predatory bugs were introduced in the third week after planting when plants began to touch. *Anthocorids* were introduced at one/10 plants to one bed per week but *Orius* were introduced at twice this rate to the other bed.

Every 14 days, 50 growing points from each bed were examined for pests and bugs; records of any visible thrips distortion of foliage were also kept. In addition, 50 upper middle and lower leaves were collected from each bed and examined under a binocular microscope in the ADAS Laboratory at Wye.
One each planting, one blue and one yellow sticky trap was hung for recording thrips and other pests every 14 days.

Some samples of 50 buds per bed were also examined and some estimates of flower damage were also recorded though this information was negated by the need to apply insecticides to the budding crop.

RESULTS

(i) Sweet peppers

Counts of animals in flowers on 6 occasions are given in Tables 1 - 6 and counts of animals on leaves on the same occasions are given in Tables 7 - 12 below. Figures 1 - 4 show the means of the four plots in each treatment.

Table 1: **Number of animals per 25 flowers on 10 June 1993**

Area	Plot	Aphids	Thrips	Anthocoris	Orius	Amblyseius
Anthocoris	1	0	0	0	0	0
	2	0	0	0	0	15
	3	0	0	0	0	15
	4	0	0	0	0	14
	Average	0	0	0	0	11.0
Orius	1	0	0	0	0	0
	2	2	0	0	0	12
	3	0	0	0	0	11
	4	0	0	0	0	9
	Average	0.5	0	0	0	8.0

Table 2 **Number of animals per 25 flowers on 23 June 1993**

Area	Plot	Aphids	Thrips	Anthocoris	Orius	Amblyseius
Anthocoris	1	0	0	0	0	6
	2	0	0	0	1	18
	3	0	0	0	0	11
	4	0	0	0	0	3
	Average	0	0	0	0.25	9.5
Orius	1	0	0	0	0	7
	2	0	0	0	2	18
	3	0	0	0	4	10
	4	3	0	0	3	17
	Average	0.75	0	0	2.25	13.0

Table 3: **Number of Animals per 25 flowers on 7 July 1993**

Area	Plot	Aphids	Thrips	Anthocoris	Orius	Amblyseius
Anthocoris	1	0	0	0	0	28
	2	0	0	0	5	0
	3	0	1	0	2	33
	4	0	0	0	1	11
	Average	0	0.25	0	2.0	18.0
Orius	1	0	1	0	1	38
	2	2	0	0	1	8
	3	5	0	0	4	24
	4	0	0	0	1	5
	Average	1.75	0.25	0	1.75	18.75

Table 4: **Number of animals per 25 flowers on 21 July 1993**

Area	Plot	Aphids	Thrips	Anthocoris	Orius	Amblyseius
Anthocoris	1	18	0	0	1	7
	2	12	2	0	0	1
	3	19	2	0	1	4
	4	4	0	0	8	9
	Average	13.25	1.0	0	2.5	5.25
Orius	1	0	0	0	16	3
	2	1	0	0	8	8
	3	0	0	0	4	4
	4	0	0	0	14	14
	Average	0.25	0	0	10.5	7.25

Table 5: **Number of animals per 25 flowers on 3 August 1993**

Treatment	Plot	Aphids	Thrips	Anthocoris	Orius	Amblyseius
Anthocoris	1	0	1	0	1	2
	2	3	0	0	3	0
	3	0	0	0	11	2
	4	1	0	0	2	0
	Average	1.0	0.25	0	4.26	1.0
Orius	1	1	0	0	16	0
	2	0	0	0	14	0
	3	3	0	0	5	1
	4	0	0	0	14	1
	Average	1.0	0	0	12.25	0.5

Table 6: **Number of animals per 25 flowers on 17 August 1993**

Treatment	Plot	Aphids	Thrips	Anthocoris	Orius	Amblyseius
Anthocoris	1	1	0	0	7	1
	2	0	0	0	7	2
	3	0	0	0	12	0
	4	0	0	0	7	0
	Average	0.25	0	0	8.25	0.75
Orius	1	0	1	0	11	0
	2	2	0	0	18	0
	3	0	0	0	23	0
	4	0	0	0	18	0
	Average	0.5	0.25	0	17.5	0

Table 7: **Number of animals per 50 leaves on 10 June 1993**

Treatment	Plot	Aphids	Thrips	Anthocoris	Orius	Amblyseius	Amblyseius eggs
Anthocoris	1	0	0	0	0	39	35
	2	2	0	0	0	28	12
	3	4	0	0	0	42	13
	4	0	0	0	0	0	0
	Average	1.5	0	0	0	27.25	15.0
Orius	1	0	0	0	0	0	0
	2	0	0	0	0	42	12
	3	0	0	0	0	47	19
	4	0	0	0	0	49	20
	Average	0	0	0	0	34.5	12.75

Table 8: **Number of animals per 50 leaves on 23 June 1993**

Treatment	Plot	Aphids	Thrips	Anthocoris	Orius	Amblyseius	Amblyseius eggs
Anthocoris	1	0	0	0	0	80	24
	2	12	0	0	0	200	75
	3	4	0	0	0	92	24
	4	7	0	0	0	166	27
	Average	5.75	0	0	0	134.5	37.5
Orius	1	0	0	0	0	295	109
	2	2	0	0	2	14	32
	3	4	0	0	0	167	19
	4	0	0	0	0	92	32
	Average	1.5	0	0	0	142.0	48.0

Table 9: **Number of animals per 50 leaves on 7 July 1993**

Treatment	Plot	Aphids	Thrips	Anthocoris	Orius	Amblyseius	Amblyseius eggs
Anthocoris	1	4	0	0	0	89	7
	2	10	0	0	0	107	5
	3	34	0	0	0	157	4
	4	17	0	0	0	150	5
	Average	16.25	0	0	0	125.75	5.25
Orius	1	9	0	0	0	145	10
	2	0	0	0	0	215	9
	3	0	0	0	0	217	20
	4	0	0	0	0	134	7
	Average	2.25	0	0	0	177.75	11.5

Table 10: **Number of animals per 50 leaves on 21 July 1993**

Treatment	Plot	Aphids	Thrips	Anthocoris	Orius	Amblyseius	Amblyseius eggs
Anthocoris	1	30	0	0	0	74	0
	2	39	0	0	0	110	0
	3	29	0	0	0	142	2
	4	30	0*	0	0	99	5
	Average	32.0	0	0	0	106.25	1.75
Orius	1	2	0	0	0	150	0
	2	0	0	0	0	167	5
	3	5	0	0	0	184	2
	4	10	0	0	2	95	2
	Average	4.25	0	0	0.5	149.0	2.25

* slight thrips damage

Table 11: **Number of animals per 50 leaves on 3 August 1993**

Treatment	Plot	Aphids	Thrips	Anthocoris	Orius	Amblyseius	Amblyseius eggs
Anthocoris	1	10	0	0	0	55	4
	2	22	0	0	0	34	0
	3	14	0	0	0	105	36
	4	9	0	0	0	102	24
	Average	13.75	0	0	0	74.0	16.0
Orius	1	20	0	0	0	177	15
	2	0	0	0	0	109	2
	3	2	0	0	0	129	27
	4	2	0	0	0	119	5
	Average	6.0	0	0	0	133.5	12.25

Table 12: **Number of animals per 50 leaves on 17 August 1993**

Treatment	Plot	Aphids	Thrips	Anthocoris	Orius	Amblyseius	Amblyseius eggs
Anthocoris	1	9	0	0	0	25	2
	2	15	0	0	4	37	0
	3	12	2	0	0	50	0
	4	0	0	0	0	69	0
	Average	9.0	0.5	0	1.0	45.25	0.5
Orius	1	10	0	0	0	62	0
	2	4	0	0	7	139	12
	3	4	0	0	2	54	4
	4	2	0	0	2	82	9
	Average	5.0	0	0	2.75	84.25	6.25

Aphids were present from the beginning of the observations but most were parasitised by *Aphidius* spp. Aphids increased slightly in both flowers and on leaves in late July and continued to be more in evidence on leaves in 'Anthocorid plots' for the next four weeks. Many aphids continued to be parasitised by *Aphidius* spp throughout the observations.

Thrips and their damage were almost non-existent throughout the observations though a few corn thrips from outdoors were seen in late August.

No *Anthocoris nemorum* were seen throughout the observations.

Orius laevigatus in flowers were low in number, but present in both treatment areas, until late July. Numbers then increased during the next four weeks and were consistently higher in the 'Orius plots'. Hardly any *Orius* were seen on leaves until the 23 August.

Fig 1.

Number of animals per 25 flowers on Anthocorid plots

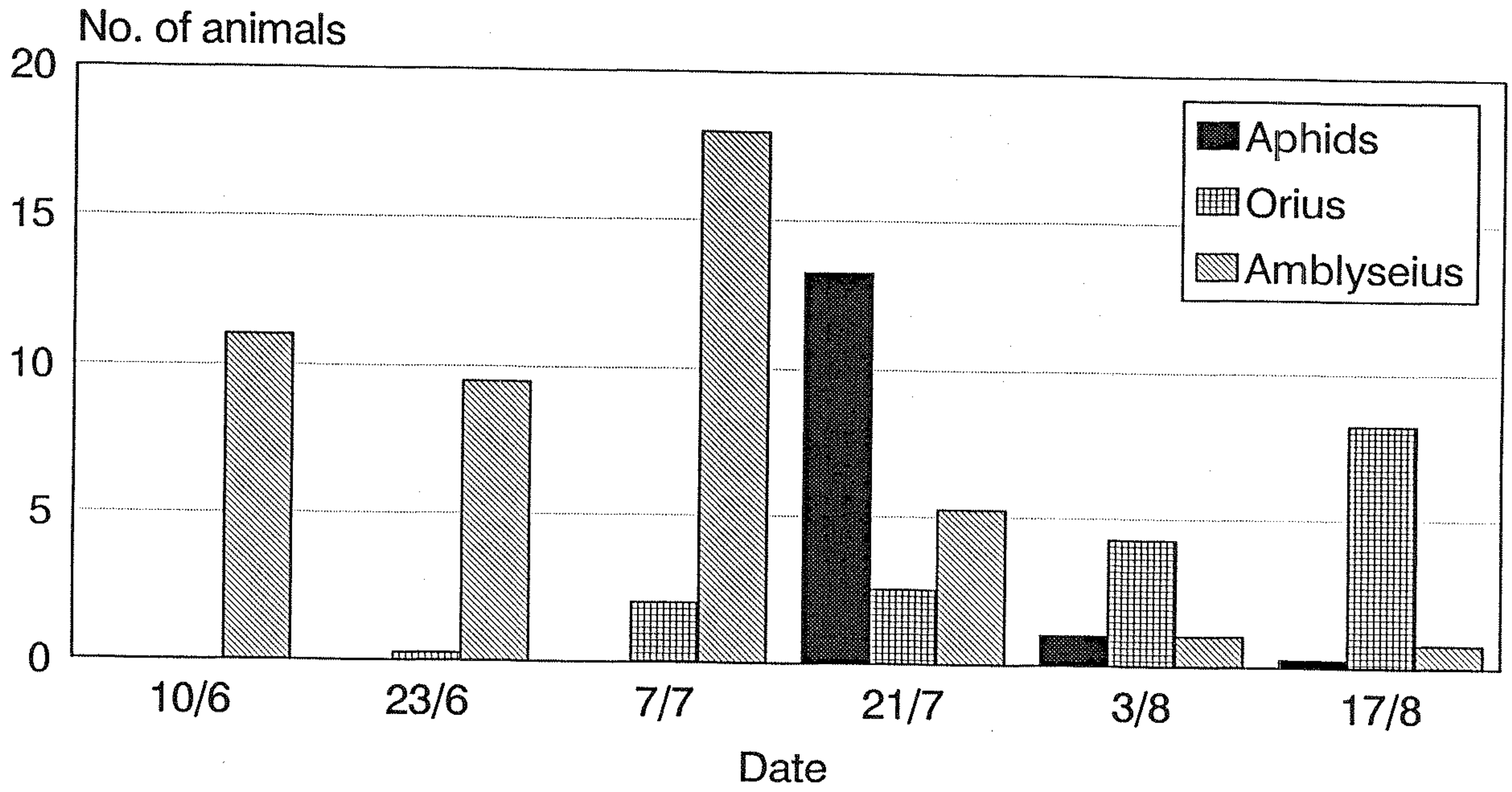


Fig 2.

Number of animals per 25 flowers on Orius plots

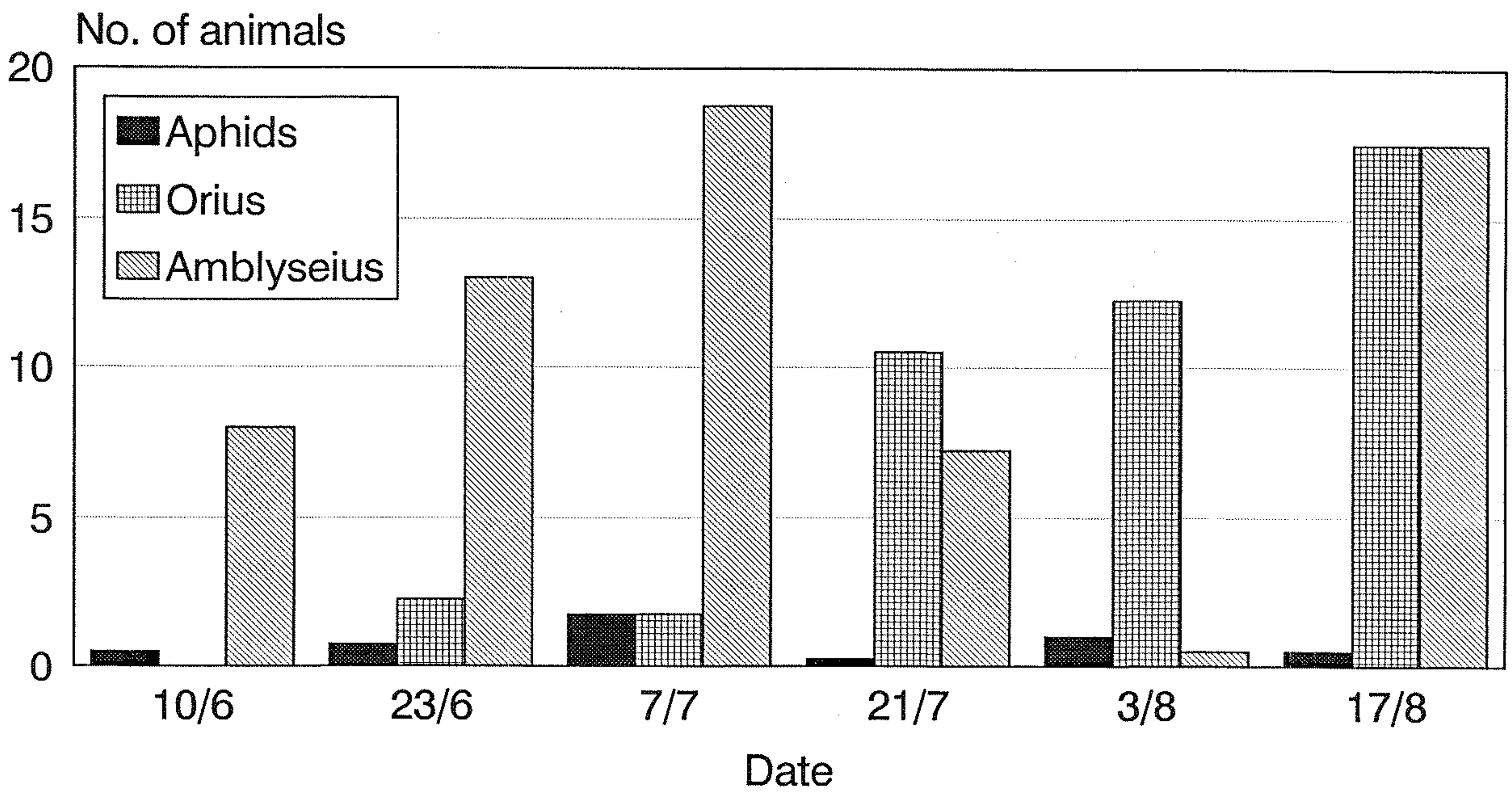


Fig 3.

Number of animals per 50 leaves on Anthocorid plots

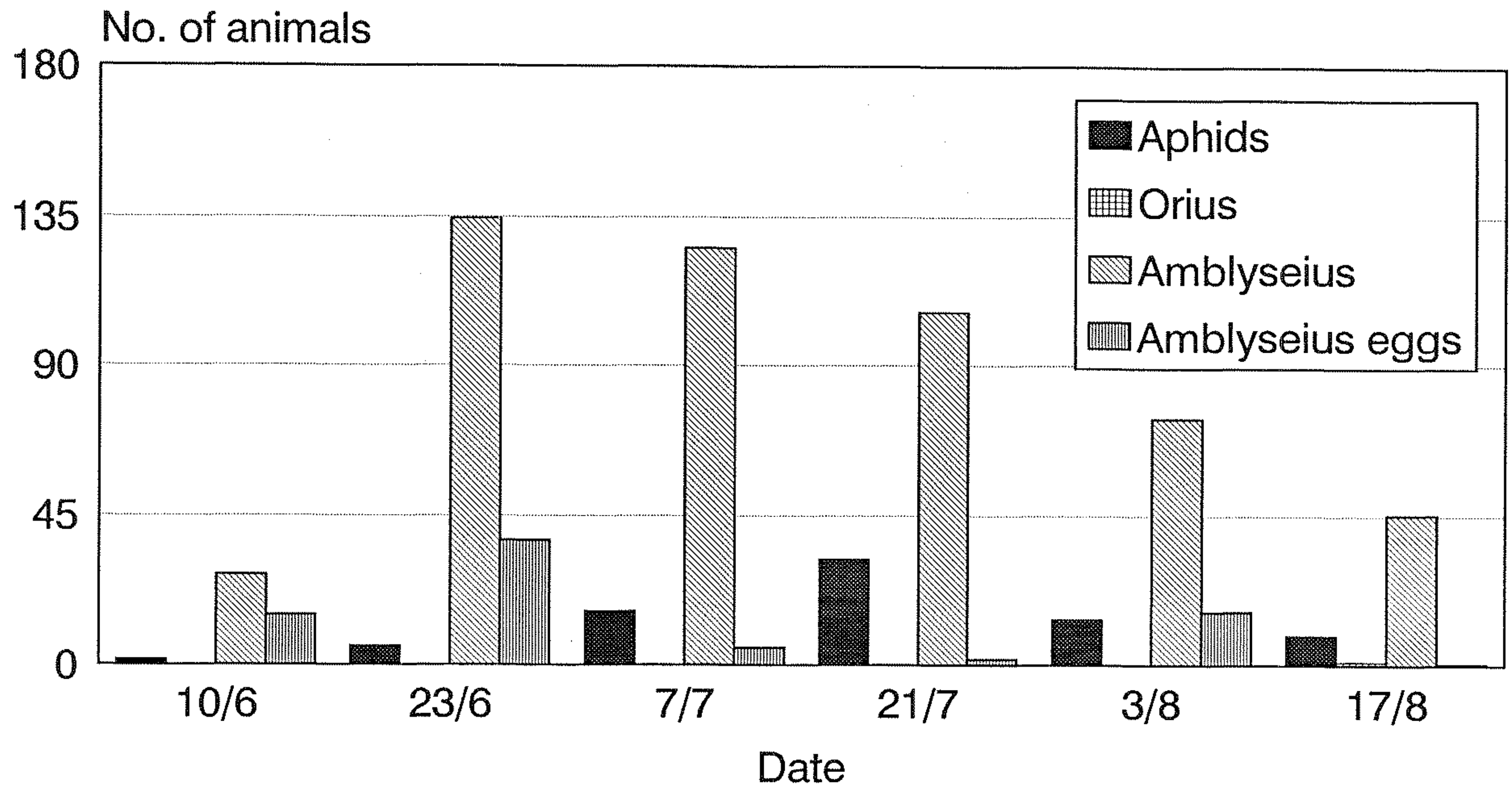
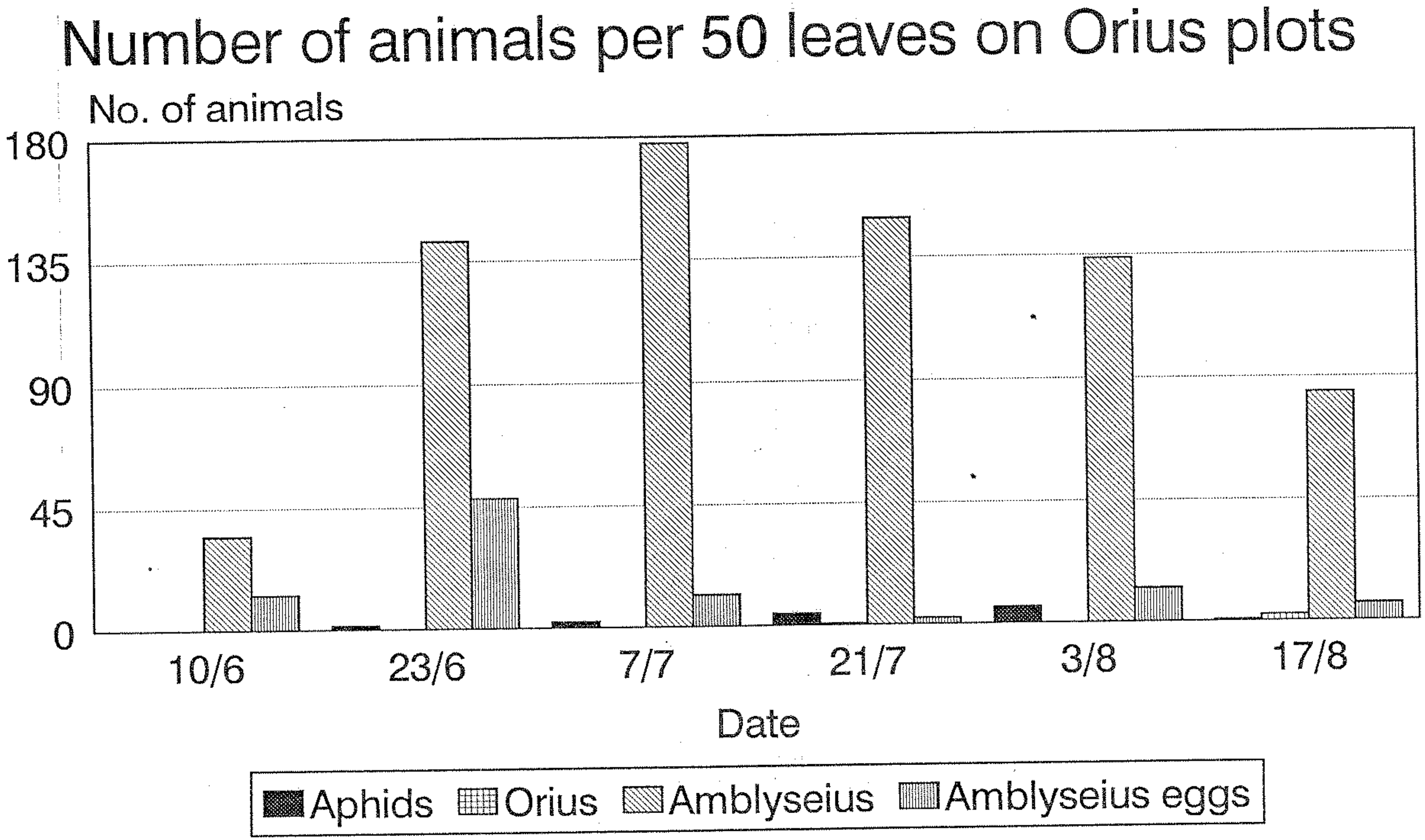


Fig 4.


Number of animals per 50 leaves on Orius plots
No. of animals
180
135
90
45
0
10/6
23/6
7/7
21/7
3/8
17/8
Date
Aphids
Orius
Amblyseius
Amblyseius eggs

Amblyseius cucumeris were consistently found at a low level in flowers throughout June and July in both treatment areas and numbers declined during August. On leaves the predatory mites were consistently present at almost 2-3 per leaf with their eggs until 17 August when numbers declined, particularly in the 'Anthocorid plots'.

Spider mites occurred sporadically throughout the observations but these were quickly eradicated by *Phytoseiulus persimillis*.

(ii) **Pot chrysanthemums**

Results of observations on aphids and thrips are given in the tables below. Hardly any predatory bugs were seen throughout the observation.

Table 13: **Aphids on plants five and six weeks after pots brought into glasshouse**

% = per cent plants affected

No = number of live aphids on 50 plants

Planting	**Orius plots**		**Anthocoris plots**		**Comments**
	%	**No**	**%**	**No**	
1	3	0	3	0	100% *Aphidius*
2	3	1	3	0	mostly Aphidius
3	10	0	6	5	" " "
4	0	0	0	0	-
5	0	0	2	1	-
6	12	4	0	0	extensive *Aphidius*
7	4	5	0	0	
8	6	1	2	2	extensive *Aphidius*
9	6	4	2	2	50% *Aphidius*

There were no significant differences in aphid (*Myzus persicae*) attack between the two treatments. Aphids were basically controlled by *Aphidius* spp. Aphids on leaves were so consistentlylow throughout the observations that most samples gave nil records. *Verticillium lecanni* was seen only occasionally.

Table 14: **Thrips on plants five or six weeks after pots brought into glasshouse**

% TD = per cent plants with thrips damage symptoms
% T = per cent plants with live thrips*
No. = number of thrips on 50 plants

	Orius plots			Anthocoris plots		
Planting	**% TD**	**% T**	**No.**	**%TD**	**% T**	**No.**
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	2	2	0	4	3
6	0	20	9	0	18	10
7	16	10	9	4	4	2
8	90	28	32	28	8	8
9	80	38	29	60	30	33

* No Western flower thrips, mostly *T. tabaci* and other immigrants from outdoors

Table 15: **Thrips* and their damage on leaves five or six weeks after pots brought into glasshouse**

(same key as for Table 14)

	Orius plots			Anthocoris plots		
Planting	**% TD**	**% T**	**No.**	**%TD**	**% T**	**No.**
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	7	0	0	2	6	2
4	30	12	6	30	8	4
5	22	6	3	18	4	2
6	10	0	0	58	14	7
7	46	2	1	62	10	6
8	54	2	1	38	12	7
9	42	26	16	62	12	7

* *T. tabaci*

Table 16: **Number of animals in buds at first sign of opening**

T = number of thrips* per bud
AC = number of Amblyseius per bud

Planting	Orius plots T	Orius plots AC	Anthocoris plots T	Anthocoris plots AC
1	0	0	0	0
2	0	0	0.12	0
3	0.04	0.19	0.19	0
4	0.12	0.04	0.08	0
5	0.17	0.07	0.07	0.07
6	0.03	0.03	0.09	0
7	0.18	0	0.08	0.71
8	0.07	0.53	0.05	0
9	-	-	-	-

* All *T. tabaci*

Table 17: **Number of thrips* per trap at first open flower**

Planting	Orius plots	Anthocoris plots
1	0	0
2	19	40
3	67	32
4	60	19
5	35	10
6	13	28
7	31	17
8	27	11
9	9	25

* No Western flower thrips, mostly *T.tabaci* and other immigrants from outdoors

The thrips attack (mostly onion thrips) developed quickly during late July/August causing excessive damage to the later plantings. The number of thrips on traps fluctuated widely and did not reflect the actual situation on the crops. The observations were abandoned in late August due to excessive damage by thrips to foliage. Damage to flowers was negligible until the seventh planting when it was decided to protect the budding crop with weekly sprays of deltamethrin/heptenophos.

(iii) **Cut-flower chrysanthemums**

Counts of animals in growing points and on leaves are given in Tables 18 and 19 below. Hardly any predatory bugs were seen throughout the observations.

Table 18: **Aphids in growing points four or five weeks after planting**

% = per cent plants affected
No = number of live aphids per 50 plants

Planting	**Orius plots**		**Anthocoris plots**		**Comments**
	%	**No**	**%**	**No**	
1	20	5	30	6	> 50% *V. lecanii*
2	12	34	8	13	> 30% *V. lecanii*
3	20	42	4	14	> 40% *V. lecanii*
4	16	26	6	2	> 60% *V. lecanii*
5	14	10	22	54	> 30% *V. lecanii*
6	4	7	8	16	Extensive *V. lecanii*
7	2	2	6	108	" " "
8	0	0	10	18	" " "
9	4	37	12	74	" " "
10	10	19	2	10	" " "

Table 19: **Aphids on leaves five weeks after planting**

Planting	**Orius plots**		**Anthocoris plots**		**Comments**
	%	**No**	**%**	**No**	
1	2	1	2	0	*V. lecanii* present
2	4	2	2	0	50-100% *V. lecanii*
3	2	1	2	2	-
4	2	0	2	4	-
5	2	1	0	0	-
6	0	0	0	0	-
7	0	0	0	0	-
8	0	0	4	1	75% *V. lecanii*
9	0	0	0	0	-
10	2	0	2	1	Aphidius present

Aphids (*Aphis gossypii*) were present from the beginning of the observations but there were no consistent differences in numbers between the two treatments. *Verticillium lecanii* consistently affected about half the aphids throughout the observations. Plantings 6-10 (in a different glasshouse to the previous five plantings) followed a similar pattern to plantings 1-5 and *V. lecanii* was again extensive.

Table 20: **Thrips in growing points 5 weeks after planting**
% = per cent plants with active thrips
No = number of thrips per 50 plants

Planting	**Opius beds**		**Anthocoris beds**	
	%	**No**	**%**	**No**
1	2	1	0	0
2	0	0	2	1
3	10	9	0	0
4	16	9	8	4
5	4	3	24	21
6	4	3	10	5
7	4	2	20	23
8	2	2	10	5
9	12	6	12	7
10	18	11	10	14

Table 21: **Thrips damage to leaves 7 weeks after planting**
% TD = per cent leaves with thrips silvering
% T = per cent leaves with live thrips
No = number of thrips per 50 leaves
% A = per cent leaves with *Amblyseius cucumeris*

Planting	**Orius beds**				**Anthocoris beds**			
	% TD	**% T**	**No**	**% A**	**% TD**	**% T**	**No**	**% A**
1	12	4	1	30	26	0	0	6
2	6	6	3	30	10	4	2	10
3	34	10	5	32	22	8	4	16
4	0	0	0	18	10	4	4	12
5	14	2	1	18	16	6	3	2
6	4	2	1	4	22	6	3	8
7	24	2	1	2	28	4	2	0
8	12	2	1	0	8	2	1	0
9	8	0	0	0	6	0	0	0
10	8	6	4	0	12	0	0	0

Numbers of thrips in growing points and on leaves were consistently low in most cultivars but c.v. Maui was badly attacked in each planting. Numbers of thrips on traps after seven weeks of trapping also showed no significant increase on either treatment. About 70-80 per cent of thrips on traps were outdoor species, not Western flower thrips.

The level of damage on c.v. Maui caused so much concern that it was decided to protect all plantings by sprays of deltamethrin/heptenophos from budding onwards. This made flower damage assessments spurious so they were not recorded; in the event, all flowers were marketable with only occasional damage with the exception of Maui and Westland in plantings 5 and 6.

Table 22: **Numbers of thrips per trap 7 weeks after planting**

Planting	Orius No	Anthocoris No
1	23	19
2	67	60
3	35	33
4	51	.5
5	46	62
6	42	16
7	21	7
8	51	22
9	3	15
10	20	10

DISCUSSION

(i) **Sweet peppers**

Anthocoris did not establish in this crop, possibly because of the lack of thrips although aphid prey were always present and feeding on *Amblyseius* could have helped them survive. However *Orius* established well, especially in flowers where they presumably fed on pollen and/or *Amblyseius* as there was no evidence that they preyed on aphids.

It was encouraging to see how *Orius* spread steadily throughout the glasshouse. It was also interesting that *Amblyseius* reproduced extensively (in spite of the lack of thrips) until late August.

(ii) **Pot chrysanthemums**

The lack of sighting of both predatory bugs was a big disappointment though this does not infer that they had no effect. In the suspected absence of these bugs then any Western flower thrips were probably controlled by the *Amblyseius/V. lecanii* components of the IPM programme. These observations were eventually abandoned because of the immigration and build-up of *Thrips tabaci* which was not controlled by any components of the programme. Sticky traps did not seem to reflect the true situation on the crops, this could be partially due to additional damage caused by immigrant thrips other than *T. tabaci* that did not survive or breed.

(iii) **Cut-flower chrysanthemums**

The lack of sightings of both predatory bugs was again a big disappointment, especially since Western flower thrips and aphids were continually present. Although Western flower thrips were basically controlled, this may be equally due to *Amblyseius/V. lecanii.* The programmed failed to control immigrant thrips that were highly attracted to c.v. Maui and Westland without which the programme could have been considered successful. Immigration of capsids during late July/early August were sufficient to warrant the inclusion of an integratable insecticide (probably heptenophos) in any commercial IPM programme during these late summer months.

Since these observations finished, IPM programmes have continued on the site and *Orius* were frequently seen during September.

CONCLUSION

In sweet peppers *Orius* establishes and spreads well even in the absence of prey. Its preference for flowers is an advantage since thrips also prefer flowers, however it is a disadvantage that it is less likely to be found on leaves in a high wire crop. *Anthocoris* should be further tested as a curative treatment in high thrips situations where it might establish and breed better.

In chrysanthemums (pot or cut-flower) neither predatory bug showed promise yet *Anthocris* has worked well in commercial situations where it can regenerate in open flowers, both sites in these observations were not conducive to the breeding of the bug. Presumably this feature also applies to *Orius,* in which event larger and more frequent introductions of bugs may be necessary. It is apparent that neither bug can help to control large immigration of thrips from outdoors and this alone means that IPM in chrysanthemums must cater for this eventuality. The integration of insecticides to control such immigrations should be designed to also control capsid bugs.

PRACTICAL RECOMMENDATIONS FOR GROWERS

The results of these observations have not produced clear-cut recommendations for the future use of *Orius* or *Anthocoris* but they have demonstrated that much further work needs to be done, particularly in chrysanthemums.

The persistent build-up of *Orius* in sweet peppers in spite of the absence of thrips is very encouraging and growers who introduce this predator need not feel that they are wasting their money. In cases of western flower thrips for which every available control mechanism is required it is a comfort to know that *Orius* can build up in flowers where the thrips are also most likely to occur. Although *Orius* introductions were made weekly in these experiments, there is no reason why the standard recommendations by the suppliers of the predators should not produce similar results.

In chrysanthemums the cost of predatory bugs is prohibitive when there is no guarantee that they will survive and have effect on thrips. The experiments do confirm that the bugs will not control large immigrations of onion thrips from outdoors. In this event, any grower using IPM in chrysanthemums should monitor thrips numbers carefully using both blue and yellow sticky traps; any sign of appreciable immigration of thrips should trigger the spray of a short persistence insecticide such as heptenophos, that will integrate fairly well. Future experiments with these predators should examine more frequent introductions of higher numbers in the anticipation that their costs may eventually be lower than at present.

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