

## INCIDENCE OF THRIPS AND APHIDS AS POTENTIAL VIRUS VECTORS IN FIELD TOMATOES

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### SUMMARY

The incidence of thrips and aphids in field tomatoes was monitored using sticky traps and plant beating techniques, and virus incidence was estimated using ELISA. *Thrips tabaci* was the only proven vector of tomato spotted wilt virus (TSWV) present and was the predominant thrips on traps and plants. TSWV reached 5% incidence following increased trap catches of *T. tabaci*. Plant samples were the best indicator of the common vectors *Myzus persicae* and *Macrosiphum euphorbiae*, whereas *Brachycaudus helichrysi* and *Cavariella aegopodii* were present on both traps and plants. Cucumber mosaic virus (CMV) and potato virus Y (PVY) reached 5% incidence following increased incidence of known vectors. No major weed sources of virus were detected.

**Keywords:** Virus vectors, tomato viruses, *Thrips tabaci*, *Myzus persicae*, weed hosts.

### INTRODUCTION

Aphids are significant vectors of several non-persistent viruses of tomatoes (Blackman and Eastop 1984) and thrips are the only known vectors of TSWV (Cho *et al* 1989). The virus diseases of tomatoes are described by Tate *et al* (1991) who reported TSWV as the most common virus in the Gisborne area, infecting 1-2% of plants in most fields with a maximum incidence of 20% at one site. The insect vectors were not identified in that study, although *Frankliniella occidentalis* was considered to be a potential cause of TSWV outbreaks. In Hawaii the appearance of this thrips was associated with increased severity of TSWV (Cho *et al* 1989), but *F. occidentalis* has not been recorded from field crops in New Zealand (Mound and Walker 1982).

The present study compared the aerial aphid and thrips fauna intercepted by sticky traps in Gisborne tomato fields with the fauna found on tomato plants. It also measured virus incidence in relation to the occurrence of potential vectors and examined weeds as virus sources.

### METHODS

Sticky traps consisting of 18 cm squares of yellow plastic sheet (Yellow Corflute, Concept Plastics, Auckland) covered with a sticky glue (Product No. 633, Davis Gelatin Ltd, Christchurch) were mounted with the base at canopy height, with 3-4 double sided traps per field. The traps were replaced approximately weekly and all aphids and thrips counted in the laboratory to determine numbers per trap day. Subsamples were removed from each trap and cleaned in xylene for identification. Aphids were stored in alcohol for identification by Mr R.G. Sunde, and thrips were mounted in polyvinyl alcohol and identified according to Mound and Walker (1982). Plants were sampled by beating the terminal 20 cm of a branch in the upper canopy, including flowers, into a plastic tray (Bues *et al* 1988). Samples were taken from 10 plants adjacent to, but not interfering with, each trap. The accuracy of beating was checked by washing plants in hot water on two sampling occasions. Trapping and sampling were carried out weekly in four early season tomato crops and four late crops and covered the period 29 October 1991 to 20 March 1992.

Virus incidence was monitored in blocks of 100 tagged plants in one early season crop and one late crop. Leaf samples were taken weekly until harvest and tested for TSWV, AMV, CMV and tomato aspermy virus (TAV) using ELISA (Clark and Adams 1977).

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## RESULTS AND DISCUSSION

Comparison of beating and washing for the same plant samples showed that beating removed 80% of the aphids found by washing, and 52% of the thrips. Comparison of the techniques for each 10 plant sample showed that the beating technique always detected the presence of thrips or aphids when they were found by washing. As washing was very labour intensive, the beating technique was adopted for plant sampling. On traps, aphids reached maximum levels in November and December and thrips in January (Fig. 1). The major species on plants followed a similar pattern.

### Aphids and non-persistent viruses

Thirty species of aphids were found on sticky traps. The thistle infesting species *Capitophorus elaeagni*, carrot aphid *C. aegopodii*, cabbage aphid *Brevicoryne brassicae* and a polyphagous aphid *B. helichrysi* were by far the most common species (Table 1). This reflects the proximity of thistles, fennel, cruciferous weeds, *Senecio* spp., clovers and other hosts along fence lines and in nearby pasture.

**TABLE 1: Percentage species composition of thrips and aphids in each month from sticky trap subsamples, and a comparison of traps and plants. N(traps) = 1589(aphids) and 521(thrips).**

	Sticky traps				Comparison	
	Nov.	Dec.	Jan.	Feb.	Traps (% of total)	Plants
<b>Aphids</b>						
<i>Myzus persicae</i>	4	2	1	5	2	45
<i>Brachycaudus helichrysi</i>	7	33	30	5	13	17
<i>Capitophorus elaeagni</i>	26	36	16	5	25	11
<i>Macrosiphum euphorbiae</i>	0.5	1	0.4	2	0.6	10
<i>Cavariella aegopodii</i>	54	7	0	24	22	2
<i>Brevicoryne brassicae</i>	2	5	25	22	11	0
<b>Thrips</b>						
<i>Thrips tabaci</i>	29	63	66	72	49	89
<i>Thrips obscuratus</i>	28	27	15	11	21	9
<i>Chirothrips manicatus</i>	7	4	4	2	4	1
<i>Ceratohrips frici</i>	35	3	8	12	15	0
<i>Aeolothrips fasciatus</i>	1	2	7	3	3	0.5

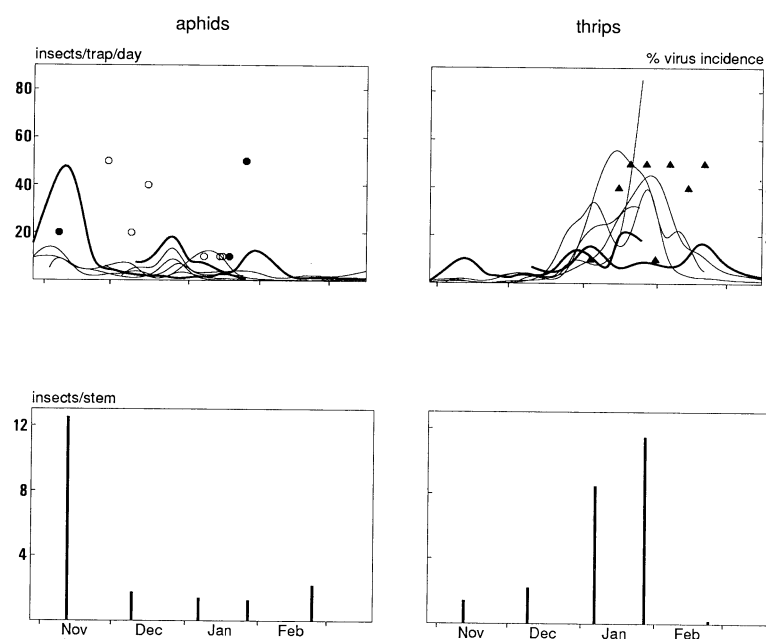
In tomato plant samples 18 aphid species were recorded with *M. persicae* occurring most consistently (Table 1). *Brachycaudus helichrysi* and *C. elaeagni* were also common but not present throughout the season. *Myzus persicae* and *M. euphorbiae* were the only species which reproduced on tomato plants, although for both species alates were the more common form. Although *M. persicae* was the dominant species on tomato plants (45%), it formed only 2.3% of the aphids on traps. In one early crop *M. persicae* was found on plants 1 month before it was detected on sticky traps.

The incidence of CMV (Fig. 1) appears to follow the peak aphid numbers, particularly in the early crop where disease levels reached 3.5 to 5% in November and December. AMV and TAV infection reached only 1% throughout the season, and PVY reached 5% in late February.

*Myzus persicae* and *M. euphorbiae* are considered to be the most efficient vectors of these non-specific viruses, although abundant species such as *B. helichrysi* and *C. aegopodii* can be significant vectors on crops they do not colonise (Blackman and Eastop 1984). *Capitophorus elaeagni* is not regarded as an important virus vector.

### Thrips and TSWV

Eleven species of thrips were identified from sticky traps and four of these occurred in plant samples. In both sampling techniques *T. tabaci* was the predominant species and *Thrips obscuratus* was next most common (Table 1). Although these were the



**Fig. 1:** Total aphid and thrip catches from sticky traps (four early and four late crops) showing estimated TSWV(▲), CMV(○) and PVY(●) infection at 2 sites (bold line), and mean numbers of *M. persicae* and *T. tabaci* per plant sample, Gisborne tomatoes, 1991-92.

only two species regularly found on tomato plants, the polyphagous species *Ceratothrips frici* and the pasture inhabiting species *Chirothrips manicatus* occurred regularly on traps, possibly originating from adjacent composite weeds, grasses or legumes including lucerne.

No immature thrips were found on plants. Subsequent rearing experiments produced very small numbers of nymphs from adults of both *T. tabaci* and *T. obscuratus* when these were confined on tomatoes. As thrips populations exceeded a mean of 2 per plant sample on only one occasion, these results suggest that tomato is not a preferred host for reproduction.

No TSWV could be detected at the early season sampling site in November and December (Fig. 1). In January and February TSWV incidence was estimated at 3.5 to 5% for a period of 6 weeks closely following an increase in thrips numbers recorded in that crop and at other trap sites.

*T. tabaci* was the only known vector of TSWV which was found on tomatoes. Although Tate *et al* (1991) suggested that *F. occidentalis* may transmit this virus from weed hosts and cause outbreaks in tomatoes, this species was not trapped or found on tomatoes in Gisborne and Hawkes Bay in either 1990-91 or 1991-92. *F. occidentalis* is a common vector of TSWV in Hawaii and North America (Cho *et al* 1989), but in New Zealand it is found almost solely on lupin, although there are records from *Melilotus*, *Chrysanthemum* and nectarine (Mound and Walker 1982; McLaren 1992).

### Weeds

Weed surveys around both sites failed to isolate significant reservoirs of virus; only CMV was isolated and this from a single plant of thorn apple (*Datura stramonium*). Surveys around other tomato and capsicum blocks in the district did isolate virus from weeds: TSWV from *Amaranthus* sp., black nightshade (*Solanum nigrum*) and white clover; CMV from Scotch thistle (*Cirsium vulgare*), fennel (*Foeniculum vulgare*), mallow (*Malva parviflora*), chamomile (*Anthemis cotula*), black nightshade and dandelion (*Taraxacum officinale*); AMV from black nightshade and dandelion.

These weed infection records and those of Tate *et al* (1991), together with New Zealand host plant records for aphids and thrips found on tomatoes, indicate the potential for viruses from weeds in crop margins. For TSWV there was only one association with a known vector; *T. tabaci* on sow thistle (*Sonchus arvensis*). At the low infection levels in this study, no major local source of TSWV infection was identified.

Of the aphids recorded both on tomatoes and virus infected weeds, *M. persicae*, *M. euphorbiae* and to a lesser extent *B. helichrysi* and *C. aegopodii* may be the most significant vectors of non-persistent viruses. These aphids are associated with four weed sources of cucumber mosaic virus (CMV) or alfalfa mosaic virus (AMV); black nightshade, fennel (*Chenopodium album*), dock (*Rumex* spp.), sow thistle and fennel.

### CONCLUSION

Since the need for early season insecticide applications in tomatoes (directed at *Helicoverpa armigera*) has declined (Walker and Cameron 1990), virus vectors remain the major target for insecticide applications in the October-December period. Our results suggest that thrips may not be a problem at this time in early crops, particularly as TSWV infected less than 1% of these plants. Later planted crops, which may be subjected to thrips infestation and virus infection at a more susceptible stage in their growth, exhibited up to 5% TSWV infection. Although aphid populations peaked earlier than thrips, the most common aphid transmitted virus (CMV) rarely infected more than 1% of plants. Trapping of thrips may be a useful predictor of TSWV infection in plants. However, trapping may be less useful for non-persistent viruses as it records only part of the aphid vector fauna.

These non-economic levels of virus infection may have been a result of the cool 1991-92 season which delayed the development of most insect populations on tomatoes (P.J.Cameron, unpublished). Under these conditions it was difficult to determine if virus originated from weedy margins or more distant sources. At high infection levels in Hawaii, Cho *et al* (1989) implicate neighbouring crops as sources of TSWV. Further work is needed to locate major virus sources, to determine if there are practical thresholds for *T. tabaci*, and to confirm the relative importance of the various aphid vectors.

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