PT018
Seed potato industry development (aphid monitoring)
1993

S Learmonth
WA Department of Agriculture

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PT018

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Telephone: (02) 9418 2200
Fax: (02) 9418 1352

FINAL REPORT

SEED POTATO INDUSTRY DEVELOPMENT
(APHID MONITORING)

by
Françoise A. Berlandier
Entomology, Plant Protection
1993

PART 1: PROJECT SUMMARY

Abstract

The aphid fauna of south-western Australia was surveyed during each potato growing season (October to May) 1988 -1992. Aphids were sampled by three methods: sticky traps, water traps and leaf sampling to gather information on the species important to potato, *Solanum tuberosum* L., production. Thirty-four sites were distributed in an area measuring approximately 90,000 square kilometres, which encompassed most of the potato growing areas of the region, and included potato crops, non-potato crops and pastures.

Thirty-three species of aphids were detected in this survey. Of these, five species feed and reproduce on potato: green peach aphid, *Myzus persicae* (Sulzer), foxglove aphid, *Aulacorthum solani* (Kaltenbach), potato aphid, *Macrosiphum euphorbiae* (Thomas), cowpea aphid, *Aphis craccivora* Koch and *Rhopalosiphoninus staphyleae* (Koch). Of these, green peach aphid was the most widespread. Green peach aphid poses the greatest threat to the potato growing industry because of its superior ability to transmit plant viruses that cause disease in potatoes, most notably potato leaf roll virus (PLRV). Green peach aphid was recorded at all sites except one and occurred in low numbers at non-potato sites. Fewer green peach aphids were recorded at southern sites than northern sites, and first arrivals were recorded later at southern sites for 2 of 3 years. Later arrival is probably influenced by the proximity of these sites to the coast and associated on-shore winds, the isolation from other potato growing areas and the later planting dates in this region. Leaf sampling was more accurate at estimating colonising aphid populations than sticky traps, which failed to predict colonising aphid activity. Water trap catches did not differ from sticky trap catches.

Sites with low aphid activity that may be suitable for growing virus-free potatoes were identified. The survey confirmed that the traditional seed producing areas (ie. the south coast between Walpole and Albany) received the least pressure from aphid species important to virus transmission. No new additional areas with similar characteristics were identified. Before this study was commissioned, the area around Margaret River was perceived as a possible new seed producing area. We found that aphids were present at this area early in the season. The threat of virus transmission associated with this aphid activity suggests that growing virus-free seed potatoes in this area is risky. The Margaret River area is not isolated from the more intensive potato producing region situated to the north, and therefore migrating aphids can easily reach and infest crops in the Margaret River region, thus facilitating PLRV infection.

The susceptibility of 'Delaware', the major potato variety produced in WA, to PLRV limits seed potato production to the south coast. Wilson and Jones (1993) suggest that the Australian-bred varieties 'Whitu' and 'Spunta', which they found were resistant to PLRV, may be suitable for production in WA. Therefore, it may be possible to utilise areas other than the south coast for seed production by growing these varieties.

Project Review

Objectives

The objective of this project was to monitor aphid activity and use this information to help identify new seed potato producing areas in WA where it may be possible to grow seed potatoes with minimal risk of virus infection transmitted by aphids.

Achievements

The project achieved it's goal of identifying aphid activity in established and potential potato growing areas of the south-west of WA. All aphids were identified to species level, and numbers and timing of activity of the important species was compared. This enabled the assessment of virus risk associated with the various species recorded.

The study confirmed that the traditional seed producing area between Walpole and Albany is the most suitable. However, no new areas as such were identified, as potential areas, such as Margaret River, were classified too risky due to the associated moderate levels of aphid activity. In addition, the recent finding that the widely grown variety 'Delaware' is susceptible to PLRV infection, restricts seed production to areas with minimal aphid activity.

Variations

The main aim of the project was adhered to throughout, and no variation was introduced.

Implementation of Results

Results of this project have been and continue to be implemented by extending the results to all associated Departmental Staff, particularly horticultural (vegetable) advisers, at regular PGITF meetings, through annual meetings between project collaborators, and by making the results (in the form of this final report) freely available to industry. In addition, at least one publication in a national or international journal will be produced from this research.

Project Details

Organisation:	Western Australian Department of Agriculture (WADA)
Project No.:	NP1
Title:	Seed Potato Industry Development (Aphid Monitoring)
Location:	Field sampling: throughout south-west WA. Office: based at South Perth, Department of Agriculture.
Personnel:	F.A. Berlandier, Entomologist (1989-92) P. Dawson, Horticultural Adviser (1989-92) S.E. Learmonth, Entomologist (1991-92) J. Mortimore, Technical Officer (1990-92) J.D. Sandow, Entomologist (1988-89) H.V.B. Gratte, Horticultural Adviser (1990-91) S.A. Harrington, Entomologist (part of 1990-91)

A large number of personnel have been associated with the running of this project, mainly because of staff movements including resignations and new appointments.

Commencement Date:	July 1, 1989
Termination Date:	June 30, 1992
Funding:	Jointly funded (50% each) by the Horticultural Research & Development Corporation (Australia) and the Potato Growing Industry Trust Fund (Western Australia). The WADA provided salaries for a number of research and technical staff involved in running the project and the infrastructure to conduct the project. In addition, the WADA funded a preliminary study, conducted in 1988-89, into aphid monitoring in south-west potato growing areas of WA that included 10 trapping sites.

Further research

We do not anticipate continuing research into the aphid component of this study, unless industry indicates that the information to date is insufficient.

Publications

Berlandier, F.A. (1990) Seed Potato Industry Development (Aphid Monitoring) Progress Report 1989-90. Unpublished Report, WA Department of Agriculture.

Berlandier, F.A. (1991a) Aphid monitoring in the potato growing areas of the south west of WA. Results from 1989/90 **Potato Grower Magazine**, Feb-Mar 1991.p.16.

Berlandier, F.A. (1991b) Summary of 1990-91 aphid monitoring in potato growing areas. **Potato Grower Magazine**, Jun-Jul 1991.p.5-6.

Berlandier, F.A. (1991c) Seed Potato Industry Development (Aphid Monitoring) Progress Report 1990-91. Unpublished Report, WA Department of Agriculture.

Berlandier, F.A. (199?) Distribution and abundance of aphids (Homoptera: Aphididae) in potato growing areas of south-western Australia (submitted)*.

Sandow, J.D. (1989) Seed Potato Industry Development (Aphid Monitoring): Interim Report 1988-89. Unpublished report WA Department of Agriculture.

* Both funding bodies will be notified of further details when the manuscript is accepted by a journal.

PART 2: TECHNICAL REPORT

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SEED POTATO INDUSTRY DEVELOPMENT (APHID MONITORING)

INTRODUCTION

Western Australia (WA) has the potential to produce and export seed potatoes to fill a gap in the world export seed market. Currently the Dutch seed potato industry monopolises this market. The Dutch plant their crop during March/April and harvests in June. Potatoes are then sold between October and May. From May onwards, the Dutch seed potatoes are physiologically old and begin to deteriorate. As a consequence, market niche appears to exist between May and October. Several Middle Eastern, Asian, Pacific and Indian Ocean countries have a demand for certified seed potatoes during the May to July period. WA is potentially able to supply these markets, as spring and summer grown potatoes are harvested from January to May.

In response to this export opportunity, the WA Horticultural Export Development Council began an investigation into the potential for an export seed potato industry in the south-west of WA. A report by Professor H. van Arkel (1988), Managing Director of the Netherlands Potato Consultative Institute, who visited WA in 1988, sets out a number of research requirements which need to be met for such an industry to be viable. Prominent amongst these requirements is a better knowledge of aphid activity in potential seed potato growing areas. This information is vital to anticipate the risks of potato leafroll virus (PLRV) transmission.

Seed potatoes must be free of virus, particularly potato leafroll virus, in order to be certifiable as seed. PLRV is seed (ie. tuber) -borne in potatoes, and occurs at low levels in WA along with potato viruses S (PVS), and X (PVX) (Wilson & Jones 1990). Of these potato viruses, PVS and PLRV are aphid-borne, but PLRV is potentially the most serious. In order to evaluate the likely incidence of these viruses in WA, information is needed on the occurrence of aphid vectors in potato-growing areas.

Seed potatoes have been produced from the south coast near Albany in WA, where virus-free potatoes have successfully been cultivated for the past 60 years. Since 1909 the most widely grown variety has been 'Delaware', which makes up to 80% potatoes produced in WA. A recent survey of the virus content of ware and seed potatoes in WA by Wilson & Jones (1990) revealed low levels PLRV in seed potatoes from Albany, and the absence of PVY, another important aphid-borne virus. Aphids are the largest group of plant-virus vectors (Kennedy, Day & Eastop, 1962), and the green peach aphid, *Myzus persicae* (Sulzer), is regarded as the most important vector of PLRV (Flanders *et al.* 1991). Both winged adults (alates) and wingless adults (apterae) are important to the spread of the virus (Flanders *et al.* 1991; Hanafi *et al.* 1989; Bacon *et al.* 1976).

The existing literature on the aphid species and distribution in the south west of WA is quite general and outdated (Eastop 1966). In 1928, Collins referred to seed potato crops in WA, mentioning that "some places are relatively free from aphids", but did not specify which aphid species nor did he specify the exact locations of these places nor the times of the year they were aphid-free. The species of aphids that occur in a potato-growing area are particularly important to virus transmission, as not all aphids colonise potatoes and therefore do not threaten potatoes, and because virus transmission efficiency of species capable of spreading PLRV varies. The suitability of a seed potato producing area is partly dependant on low levels of aphid activity. Lack of this information makes its difficult to predict aphid activity and associated virus spread in specific areas, and more importantly, makes it impossible to demonstrate to potential seed potatoes export markets that the crops were produced in a suitable seed-producing area.

This study was aimed to survey the timing of activity of aphid species occurring in the potato-growing areas of south-west WA during the summer potato growing period. Green peach aphid activity is dicussed in relation to PLRV spread and hence suitability of sites for seed potato production.

MATERIALS AND METHODS

Sites

A total of thirty-one sites were monitored from late spring to early autumn (October to May) over four years (Fig. 1). Most of the sites were in the vicinity of potato crops (Fig. 2). Ten sites were monitored in 1988-89 (Table 1a), twenty-one in 1989-90 (Table 1b), nineteen in 1990 -1991 (Table 1c) and twenty-one in 1991-92 (Table 1d).

Sampling method

The sites were monitored by either or a combination of sticky cylindrical traps, water traps and by taking samples of potato leaves (Table 2).

Migratory (winged) aphids: sticky traps

Two yellow sticky cylindrical traps were run at each site: one at the north west and at the south east corners of the crop or paddock being monitored. Yellow was chosen because it is the most attractive colour to aphids. The trap consisted of a 2L pickle jar covered with a 13cm by 40cm rectangle of yellow Contact ®(Nylex corporation) erected at 5-8 feet on a steel star picket. Traps were activated by removing the backing of the contact, and were renewed on a weekly basis.

Migratory (winged) aphids: water traps

Yellow water (Moericke) traps were used in addition to sticky traps in 1990-1991. One trap, a white plastic box 12cm deep by 41cm by 31cm coated on the inner surfaces with either yellow paint or yellow Contact®, was placed 8-10 m into the NE and SW corners of the crop. Traps were maintained at crop height and were cleared weekly.

Colonising aphids: leaf samples

Colonising aphids were sampled from 1989 onwards in sites associated with potato crops. Two samples consisting of 20 lower leaves (**not** leaflets) were taken weekly from each crop. One sample was taken from a diagonal transect starting from the SE and the other starting from the NW corner of each crop. The leaves were placed in plastic bags and returned to the laboratory, where they were washed three times with hot water to kill and dislodge the aphids. The washings were passed through a sieve to extract aphids, which were then identified to species level with the aid of a microscope.

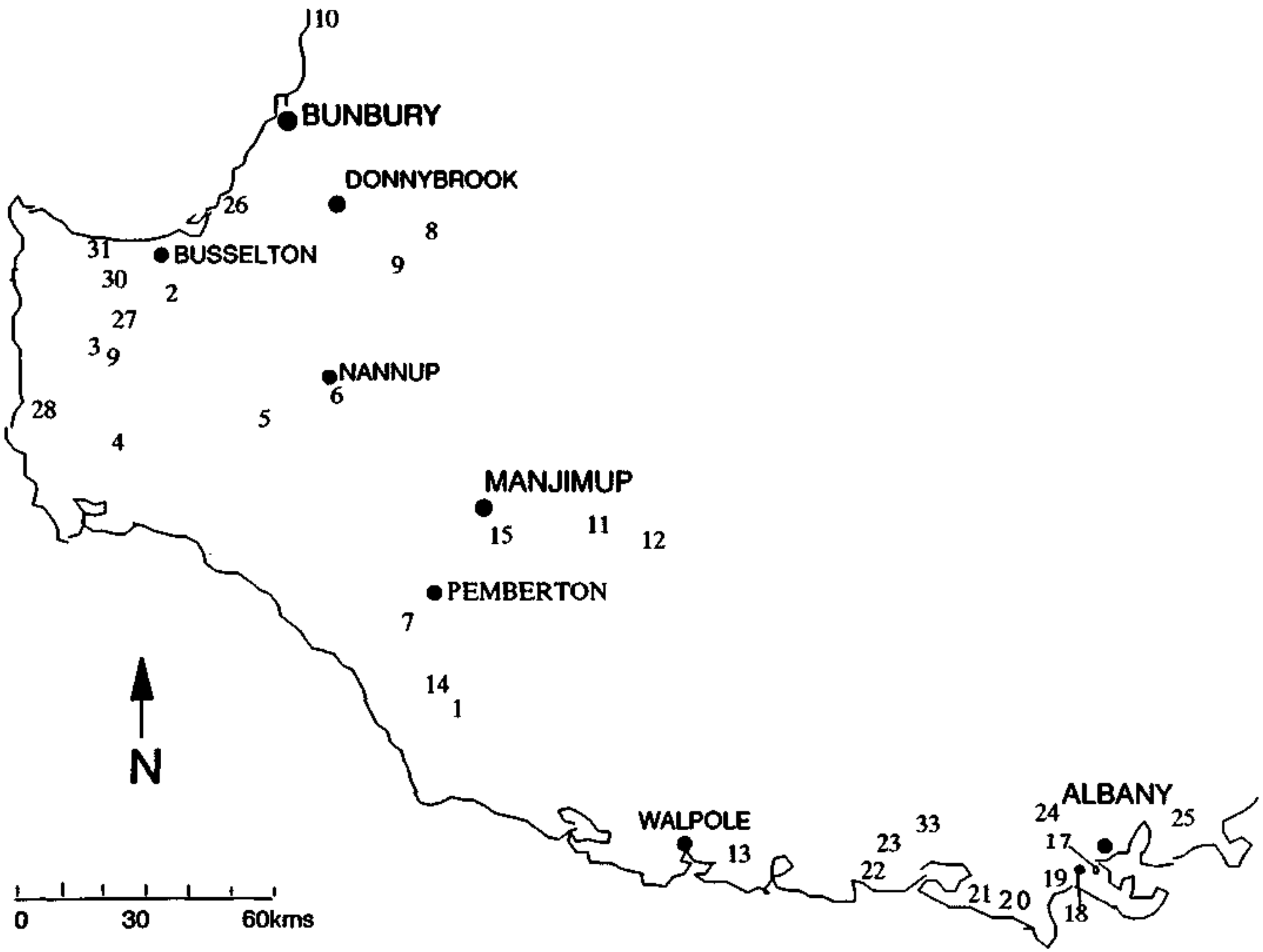

Fig. 1. Locations of aphid-monitoring sites.

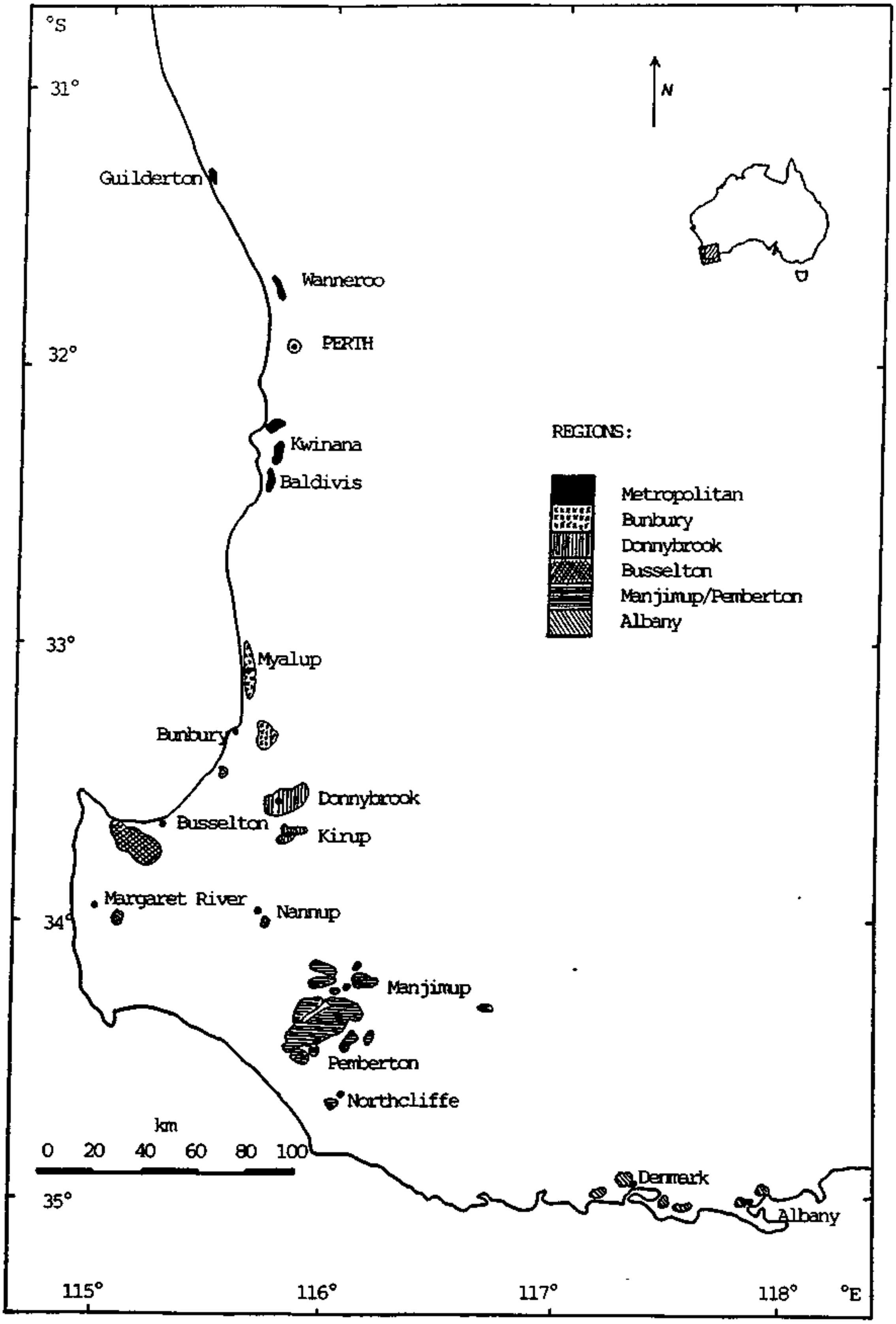

Fig 2. Potato growing areas of western Australia[1]

[1]From Learmonth, S.E. & J.N. Matthiessen (1991) Soil Insect Pests of Potatoes, final report RIRDC Project No. DAW007A & HRDC Project No. P/0021/R3.

Grower survey

From 1989 onwards surveys were conducted to record the insecticide practice at each site associated with a potato crop. This information was needed to help explain variation in aphid numbers. A copy of the survey form is included in the appendix.

Statistical analysis

Only data on numbers of green peach aphid were analysed. Other potato-colonising species were not widespread and in addition, do not pose a great a risk as green peach aphid. The first year's data was omitted from the analyses, as leaf sampling was not used. Timing of first arrival, regardless of technique which detected arrival, at sites associated with potato crops and monitored by leaf sampling and sticky traps, was converted to days after October 1. Sites were grouped according to region (Table 3), and differences between days were statistically analysed to ascertain differences between sites and between regions.

Table 1a. Details of 1988-89 sites.

Site	*Farmer*	*Crop monitored*	*Date potatoes sown*	*Surrounding vegetation*
1	Smithers	Pasture	n/a	Grassy pasture, lucerne, native bush
2	Cuthbert	Potatoes	late January	Pasture and native bush
3	Darnell	Potatoes	mid October	Clover pasture, native bush
4	Wren	Vegetables	n/a	Pasture and native bush
5	Birnee	Lucerne	n/a	Clover pasture and berries and native bush
6	Lee	Potatoes	mid October	Clover pasture, native bush
7	J. Della-Franca	Potatoes	late November	Clover pasture , native bush
8	MHRC	Potatoes	September & December	Pasture, lucerne cereals, vegetables and fruit trees
9b	Dellagostino	Potatoes	mid October	Pasture, native bush & fruit trees
10	Wilmont	Potatoes	late January	Vegetables, cereal, native bush, lucerne

Table 1b. Details of 1989-90 sites.

Site	*Farmer*	*Crop Monitored*	*Date potatoes sown*	*Surrounding vegetation*
1	Smithers	Pasture	n/a	native bush
3	Darnell	Potatoes	October	pasture, native bush
4	Wren	Crucifers Tomatoes	n/a	pasture, native bush
5	Birnee	Pasture	n/a	pasture, native bush
6	Lee	Potatoes	October	onions, pasture, native bush
7	J. Della-Franca	Potatoes	August	Karri (*E. diversicolor*) forest, pasture, buckwheat
11	Ipsen	Potatoes	September	pasture, oats, native bush
12	Phillips	Potatoes	October	onions, pasture, native bush
13	Bellanger	Potatoes	December	pasture, some lucerne, pine trees, native bush
14	R. Della-Franca	Potatoes	September	pasture, ryegrass, native bush
15	MHRC	Potatoes	January	onions, pasture, oats, peas, cruciferous crops
16	MHRC	Potatoes	January	onions, pasture, oats, peas, cruciferous crops
17	Tweddle	Potatoes	November	pasture, native bush
18	Allen	Potatoes	December	pasture, native bush
19	Reddin	Potatoes	November/ December	pasture, potatoes
20	Wolfe	Potatoes	December	pasture, potaotes and native bush
21	Mitchell	Potatoes	November	native bush
22	Liang	Potatoes	November	native bush
23	Farr	Potatoes	November December	native bush
24	Ayres	Potatoes	November	native bush, potatoes
25	Bocian	Potatoes	November	potatoes, pasture, native bush

Table 1c. Details of 1990-91 sites.

Site	*Farmer*	*Crop monitored*	*Date potatoes sown*	*Surrounding vegetation*
1	Smithers	Pasture	n/a	native bush
2	Carter	Potatoes	October & January	pasture, native bush
3	Darnell	Potatoes	October	pasture, native bush
4	Wren	Crucifers Tomatoes	n/a	pasture, native bush
5	Birnee	Pasture	n/a	pasture, native bush
6	Lee	Potatoes	October	onions, potatoes, pasture, native bush
7	J. Della-Franca	Potatoes	August & September	Karri (*E. diversicolor*) forest, pasture, buckwheat
8	Russell	Potatoes	October	pasture
9a	Arthur	Potatoes	October	pasture, native bush
11	Ipsen	Potatoes	September	onions, pasture, native bush
12	Phillips	Potatoes	October	cauliflower, onion, peas, pasture, native bush
13	Bellanger	Pasture		pasture, small plot potatoes, pine trees, native bush
14	R. Della-Franca	Potatoes	October	poatoes, pasture, native bush
15	Femia	Potatoes	September	onions, pasture, oats, peas, cruciferous crops,
17	Tweddle	Potatoes	December	pasture, native bush
18	Allen	Potatoes	December	pasture, native bush
20	Wolfe	Potatoes	December	pasture, potatoes, pumpkin, and native bush
21	Mitchell	Potatoes	November	native bush
22	Laing	Potatoes	November	native bush

Table 1d. Details of 1991-92 sites.

Site	*Farmer*	*Crop monitored*	*Date crop sown*	*Surrounding vegetation*
2	Carter	Potatoes	July	pasture, native bush
3	Darnell	Potatoes	November	pasture, native bush
4	Wren	Crucifers, tomatoes	n/a	pasture, native bush
7	J. Della-Franca	Potatoes	December	Karri (*E. diversicolor*) forest, pasture, buckwheat
9a	Arthur	Potatoes	November	pasture, native bush
11	Ipsen	Potatoes	October & November	pasture, native bush
12	Phillips	Potatoes	October	cauliflower, pasture,
14	R. Della-Franca	Potatoes	September, November	potatoes, pasture, native bush
15	Femia	Potatoes	September	pasture, oats, stonefruit orchard
17	Tweddles	Potatoes	December	pasture, native bush
18	Allen	Potatoes	December	pasture, native bush
19	Shirley	Potatoes	November	pasture, native bush
20	Wolfe	Potatoes	November	pasture, carrots, watermelon, beetroot, potatoes, pumpkin, and native bush
21	Mitchell	Potatoes	November	potatoes, native bush
22	Laing	Potatoes	November	native bush
26	Forrest	potatoes	late January	potatoes, native bush
27	Vlietman	Tomatoes, watermelon, squash	n/a	native bush
28	B. Darnell	Pasture	n/a	native bush
30	Feutrill	Potatoes	late January	potatoes, native bush
31	Rose	Potatoes	late January	potatoes, native bush
33	Sherewood	Pasture	n/a	pasture, native bush

Table 2. Type of sampling carried out at each site.

Site	*Grower*	*1988-89*	*1989-90*		*1990-91*			*1991-92*	
		trap only	*trap*	*leaf*	*trap*	*leaf*	*water*	*trap*	*leaf*
1	Smithers	*	*		*				
2	Cuthbert (1988-89) Carter (1990-92)	*			*	*	*	*	*
3	Darnell	*	*	*	*	*	*	*	*
4	Wren	*	*		*			*	
5	Birnee	*	*		*				
6	Lee	*	*	*	*	*			
7	J. Della-Franca	*	*	*	*	*	*	*	*
8	Russell				*	*	*		
9a	Ray Arthur				*	*		*	*
9b	Dellagestino	*							
10	Wilmont	*							
11	Ipsen		*	*	*	*		*	*
12	Phillips		*	*	*	*		*	*
13	Bellanger		*	*	*				
14	R. Della-Franca		*	*	*	*		*	*
15	MHRC (1989-90) Femia (1990-92)	*	*	*	*	*	*	*	*
16	MHRC								
17	Tweddle		*	*	*	*		*	*
18	Allen		*	*	*	*	*	*	*
19	Reddin (1989-90) Shirley (1991-92)		*	*				*	*
20	Wolfe		*	*	*	*		*	*
21	Mitchell		*	*	*	*	*	*	*
22	Liang		*	*	*	*		*	*
23	Farr		*	*					
24	Ayres		*	*					
25	Bocian		*	*					
26	Forrest							*	*
27	Vlietman							*	
28	B. Darnell							*	
30	B. Feutrill							*	*
31	K. Rose							*	*
33	Sherewood							*	

* indicates use of the associated technique.

Table 3. Aphid monitoring sites grouped by region.

"Busselton"	*"Manjimup"*	*"Albany"*
2,3,4,5,6,8,9a,9b,10,26, 28,30,31,	1,7,11,12,14,15,16	13,17,18,19,20,21,22,23, 24,25,33

RESULTS

A total of 33 aphid species were trapped and identified (Table 4). Five of these species are colonisers of potatoes: cowpea aphid, *Aphis craccivora* Koch, foxglove aphid, *Aulacorthum solani* (Kaltenbach), potato aphid, *Macrosiphum euphorbiae* (Thomas) and *Rhopalosiphoninus staphyleae* (Koch). The activity of all these aphids varied between and amongst sites. Limited results are presented for potato-colonising species other than green peach aphid. The other 28 species colonise a variety of plants including grasses, horticultural crops and native plants.

Total number and timing of first arrival of green peach aphid as determined by sticky traps, water traps and leaf sampling at each site for each season are presented in Table 5. Weekly catches of green peach aphid at each site for the duration of the study are presented in Appendix 2.

1988-89

Both green peach aphid and potato aphid were recorded by sticky traps from all sites. Foxglove aphid was not detected.

Several trapping methods were used in the subsequent years. The following is a summary of potato-colonising aphid species occurring at all sites, where the trapping technique is not distinguished.

1989-90

Green peach aphid was recorded at 95.2% of sites, potato aphid from 27.8% of sites. Again foxglove aphid was not recorded.

1990-91

Green peach aphid was recorded from 94.7% of sites, foxglove aphid from 94.5% of sites, and potato aphid from 21.1% of sites

1991-92

Green peach aphid was recorded from all sites, foxglove aphid from 61.9% of sites, and potato aphid from 38.1% of sites.

Table 4. Species of aphids recorded in the survey conducted in south-west Western Australia 1988-1992.

SPECIES	COMMON NAME
Acyrthosiphon kondoi **(Shinji)**	Bluegreen aphid
A. pisum **(Harris)**	Pea aphid
Anomalaphis **sp. *nov.***	Native species
Aphis craccivora **(Koch)**	Cowpea aphid
A. gossypii **Glover**	Cotton aphid
Aulacorthum solani **(Kaltenbach)**	Glasshouse potato aphid
Brachycaudus helichrysi **(Kaltenbach)**	Leafcurl plum aphid
B. rumexicolens **(Patch)**	Dock aphid
Brevicoryne brassicae (L.)	Cabbage aphid
Capitophorus elaeagni **(del Guercio)**	
Capitophorus hippophaes **(subsp. *mitegoni)* Eastop**	
Cavariella aegopodi **(Scopoli)**	Willow-carrot aphid
Ceriferella **spp.**	Native species
Dysaphis aucupariae **(Buckton)**	Wild service aphid
Geocia sp.	
Hyperomyzus lactucae **(L.)**	Sowthistle aphid
Hysteroneura setariae **(Thomas)**	Rusty plum aphid
Lipaphis erysimi **(Kaltenbach)**	Turnip aphid
Macrosiphum euphorbiae **(Thomas)**	Potato aphid
M. rosae **(L.)**	Rose aphid
Myzus persicae **(Sulzer)**	Green peach aphid
Pemiphigus spp.	
Rhopalosiphoninus (Myzosiphon) staphyleae **(Koch)**	
Rhopalosiphum maidis **(Fitch)**	Corn leaf aphid
R. padi **(L.)**	Bird cherryoat aphid
R. rufiabdominalis/insertum	Rice root/Apple grass aphid
Smythurodes **spp.**	
Taiwanaphis **sp.**	Native species
Tetraneura (Tetraneurella) nigrabdominalis **(Sasaki)**	
Therioaphis trifolii **f. *maculata*** **(Buckton)**	Spotted alfalfa aphid
Tinocallis ulmiparvifoliae **Matsumura**	
Toxoptera citricidus **(Kirkalady)**	Tropical citrus aphid
Tuberculatus (Tuberculoides) annulatus **(Hartig)**	

Table 5. Total number and date of first appearance of green peach aphids trapped by either sticky traps, leaf sampling or by water traps, separated by site and year.

TRAP	*LONG*	*LAT.*	*YEAR*	*SAMPLING METHOD*					
				Sticky trap		*Leaf sample*		*Water trap*	
				No. aphid	*1st app*	*No. aphid*	*1st app*	*No. aphi*	*1st app*
1	116.12	34.75	1988-89	1	7 March	-	-	-	-
			1989-90	4	16 Feb	-	-	-	-
			1990-91	3	14 Dec	-	-	-	-
2	115.22	33.75	1988-89	184	26 Nov	-	-	-	-
			1990-91	91	8 Jan	3	17 Apr	24	7 Apr
			1991-92	57	19 Nov	37	26 Feb	-	-
3	115.2	33.93	1988-89	17	7 Mar	-	-	-	-
			1989-90	8	27 Dec	0	n/s	-	-
			1990-91	63	30 Oct	0	n/s	0	n/s
			1991-92	23	11 Feb	1	11 Feb	-	-
4	115.23	34.12	1988-89	52	9 Nov	-	-	-	-
			1989-90	6	20 Nov	-	-	-	-
			1990-91	8	6 Nov	-	-	-	-
			1991-92	7	4 Mar	-	-	-	-
5	115.56	34.08	1988-89	26	21 Feb	-	-	-	-
			1989-90	2	30 Jan	-	-	-	-
			1990-91	3	30 Oct	-	-	-	-
6	115.73	33.93	1988-89	23	7 Mar	-	-	-	-
			1989-90	2	20 Apr	11	30 Jan	-	-
			1990-91	4	30 Oct	1	20 Nov	-	-
7	116.03	34.47	1988-89	6	9 Nov	-	-	-	-
			1989-90	212	19 Jan	583	15 Dec	-	-
			1990-91	5	8 Mar	36	11 Jan	14	11 Jan
			1991-92	56	4 Feb	157	4 Feb	-	-
8	116.07	33.63	1990-91	15	20 Mar	16	28 Dec	27	27 Mar
9A	115.2	33.9	1990-91	10	30 Oct	3	6 Mar	-	-
			1991-92	53	25 Mar	0	n/s	-	-
9B	115.9	33.72	1988-89	74	14 Mar	-	-	-	-
10	115.68	33.12	1988-89	55	24 Jan	-	-	-	-
11	116.63	34.33	1989-90	6	30 Apr	464	5 Jan	-	-
			1990-91	16	2 Nov	0	n/s	-	-
			1991-92	14	25 Feb	2	26 Nov	-	-
12	116.47	33.33	1989-90	90	20 Apr	5	22Dec	-	-
			1990-91	45	2 Nov	6	23 Nov	-	-
			1991-92	2	24 Mar	3	11 Feb	-	-
13	116.87	35	1989-90	1	30 Mar	19	23 Feb	-	-
			1990-91	1	9 May	-	-	-	-
14	116.12	34.65	1989-90	74	26 Jan	588	22 Dec	-	-
			1990-91	3	18 Mar	9	2 Nov	-	-
			1991-92	11	11 Feb	769	26 Nov	-	-
15	116.13	34.25	1988-89	112	15 Nov	-	-	-	-
			1989-90	121	5 Jan	2510	5 Jan	-	-
			1990-91	74	2 Nov	314	2 Nov	152	22 Feb
			1991-92	14	11 Feb	16	11 Feb	-	-
16	116.13	34.25	1989-90	9	16 Feb	11	23 Feb	-	-
17	117.83	35.05	1989-90	2	26 Apr	142	14 Mar	-	-
			1990-91	5	16 Nov	11	21 Mar	-	-
			1991-92	3	18 Dec	14	19 Feb	-	-
18	117.8	35.05	1989-90	8	8 Mar	0	n/s	-	-
			1990-91	2	18 Apr	0	n/s	0	n/s
			1991-92	28	4 Mar	0	n/s	-	-
19	117.76	35.05	1989-90	1	19 Apr	0	n/s	-	-
			1991-92	4	15 Apr	4	26 Feb	-	-
20	117.59	35.06	1989-90	1	10 May	0	n/s	-	-
			1990-91	0	n/s	0	n/s	-	-
			1991-92	2	19 Feb	2	4 Mar	-	-
21	117.42	35.05	1989-90	19	28 Feb	39	2 Feb	-	-
			1990-91	4	7 Mar	0	n/s	1	Mar
			1991-92	8	4 Mar	87	15 Jan	-	-
22	117.22	35	1989-90	2	8 Mar	258	25 Jan	-	-
			1990-91	0	n/s	2	27 Mar	-	-
			1991-92	7	27 Nov	8	26 Feb	-	-
23	117.36	34.93	1989-90	0	n/s	0	n/s	-	-
24	117.77	34.88	1989-90	4	3 May	0	n/s	-	-
25	118.08	34.91	1989-90	4	1 Mar	0	n/s	-	-
26	115.5	33.58	1991-92	551	28 Jan	1180	4 Mar	-	-
27	115.2	33.81	1991-92	117	4 Mar	-	-	-	-
28	115.12	34.07	1991-92	6	11 Feb	-	-	-	-
30	115.23	33.72	1991-92	107	18 Mar	52	26 Feb	-	-
31	115.2	33.7	1991-92	183	26 Feb	198	26 Feb	-	-
33	115.43	34.92	1991-92	2	20 Nov	-	-	-	-

'-' = not applicable
'n/s' = not sighted

Timing of first arrival of green peach aphid

Green peach aphid arrived significantly earlier ($p < 0.01$) at the Busselton and Manjimup sites for the 1989-90 and 1990-91 seasons (Fig. 3). However, aphid arrival was the same for all regions in 1991-92. There was no evidence of differences between sites within regions, indicating the differences between sites can be explained by the region to which they belong.

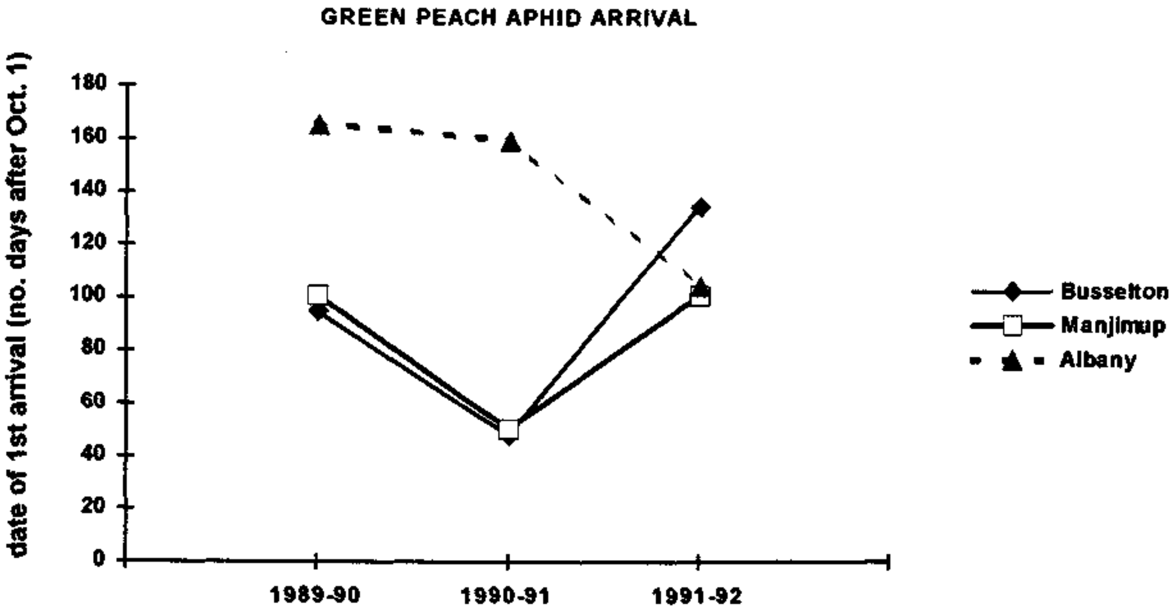

Fig. 3. Comparison of timing of first green peach aphid arrival at each regions from 1989-92.

Grower survey

Results of the growers survey are presented in Table 6. Most growers responded to the survey, and the return rate of questionnaires averaged over 70%. On average, growers in the Busselton and Manjimup regions sprayed their crops with insecticides more often than the Albany growers.

Table 6. Mean number of insecticide sprays applied per study site (potato crops only), grouped by region, determined by surveying growers with questionnaires.

Year	*Busselton*	*Manjimup*	*Albany*
1989-90	3, n=2	6.4, n=5	3.5, n=8
1990-91	5, n=1	4, n=1	4.2, n=5
1991-92	5.8, n=5	6, n=5	3.8, n=5

DISCUSSION

Sites

Sampling was abandoned at some sites where high levels of aphids were recorded, which deemed the area inappropriate for seed potato production early in the study, and therefore to continue monitoring was unnecessary. However, some sites with these characteristics were retained, to provide baseline data for comparison with sites with low levels of aphid activity. New sites were also selected to replace "abandoned" sites.

Sampling methods

Sticky traps

Sticky yellow cylindrical traps were based on sticky trap designs commonly used for sampling alate aphids. The method was effective in catching winged adults, and traps remained sticky for much longer than the sampling period of 1 week. Traps were simple to operate, and were selective in catching winged aphids, which facilitated sorting traps catches.

Water traps

The water trap was difficult and time-consuming to use. All aspects of operation had associated problems: from setting up and maintaining the trap, to retrieving and sorting samples. The trap was very vulnerable, as the contents were easily dislodged if the trap was disturbed by wind, wildlife or stock. Maintenance of traps more frequently than weekly was not possible due to remoteness of sites. Retrieval of samples was difficult, as the contents had to be carefully strained to prevent any loss of the sample. The traps attracted many types of insects, sometimes in very large numbers. Trap catches at times included ferment flies (Drosophila) in their tens of thousands and only a very small number of aphids. Sorting aphids from these large samples was extremely time consuming and impractical.

Use of water traps were abandoned after one season as they did not provide any additional information to leaf sampling and sticky traps.

Leaf samples

Collection and sorting of leaf samples was a useful additional aphid monitoring technique. Very low numbers of alate (winged) aphids which initiate aphid colonies may not always be detected by sticky traps.

Comparison of sampling methods

Sticky traps were not as efficient as leaf collections for monitoring green peach aphid, as presence of this species was most often recorded first by either the leaf method alone

(51.4% of the time) or simultaneously by the leaf method and trap (17.1% of the time). In addition, the water traps, in comparison to the sticky cylindrical trap, was difficult and time-consuming to use. Therefore, using sticky traps alone to monitor aphids in potato crops is relatively less accurate, as traps are capable of predicting colonising aphids on approximately 30% of occasions. As a consequence, PLRV spread may occur before aphid presence is detected if traps alone were used to monitor aphid activity. Flanders *et al.* (1991) highlighted the importance of early detection of colonising aphid activity by demonstrating that apterae, even at low numbers, were primarily responsible for PLRV spread. This highlights the need for proper sampling when monitoring aphids in potato crops, for instance, when the farmer might want to maintain aphid numbers below the acceptable threshold. Monitoring aphid thresholds in seed potato crops is discussed in a later section.

Although catches using yellow traps as an atttractant are biased, in that some species are more attracted than others to yellow, Boiteau (1990) demonstrated that green peach aphid and potato aphid are most attracted to yellow. As this study was mainly concerned with these species, the bias did not unduly affect the aim of this project.

Despite the relative inefficiency of sticky traps at predicting aphid colonisation, they are complementary to leaf sampling and their use is recommended in conjunction with this technique when monitoring aphid activity in crops .

Factors influencing distribution, abundance and activity of green peach aphid

The earliest record of green peach aphid in WA is 1943, by Norris (1943), who recorded this aphid at Yarloop, Wongan Hills, Gingin, Fremantle and Wyening. This widespread distribution indicates that it was likely to have been introduced earlier. Because this species had been present in WA for approximately 50 years when the present study was conducted and because it has a wide host range (this species has been recorded from over 40 plant families) may explain our result of it's widespread distribution. Green peach aphids were absent from site 23, possibly because traps at this site were run for part of a single season, which may not have been long enough to detect aphid activity.

As part of normal crop management practice, most potato crops receive regular insecticide applications, which probably accounts for some of the variability in green peach aphid numbers recorded in crops (as measured by leaf sampling). Despite the influence of insecticide treatment, aphid numbers in Albany remained lower than elsewhere. This was demonstrated by the results of a survey of insecticide practices of growers (Table 6), which showed that Albany growers sprayed their crops far less frequently that growers in other areas, yet green peach aphids were mostly either absent or present in low numbers. For example, compare site 8, where a total of 5 aphids had been found by sticky traps and leaf sampling between 1989-92, yet the crops had been sprayed 6 times, with site 7, where 2722 aphids were found in a single season, during which the crop has been sprayed 7 times.

Green peach aphid activity was very high at many sites (7, 11, 14 & 15) between Manjimup and Pemberton, an area of concentrated ware potato production (Fig 2). The most probable explanation for this high level of aphid activity is linked to the reduced number of insecticide applications. Ware crops are not treated with insecticide as often as seed crops, thus permitting aphid populations to readily "build up" in ware crops, numbers which were reflected in the trap catches.

Green peach aphid was detected in leaf samples from more sites than other potato-colonising species, and was also found in higher numbers in these samples. This was probably partly due to the effect of the sampling method, which was biased toward green peach aphid. However, this bias did not detract from the overall aim of the study, as the aphid of greatest concern was green peach aphid.

There are several likely reasons responsible for green peach aphid arriving significantly earlier at the more northern sites (Busselton & Manjimup regions) than at southern sites (Albany), where they persisted in lower numbers, during two out of the three years of monitoring (Fig. 3). Firstly, consider the source of aphids - the only source is to the north of coastal area (aphids are unlikely to originate from the sea!), unlike the Manjimup or Busselton potato growing areas which are surrounded by ware crop and continuous potato cultivation that possible sources of aphids. Secondly, the prevailing winds are southerly, either SW or SE, which helps to prevent weak flying aphids, from approaching the coastal area. In addition, time of sowing may have influenced aphid activity. Potato crops in Albany are sown once a year, unlike the other regions, where longer seasons or continuous cropping takes places (Table 7). Lack of potato crops in between seasons at Albany may account for fewer suitable host plants, and therefore fewer local sources of green peach aphid.

Table 7. Sowing times for potatoes in south-west Western Australia (P. Dawson, pers.comm.).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Busselton	■	■				■	■					
Marg. River										■	■	■
Donnybrook	■	■				■	■			■		
Manjimup	■								■	■	■	■
Albany										■	■	■

Implications of green peach aphid activity to PLRV spread and in selecting suitable seed potato growing sites

To evaluate the risk of secondary PLRV spread in potatoes by aphids, knowledge on the species, distribution, and activity of aphids in the area must be considered when selecting sites to grow seed potatoes. The species of aphids present are important, as the ability to transmit PLRV has been demonstrated in only a few species. Additional factors that need to be taken into account are: firstly, the presence of a virus source, (ie. PLRV-infected plants), which Wilson & Jones (1990) have established exist locally at low levels; and secondly, timing of the arrival of aphids, particularly green peach aphid. Two important implications to PLRV spread are associated with early aphid arrival: firstly, a young potato crop is more susceptible to virus infection than a mature crop, and secondly, aphids exploit the longer growing season by building-up in the crop, thereby generating large numbers of wingless aphids that may also significantly contribute to secondary virus spread.

The widespread distribution of green peach aphid in south-western Australia and the existence of PLRV at first indicates no areas suitable for growing seed potatoes. Because low numbers of apterous aphids pose a threat in the form of virus transmission, even areas with low numbers of green peach aphid early in the season identified by this study are unlikely to be considered totally safe for seed potato production.

The combination of late arrival and low aphid pressure in the Albany region indicates that it is most suitable for seed potato production. This result supports that of Collins (1928), who indicated that certain areas in south-western Australia are subject to low aphid pressure, but more importantly, specifies the locations of these places and identifies the species present, which Collins (1928) failed to do.

Prior to this study, the region around Margaret River was considered as a potentially new area for seed potato production. However, this area is not isolated enough from other regions of potato production to deem it aphid-free. This was supported by the results of this study, which found no difference in timing of first arrival among Busselton sites. Winged aphids can travel hundreds of kilometres in air currents (Dixon 1985). Therefore, migrant aphids produced in crops near Busselton could theoretically easily travel to the Margaret River sites (site 3). This theory is supported by the finding that aphids consistently appeared early at site 3, indicating that they originated from potato crops in the north. Alternatively, these early arrivals may have developed from a local green peach aphid infestation. Therefore, consideration also should be given to the possibility that local populations of green peach aphid may exist year-round on home vegetable gardens or hobby farms in the Margaret River region.

Green peach aphid is probably active year-round in the Busselton and Manjimup regions, owing to the proximity of intensive horticultural operations. These populations represent a continual threat to seed potato crops, both in terms of transmitting PLRV and causing feeding damage. Areas situated near sites of ware and processing potato production are particularly at risk, as continuous cultivation also provides plenty of opportunity for aphid populations to establish in these often untreated crops. These large numbers of aphids are a potential source of infestation to seed crops grown in the area, and would facilitate virus transfer from non-seed crop sources to seed crops (Bacon *et al.* 1976). This effectively rules out the possibility of selecting sites in the Busselton and Manjimup regions for seed production.

As long as WA continues to grow 'Delaware' as the major potato variety, it's susceptibility to PLRV infection will limit seed potato production to the south coast. The available land for seed production in the south coast is already being used to full capacity, and seed potatoes are mostly produced for local use. Therefore, production for export is very limited. On a more promising note, Wilson and Jones (1993) have found that the Australian-bred varieties 'Whitu' and 'Spunta' are resistant to PLRV. Therefore, it may be possible to utilise areas other than the south coast for seed production by growing these varieties.

Control of PLRV by insecticides

Use of insecticides to control PLRV in susceptible potato varieties has been considered as alternative to control by cultural methods such as growing the crop in a suitably 'safe' site.

However, insecticides are costly and seldom effective. Bacon *et al.* (1976) found that regular insecticide treatments provided little or no protection to plants from alate viruliferous aphids. In WA, seed potatoes can be successfully grown in areas identified as low aphid risk, such as the south coast. Despite the relative safety of this region, the grower should be aware of the threat of PLRV, and if the need arises, should attempt to control aphids with granular systemics (eg. phorate) at seeding time in preference to insecticide sprays, and use sprays only as a last resort. Growers in low risk areas still need to closely monitor their crops for aphids, and apply sprays only if necessary (ie. if the aphid threshold is exceeded - see later section). Minimal use of sprays are recommended for 2 reasons: one, frequent spraying is of inconsistent value (Woodford *et al.* 1983), and two, they select for insecticide resistance in green peach aphid.

The efficacy of sprays to control aphids are subject to a number of factors; firstly the correct application procedure is essential, secondly, suitable weather conditions are required for efficient spray application. Spraying aphids at low levels can cause increases in virus incidence. Sprayed aphids become agitated and probe the plants more than normal, thus spreading the virus. Two reasons have been put forward to explain this: one, sub-lethal amounts of spray may be the cause, or two, a correct dose of spray was applied but the chemical's mode of action is not instantaneous and the aphids die after a delayed time interval, during which they can move about plants and spread virus before they die.

Insecticide resistance in green peach aphid is well documented (refs), and has been recorded in WA (Berlandier & Dadour 1992). The cause of resistance is due to several factors, the most significant being routine spraying. Resistance in green peach aphid to various chemicals is inevitable, therefore measures should be taken to delay the onset of resistance. If resistance has been recorded, management of resistance is strongly recommended to preserve the number of currently available chemicals. To wait for the release of effective new insecticides for control of resistant aphids can take up to 10 years, and with laws for chemical registration becoming more and more stringent, the process could lengthen in the future.

Thresholds for control of green peach aphid

A number of researchers have attempted to establish thresholds for green peach aphid and PLRV control by examining correlations between PLRV infection and aphid numbers, with varying results. Correlations between numbers of colonising aphids and PLRV spread have been found, but it is difficult to correlate numbers of winged aphids with PLRV spread.

Cancelado & Radcliffe (1979) determined that foliar sprays were needed when ca. 10 apterae/105 leaves were recorded in Minnesota. This translates to 1.9 aphids/20 leaves in our study. In California, Bacon *et al.* (1976) found no correlation between numbers of apterae and PLRV infection, but demonstrated that PLRV incidence was highest in years of "greatest alate aphid populations" as determined by water (Moericke) traps. Byrne & Bishop (1979) contracted a simple model for green peach aphid thresholds for seed potato crops in Idaho, USA. They found that if 0.2% of the crop was infected with PLRV, and if more than 10 green peach aphids/50 leaves were recorded in 2 consecutive sampling periods, then spraying was warranted. To draw a parallel to our study, more than 2.5 aphids/20 leaves would warrant spraying to control PLRV.

In summary, research in the USA indicates that a need to spray arises when a threshold of approximately 2 green peach aphids/20 leaves is reached. To maintain this threshold in WA, monitor colonising aphids by leaf sampling. If the grower intends to utilise only one sampling method, leaf sampling rather than sticky traps is recommended. However, use of sticky traps in combination with leaf sampling as an additional technique is warranted. In addition, to make best use of the aphid-free period around Albany, and to minimise crop exposure to PLRV, crops should be planted no later than November.

RECOMMENDATIONS & CONCLUSIONS

The coastal swamp area between Walpole and Albany has been the traditional seed producing region since early this century, and the findings of this current study support the use of this area for seed potato production. Furthermore, the study presents detailed evidence on aphid species and activity for the first time, which may explain why PLRV infection in potatoes is rare in the area. Although the relative absence of aphids in the area has been previously discussed in the literature (Collins 1928), details on the species involved have never been provided.

Cultivation of the PLRV susceptible variety 'Delaware' will continue to restrict seed producing sites to this traditional area due to the relatively low levels of green peach aphid activity and hence lower risk of PLRV infection, as compared with other current potato (ware) growing areas. However, it may be possible to utilise less favourable sites outside the south coast swamp area for successful seed production following the introduction of suitable PLRV-resistant varieties, such as 'Whitu' and 'Spunta'. Only then can we further explore the possibility of producing seed potatoes for export to overseas markets.

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Appendices

Appendix 1. Questionnaire on insecticide practices sent to growers.

APHID MONITORING IN POTATO CROPS 1991-92

Name________________________

Property_____________________

PLEASE RETURN FORM TO :

Francoise Berlandier
Entomology Branch
Department of Agriculture
SOUTH PERTH 6151
(09) 368 3249

POTATO CROP DETAILS

Variety______________________

Origin of seed________________

Date of sowing_______________

Acreage_____________________

Age of seed__________________

Date of haulm destruction______

Seed or ware potatoes_________

CHEMICAL TREATMENT DETAILS

Date	Herbicide/ Pesticide	Target pest	Rate of application	Sucess of application	Comments

Appendix 2. Weekly counts of green peach aphids

To allow easy comparison of aphid numbers between years, the date of the weekly aphid counts was converted to the corresponding week of the month. For examples, dates 1-7 were allocated week 1, and so on:

Date of month	Week
1 - 7	1
8 - 14	2
15 - 21	3
22 - 28	4
29 - 29	5

Numbers of M. persicae over 4 seasons, 1988–92: sites 2, 3, 9a, 27, 30, 31
MAP1.WQ1, DISK 2B

SITE:		31			31			30			30		
NAME:		K.Rose			K.Rose			B. Feutrill			B. Feutrill		
YEAR:		1991–92			1991–92			1991–92			1991–92		
SAMPLE:		STICKY			LEAF			STICKY			LEAF		
Month	wk	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*
Oct	4												
	5												
Nov	1												
	2	0	0	*0*				0	0	*0*			
	3	0	0	*0*				0	0	*0*			
	4	0	0	*0*				0	0	*0*			
Dec	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	0	*0*				0	0	*0*			
Jan	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												
Feb	1	0	0	*0*				0	0	*0*			
	2	0	0	*0*				0	0	*0*			
	3	0	0	*0*	0	0	*0*	0	0	*0*			
	4	1	0	*1*	0	1	*1*	0	0	*0*	3	0	*3*
Mar	1	0	N/D	*0*	0	1	*1*	0	0	*0*	0	1	*1*
	2	0	0	*0*	7	3	*10*	0	0	*0*	6	2	*8*
	3	0	4	*4*	23	56	*79*	0	1	*1*	9	0	*9*
	4	26	10	*36*	53	18	*71*	4	1	*5*	10	5	*15*
Apr	1	1	41	*42*	5	11	*16*	9	10	*19*	4	12	*16*
	2	4	11	*15*	0	1	*1*	3	7	*10*	0	0	*0*
	3	4	3	*7*	0	1	*1*	1	12	*13*	0	0	*0*
	4	21	7	*28*	2	13	*15*	3	9	*12*	0	0	*0*
	5	16	13	*29*	3		*3*	4	16	*20*			
May	1	2	4	*6*				1	2	*3*			
	2	4	3	*7*				0	8	*8*			
	3	4	4	*8*				1	15	*16*			
	4												
TOTAL		83	100	183	93	105	198	26	81	107	32	20	52

SITE		27			3			3			3			3			3			3			3		
NAME		VUITMAN			DARNELL			DARNELL			DARNELL			DARNELL			DARNELL			DARNELL			DARNELL		
YEAR		1991-92			1988-89			1989-90			1989-90			1990-91			1990-91			1991-92			1991-92		
SAMPLE		STICKY			STICKY			STICKY			LEAF			STICKY			LEAF			STICKY			LEAF		
Month	wk	NE	SW	TOTAL	NE	SE	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL
Oct	4																								
	5													1	0	1									
Nov	1													0	0	0									
	2	0	0	0	0	0	0							0	0	0				0	0	0			
	3	0	0	0	0	0	0	0	0	0				0	0	0	0	0	0	0	0	0			
	4	0	0	0	0	0	0	0	0	0				0	0	0	0	0	0	0	0	0			
Dec	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0
	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	N/D	N/D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jan	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5							0	0	0	0	0	0				0	0	0				0	0	0
Feb	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	N/D	N/D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1
	3	0	0	0	0	0	0	1	0	1				0	0	0				1	0	1	0	0	0
	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				0	0	0	0	0	0
Mar	1	1	0	1	1	1	2	N/D	0	0				0	0	0				0	0	0	0	0	0
	2	0	0	0	1	0	1	0	0	0				0	0	0				0	0	0			
	3	0	0	0	N/D	N/D	0	0	0	0	0	0	0	0	0	0				0	0	0			
	4	4	2	6	0	0	0	0	0	0				0	0	0				0	0	0			
Apr	1	0	0	0	N/D	N/D	0	1	0	1				0	0	0				0	0	0			
	2	1	0	1	1	1	2	N/D	0	0				N/D	N/D	0				1	1	2			
	3	1	1	2	0	0	0	0	0	0				0	0	0				2	0	2			
	4	0	1	1	0	0	0	2	0	2				1	1	2				0	1	1			
	5	0	0	0	N/D*	N/D	0	2	0	2				17	2	19				1	2	3			
May	1	1	4	5	0	0	0							12	3	15				1	0	1			
	2	0	36	36	12	0	12							0	22	22				1	7	8			
	3	5	60	65	0	0	0							2	2	4				2	2	4			
	4				0	0	0																		
TOTAL		13	104	117	15	2	17	8	0	8	0	0	0	33	30	63	0	0	0	9	14	23	0	1	1

2 CARTER 1988-89 STICKY			2 CARTER 1990-91 STICKY			2 CARTER 1990-91 LEAF			2 CARTER 1991-92 STICKY			2 CARTER 1991-92 LEAF		
NW	SE	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*
			0	0	*0*									
			0	0	*0*									
0	0	*0*	0	0	*0*				0	0	*0*			
0	0	*0*	0	0	*0*				1	0	*1*			
0	1	*1*	0	0	*0*				0	0	*0*			
0	0	*0*	0	0	*0*				0	0	*0*			
0	0	*0*	0	0	*0*				0	0	*0*			
0	0	*0*	0	0	*0*				0	0	*0*			
0	0	*0*	0	0	*0*				0	0	*0*			
0	0	*0*	0	0	*0*				0	0	*0*			
0	0	*0*	1	0	*1*				0	0	*0*			
0	0	*0*	0	0	*0*				0	0	*0*			
0	1	*1*	0	0	*0*				0	0	*0*			
0	0	*0*	0	0	*0*				0	0	*0*			
N/D	0	*0*	0	0	*0*				0	0	*0*			
N/D	N/D	*0*	0	0	*0*				0	0	*0*			
0	0	*0*	0	0	*0*				0	0	*0*		0	*0*
0	0	*0*	0		*0*	0	0	0	0	0	*0*	2	0	*2*
0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	9	0	*9*
0	0	*0*	0		*0*	0	0	*0*	0	0	*0*	8	0	*8*
0	0	*0*	0	0	*0*	0	0	*0*	0	2	*2*	0	0	*0*
4	0	*4*	1	0	*1*	0	0	*0*	0	2	*2*	8	1	*9*
N/D	N/D	*0*	0	0	*0*				2	0	*2*	8	1	*9*
42	7	*49*			*0*	1	0	*1*	1	1	*2*	0	0	*0*
0	0	*0*	32	17	*49*	0	0	*0*	7	3	*10*	0	0	*0*
0	0	*0*	5	6	*11*				2	3	*5*	0	0	*0*
0	0	*0*	2	20	*22*	0	0	*0*	2	3	*5*	0	0	*0*
98	31	*129*	0	2	*2*	1	1	*2*	4	6	*10*			
0	0	*0*	2	3	*5*		0	*0*	5	13	*18*			
0	0	*0*												
144	40	***184***	43	48	***91***	2	1	***3***	24	33	***57***	35	2	***37***

* 2 WEEKS DATA

SITE:		9a			9a			9a			9a		
NAME:		R. Arthur			R. Arthur			R. Arthur			R. Arthur		
YEAR:		1990-91			1990-91			1991-92			1991-92		
SAMPLE:		STICKY			LEAF			STICKY			LEAF		
Month	wk	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*
Oct	4												
	5	3	2	*5*									
Nov	1	0	0	*0*									
	2	0	0	*0*				0	0	*0*			
	3	0	0	*0*				0	0	*0*			
	4	0	0	*0*				0	0	*0*			
Dec	1	0	0	*0*				0	0	*0*			
	2	0	0	*0*				0	0	*0*	0	0	*0*
	3	0	0	*0*	0	0	*0*	0	0		05#3-0	0	*0*
	4	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	5	0	0	*0*				0	0	*0*	0	0	*0*
Jan	1	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	2	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	3	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	4	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	5	0	0	*0*	0	0	*0*	0	0	*0*			
Feb	1	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	2	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	3	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	4	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
Mar	1	0	0	*0*	2	0	*2*	0	0	*0*	0	0	*0*
	2	0	0	*0*	1	0	*1*	0	0	*0*			
	3	0	0	*0*				1	0	*1*			
	4	0	0	*0*				0	1	*1*			
Apr	1	0	0	*0*				0	0	*0*			
	2	0	0	*0*				0	1	*1*			
	3	0	1	*1*				2	0	*2*			
	4	0	0	*0*				0	6	*6*			
	5							3	2	*5*			
May	1	0	0	*0*				10	5	*15*			
	2	3	0	*3*				13	9	*22*			
	3	1	0	*1*									
	4	0	0	*0*									
TOTAL		7	3	*10*	3	0	*3*	29	24	*53*	0	0	*0*

MAP2.WQ1

6 LEE 1988-89 STICKY			6 LEE 1989-90 LEAF			6 LEE 1989-90 LEAF			6 LEE 1990-91 STICKY			6 LEE 1990-91 LEAF				1990-91			1991-92		
NW	SE	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL		NE	SW	TOTAL	NE	SW	TOTAL
									0	2	2					1	0	1			
									0	0	0					0	0	0			
0	0	0							1	0	1					0	0	0	0	0	0
0	0	0	0	0	0				0	0	0	1	0	1		0	0	0	0	0	0
0	0	0	0	0	0				0	0	0	0	0	0		0	0	0	0	0	0
0	0	0										0	0	0							
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0		0	0		0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0
																0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0		0		0	0	0	0	0	0
			0	0	0	9	0	9	0	0	0	0	0	0							
0	0	0	0	0	0	0	1	1	0	0	0		0	0		0	0	0	0	0	0
			0	0	0	0	1	1	0	0	0	0	0	0		0	0	0	0	1	1
0	0		0	0	0				1	0	1		0	0		0	0	0	1	0	1
0		0	0	0	0				0	0	0		0	0		0	0	0	0	0	0
1	1	2							0	0	0		0	0		0	0	0	0	0	0
0	0	0			0				0	0	0		0	0		0	0	0	0	0	0
			0	0	0				0	0	0					0	0	0	0	0	0
0	0	0	0	0	0				0	0	0					0	0	0	0	0	0
0	1	1																			
0	0	0	0	0	0				0	0	0					0	0	0	0	0	0
5	6	11	0	0	0											N/D	N/D	0	1	1	2
0	0	0	0	1	1				0	0	0					0	0	0	2	0	2
		0							0	0	0					1	1	2	0	1	1
			0	0	0											17	2	19	1	2	3
0	0	0	1	0	1				0	0	0					12	3	15	1	0	1
0	2	2							0	0	0					0	22	22	1	7	8
0	0	0							0	0	0					2	2	4	2	2	4
1	6	7							0	0	0										
7	16	23	1	1	2	9	2	11	2	2	4	1	0	1	0	33	30	63	9	14	23

MAPL.WQ1

SITE		28			4			4			4		
NAME		B. DARNELL			WREN			WREN			WREN		
YEAR		1991-92			1988-89			1989-90			1990-91		
SAMPLE		STICKY			STICKY			STICKY			STICKY		
		NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*
Oct	4												
	5										0	0	*0*
Nov	1										1	0	*1*
	2	0	0	*0*	1	0	*1*				1	1	*2*
	3	0	0	*0*	0	0	*0*	0	1	*1*	0	0	*0*
	4	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	5				0	0	*0*						
Dec	1	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	2	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	3	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	4	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	5	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
Jan	1	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	2	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	3	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	4	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	5	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
Feb	1	1	0	*1*	n/d	0	*0*	0	0	*0*	0	0	*0*
	2	0	0	*0*	n/d	n/d	*0*	1	0	*1*	0	0	*0*
	3	0	0	*0*	1	n/d	*1*	0	1	*1*	0	0	*0*
	4	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
Mar	1	0	0	*0*	0	0	*0*	n/d	n/d	*0*	1	0	*1*
	2	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	3	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	4	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	5				0	1	*1*						
Apr	1	1	0	*1*	n/d	n/d	*0*	0	0	*0*	0	0	*0*
	2	0	0	*0*	3	4	*7*	0	0	*0*	n/d	n/d	*0*
	3	0	0	*0*	0	0	*0*	0	1	*1*	0	0	*0*
	4	0	1	*1*	6	n/d	*6*	0	0	*0*	0	0	*0*
	5	0	0	*0*			*0*	n/d	n/d	*0*	n/d	n/d	*0*
May	1	0	1	*1*	0	0	*0*	1	1	*2*	0	1	*1*
	2	0	2	*2*	12	0	*12*				1	0	*1*
	3				10	3	*13*				0	2	*2*
	4				3	8	*11*				0	0	*0*
		2	4	*6*	36	16	*52*	2	4	*6*	4	4	*8*

SITE		4			5			5			5		
NAME		WREN			BIRNEE			BIRNEE			BIRNEE		
YEAR		1991-92			1988-89			1989-90			1990-91		
SAMPLE		STICKY			STICKY			STICKY			STICKY		
		NE	SW	*TOTAL*	NW	SE	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*
Oct	4												
	5										0	1	*1*
Nov	1										0	0	*0*
	2	0	0	*0*	0	0	*0*				0	0	*0*
	3	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	4	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	5				n/d	n/d	*0*						
Dec	1	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	2	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	3	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	4	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	5	0	0	*0*	0	0	*0*						
Jan	1	0	0	*0*	0	0	*0*	0		*0*	0	0	*0*
	2	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	3	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	4	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	5	0	0	*0*	0	0	*0*	1	0	*1*	0	0	*0*
Feb	1	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	2	0	0	*0*	n/d	n/d		0	0	*0*	0	0	*0*
	3	0	0	*0*	0	n/d	*0*	0	0	*0*	1	0	*1*
	4	0	~~1~~ 0	~~1~~	2	1	*3*	0	0	*0*	1	0	*1*
Mar	1	0	~~0~~ 1	~~0~~ 1	1	0	*1*				0	0	*0*
	2	0	0	*0*	0	1	*1*	0	0	*0*	0	0	*0*
	3	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	4	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	5				0	0	*0*						
Apr	1	0	0	*0*	n/d	n/d	*0*	0	0	*0*	0	0	*0*
	2	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	3	0	3	*3*	0	0	*0*	0	0	*0*			
	4	0	0	*0*	0	3	*3*	0	0	*0*	0	0	*0*
	5	0	0	*0*	n/d	n/d	*0*	0	0	*0*			
May	1	1	1	*2*	0	1	*1*	1	0	*1*	0	0	*0*
	2	1	0	*1*	6	1	*7*				0	0	*0*
	3				3	2	*5*				0	0	*0*
	4				5	0	*5*						
		2	5	*7*	17	9	*26*	2	0	*2*	2	1	*3*

MAP3.WQ1

Numbers of M. persicae over 4 seasons, 1988-92, 4 histograms for map 2

SITE:		10			26			26			8			8			9b		
NAME:		WILMOT			FORREST			FORREST			RUSSELL			RUSSELL			DELLAGESTINO		
YEAR:		1988-89			1991-92			1991-92			1990-91			1990-91			1988-89		
SAMPLE:		STICKY			STICKY			LEAF			STICKY			~~STICKY~~			STICKY		
Month		NW	SE	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NW	SE	*TOTAL*	NE	SW	*TOTAL*	NW	SE	*TOTAL*
Oct	4																		
	5										0	0	*0*						
Nov	1										0	0	*0*						
	2		0	*0*	0	0	*0*				0	0	*0*				0	0	*0*
	3	0	0	*0*	0	0	*0*				0	0	*0*	0	0	*0*	0	0	*0*
	4	0	0	*0*	0	0	*0*				0	0	*0*	0	0	*0*	0	0	*0*
	5	0	0	*0*										0	0	*0*	0	0	*0*
Dec	1	0	0	*0*	0	0	*0*				0	0	*0*	0	0	*0*	0	0	*0*
	2	0	0	*0*	0	0	*0*				0	0	*0*	0	0	*0*			*0*
	3	0	0	*0*	0	0	*0*				0	0	*0*	0	0	*0*	0	0	*0*
	4	0	0	*0*	0	0	*0*				0	0	*0*	0	1	*1*	0	0	*0*
	5				0	0	*0*												
Jan	1	0	0	*0*	0	0	*0*					0	*0*	0	0	*0*	0	0	*0*
	2	0	0	*0*	0	0	*0*				0	0	*0*	0	0	*0*	0	0	*0*
	3	0	0	*0*	0	0	*0*				0	0	*0*	0		*0*	0	0	*0*
	4	1	0	*1*	0	2	*2*				0	0	*0*	0	0	*0*	0	0	*0*
	5	0	0	*0*							0	0	*0*	0	0	*0*			
Feb	1	0	0	*0*	0	0	*0*				0	0	*0*	0	0	*0*	0	0	*0*
	2				0	1	*1*				0	0	*0*	0	0	*0*			
	3	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	1	*1*	0	0	*0*
	4	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*				0		*0*
Mar	1	0	0	*0*	0	0	*0*	1	1	*2*	0	0	*0*	0	0	*0*	0	0	*0*
	2	0	0	*0*	0	0	*0*	8	7	*15*	0	0	*0*	0	6	*6*	1	0	*1*
	3				0	0	*0*	27	14	*41*	1	0	*1*	0	1	*1*	1	0	*1*
	4	0	0	*0*	66	4	*70*	87	25	*112*	0	0	*0*	0	0	*0*	2	0	*2*
	5	2	0	*2*															
Apr	1	0	0	*0*	73	30	*103*	547	257	*804*	0	0	*0*	0	1	*1*	0		*0*
	2	0	0	*0*	171	68	*239*	110	58	*168*							17	1	*18*
	3	5	5	*10*	14	68	*82*	10	12	*22*	0	1	*1*	1	0	*1*	10	4	*14*
	4	4	1	*5*	9	7	*16*	5	11	*16*	2	0	*2*	0	0	*0*	12	7	*19*
	5				8	9	*17*	0		*0*	0	0	*0*						
May	1	2	0	*2*	2	3	*5*	0		*0*	4	3	*7*	0	0	*0*	1	2	*3*
	2	4	2	*6*	7	0	*7*				1	0	*1*	2	2	*4*	5	8	*13*
	3	12	2	*14*	5	4	*9*				2	1	*3*	0	1	*1*	1	0	*1*
	4	10	5	*15*													1	1	*2*
		40	15	*55*	355	196	*551*	795	385	*1180*	10	5	*15*	3	13	*16*	51	23	*74*

M.AP4.WQ1

Numbers of M. persicae over 4 seasons, 1988-92; 8 histograms for map 4

SITE		15			15			15			15b			15b			15			15			15			15		
NAME		MHRC			MHRC			MHRC			C. WILSON			C. WILSON			FEMA			FEMA			FEMA			FEMA		
YEAR		1988-89			1989-90			1989-90			1989-90			1989-90			1990-91			1990-91			1991-92			1991-92		
SAMPLE		STICKY			STICKY			LEAF			STICKY			LEAF			STICKY			LEAF			STICKY			LEAF		
Month	wk	NW	SE	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	SW	NE	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL
Oct	4																											
	5																											
Nov	1																1	0	1	0	2	2						
	2	0	0	0													0	0	0	0	1	1						
	3	0	1	1													0	0	0	0	0	0						
	4	0	0	0													0	0	0	0	0	0	0	0	0			
	5	0	0	0													0	0	0	0	0	0						
Dec	1	0	0	0	0	0	0	0		0							0	0	0	0	0	0	0	0	0			
	2	0	0	0	0	0	0	0		0							0	0	0	0	0	0	0	0	0			
	3	0	0	0	0	0	0	0	0	0							0	0	0	0	0	0	0	0	0			
	4	0	0	0	0	0	0	0	0	0							0	0	0	0	0	0	0	0	0			
	5				0	0	0	n/d	0	0													0	0	0			
Jan	1	0	0	0	0	2	2	32	1	33							0	0	0	0	0	0	0	0	0			
	2	0	0	0	0	0	0	22	5	27							0	0	0	0	0	0	0	0	0			
	3	0	0	0	2	1	3	177	264	441							0	0	0	0	0	0	0	0	0			
	4	0	0	0	6	1	7	587	235	822							0	0	0			0	0	0	0			
	5	0	0	0																								
Feb	1	0	0	0	0	16	16	725	138	863							0	0	0		0	0	0	0	0	0	0	0
	2				14	49	63	206	89	295							0	0	0	3	1	4	0	1	1	4	0	4
	3	0	0	0	3	16	19	17	2	19	2	2	4		0	0	0	0	0	0	12	12	1	0	1	1	1	2
	4	3	1	4	0	0	0	0	0	0	1	0	1	2	2	4	1	0	1	53	13	66	1	0	1	9	0	9
Mar	1	0	0	0	0	0	0	10	n/d	10	1	0	1		0	0	9	3	12	22	23	45	0	0	0	0	0	0
	2	4	0	4	0	0	0	0	0	0	0	0	0	2	0	2	16	11	27	108	29	137	0	0	0	0	0	0
	3				0	0	0		0	0	0	0	0	0	0	0	2		2	1	32	33	1	0	1	1	0	1
	4	0	0	0	0	0	0				0	0	0	0	0	0	1	0	1	0	9	9	0	1	1			
	5	4	3	7	0	0	0				0	0	0	0	0	0	2	0	2	1	4	5	0	0	0			
Apr	1	0	0	0	0	0	0				0	0	0	2	1	3	0	0	0				1	1	2			
	2	15	4	19							0		0				0	0	0				0	0	0			
	3	18	9	27							0	0	0	0	0	0	0	1	1				0	1	1			
	4	10	17	27	n/d	n/d	0										1	0	1				0	0	0			
	5				2	0	2				0	0	0	0	0	0												
May	1	10	3	13	3	0	3					0	0	1	1	2	1	1	2				0	2	2			
	2	4	1	5	1	1	2				0	0	0	n/d	0	0	5	2	7				2	0	2			
	3	2	0	2	3	1	4				3	0	3	0		0	12	3	15				1	1	2			
	4	1	2	3													2	0	2									
		71	41	112	34	87	121	1776	734	2510	7	2	9	7	4	11	53	21	74	188	126	314	7	7	14	15	1	16

SITE:		11			11			12			12			12			12			12			12		
NAME:		IPSEN			IPSEN			PHILLIPS			PHILLIPS			PHILLIPS			PHILLIPS			PHILLIPS			PHILLIPS		
YEAR:		1991-92			1991-92			1989-90			1989-90			1990-91			1990-91			1991-92			1991-92		
SAMPLE:		STICKY			LEAF			STICKY			LEAF			STICKY			LEAF			STICKY			LEAF		
Month	wk	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*
Oct	4																								
	5																								
Nov	1													1	0	*1*									
	2													0	0	*0*									
	3							0	0	*0*				0	0	*0*									
	4	0	0	*0*	0	1	*1*	0	0	*0*	0	0	*0*	0	0	*0*	0	2	*2*	0	0	*0*			
	5													0	0	*0*	0	0	*0*						
Dec	1	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	2	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	3	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	4	0	0	*0*	0	0	*0*	0	0	*0*	2	1	*3*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	5	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*							0	0	*0*	0	0	*0*
Jan	1	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	2	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	n/d	0	*0*	0	0	*0*	0	0	*0*
	3	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	4							0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*						
	5	0	0	*0*	0	0	*0*													0	0	*0*	0	0	*0*
Feb	1	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	1	*1*	0	0	*0*	0	0	*0*
	2	0	0	*0*	0	0	*0*	0	0	*0*	0	2	*2*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	3	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	1	0	*1*
	4	1	1	*2*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	1	*1*	0	0	*0*	1	0	*1*
Mar	1	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	2	*2*	0	0	*0*	1	0	*1*
	2	1	0	*1*	1	0	*1*	0	0	*0*	0	0	*0*	1	0	*1*	0	0	*0*	0	0	*0*	0	0	*0*
	3	1	0	*1*	0	0	*0*	0	0	*0*	0	0	*0*	1	0	*1*	0	0	*0*	0	0	*0*	0	0	*0*
	4	0	0	*0*				0	0	*0*	0	0	*0*	0	0	*0*				0	1	*1*			
	5	0	0	*0*				0	0	*0*	0	0	*0*	0	0	*0*				0	0	*0*			
Apr	1	1	0	*1*				0	0	*0*		0	*0*	0	0	*0*				0	0	*0*			
	2	2	1	*3*				0	0	*0*				0	0	*0*				0	0	*0*			
	3							0	1	*1*				1	0	*1*									
	4	2	1	*3*										1	0	*1*				0	0	*0*			
	5	1	0	*1*				9.8	16.1	*25.9*										0	0	*0*			
May	1	2	0	*2*				19	37	*56*				14	2	*16*				0	0	*0*			
	2	0	0	*0*				4	2	*6*				15	3	*18*				0	0	*0*			
	3	0		*0*				1	0	*1*				1	1	*2*				0	1	*1*			
	4													2	2	*4*									
		11	3	*14*	1	1	*2*	33.8	56.1	*89.9*	2	3	5	37	8	*45*	0	6	6	0	2	*2*	3	0	3

SITE:		7			7			7			7			7			7			7		
NAME:		J. DELLA-FRANCA			J. DELLA-FRANCA			J. DELLA-FRANCA			J. DELLA-FRANCA			J. DELLA-FRANCA			J. DELLA-FRANCA			J. DELLA-FRANCA		
YEAR:		1988-89			1989-90			1989-90			1990-91			1990-91			1991-92			1991-92		
SAMPLE:		STICKY			STICKY			LEAF			STICKY			LEAF			STICKY			LEAF		
Month	wk	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*
Oct	4																					
	5																					
Nov	1										0	0	*0*	n/d	n/d	*0*						
	2	1	1	*2*							0	0	*0*	0	0	*0*						
	3	0	0	*0*	0	0	*0*	0		*0*	0	0	*0*	0	0	*0*						
	4	0	0	*0*	0	0	*0*	0		*0*	0	0	*0*	0	0	*0*	0	0	*0*			
	5	0	0	*0*							0	0	*0*	0	0	*0*						
Dec	1	0	0	*0*	0	0	*0*	0		*0*	0	0	*0*	0	0	*0*	0	0	*0*			
	2	0	0	*0*	0	0	*0*	0		*0*	0	0	*0*	0	0	*0*	0	0	*0*			
	3	0	0	*0*	0	0	*0*	3		*3*	0	0	*0*	0	0	*0*	0	0	*0*			
	4	0	0	*0*	0	0	*0*	6		*6*	0	0	*0*	0	0	*0*	0	0	*0*			
	5	0	0	*0*	0	0	*0*	34		*34*							0	0	*0*			
Jan	1	0	0	*0*	0	0	*0*	4		*4*	0	0	*0*	0	0	*0*	0	0	*0*			
	2	0	0	*0*	0	0	*0*	0		*0*	0	0	*0*	5	5	*10*	0	0	*0*	0	0	*0*
	3	0	0	*0*	1	0	*1*	0		*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	4	0	0	*0*	10	4	*14*				0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	5										0	0	*0*									
Feb	1	0	0	*0*	8	34	*42*	509		*509*	0	0	*0*	0	0	*0*	1	0	*1*	0	2	*2*
	2	0	0	*0*	8	112	*120*	24		*24*	0	0	*0*	0	0	*0*	0	0	*0*	1	2	*3*
	3	0	0	*0*	1	25	*26*	3		*3*				0	0	*0*	3	1	*4*	0	11	*11*
	4				0	1	*1*	0		*0*	0	0	*0*	5	1	*6*	3	0	*3*	42	5	*47*
Mar	1	2	2	*4*				0		*0*	0	1	*1*	2	8	*10*	0	0	*0*	5	5	*10*
	2	0	0	*0*	n/d	n/d	*0*	0		*0*	1	0	*1*	1	0	*1*	16	2	*18*	20	36	*56*
	3	0	0	*0*	0	0	*0*				0	0	*0*	0	0	*0*	6	3	*9*	13	11	*24*
	4	0	0	*0*	0	0	*0*				0	0	*0*	0	0	*0*	10	6	*16*	3	1	*4*
	5				0	0	*0*				0	0	*0*	0	0	*0*	1	0	*1*	0	0	*0*
Apr	1	0	0	*0*	0	0	*0*				0	0	*0*	0	1	*1*						
	2	0	0	*0*							0	0	*0*	1	0	*1*	2	0	*2*			
	3	0	0	*0*	1	n/d	*1*				0	0	*0*	3	4	*7*	0	0	*0*			
	4										0	0	*0*				0	0	*0*			
	5				0	3	*3*										0	1	*1*			
May	1	0	0	*0*	3	0	*3*				0	0	*0*				0	0	*0*			
	2	0	0	*0*	0	0	*0*				0	0	*0*				0	0	*0*			
	3	0	0	*0*	1	0	*1*				0	1	*1*				0	0	*0*			
	4	0	0	*0*							2	0	*2*									
		3	3	*6*	33	179	*212*	583	0	*583*	3	2	*5*	17	19	*36*	42	13	*55*	84	73	*157*

*Pipeline only

SITE:		1			1			1			11			11			11			11		
NAME:		SMITHERS			SMITHERS			SMITHERS			IPSEN			IPSEN			IPSEN			IPSEN		
YEAR:		1988-89			1989-90			1990-91			1989-90			1989-90			1990-91			1990-91		
SAMPLE:		STICKY			STICKY			STICKY			STICKY			LEAF			STICKY			LEAF		
Month	wk	NE	SW	*TOTAL*	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL
Oct	4																					
	5																					
Nov	1							0	0	*0*							1	0	0.5	0	0	0
	2	0	0	*0*				0	0	*0*							0	0	0	0	0	0
	3	0	0	*0*	0	0	*0*	0	0	*0*	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	*0*	0	0	*0*	0	0	*0*	0	0	0	0	0	0	0	0	0	0	0	0
	5	0	0	*0*				0	0	*0*								0	0	0	0	0
Dec	1	0	0	*0*	0	0	*0*	0	0	*0*	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	*0*	0	0	*0*	0	1	*1*	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	*0*	0	0	*0*	0	0	*0*	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	*0*	0	0	*0*	0	0	*0*	0	0	0	0	0	0	0	0	0	0	0	0
	5				0	0	*0*				0	0	0	0	0	0						
Jan	1	0	0	*0*	0	0	*0*	0	0	*0*	0	0	0	2	3	2.5	0	0	0	0	0	0
	2	0	0	*0*	0	0	*0*	0	0	*0*	0	0	0	4	0	2	0	0	0	0	0	0
	3	0	0	*0*	0	0	*0*	0	0	*0*	0	0	0	6	5	5.5	0	0	0	0	0	0
	4	0	0	*0*	0	0	*0*	0	0	*0*	0	0	0		412	206	0	0	0	0	0	0
	5													29		14.5						
Feb	1				0	0	*0*	0	0	*0*	0	0	0	0	0	0	0	0	0		0	0
	2				0	0	*0*	0	0	*0*	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	*0*	0	1	*1*	0	0	*0*	0	0	0	0	1	0.5	0	0	0			
	4				0	0	*0*	0	0	*0*	0	0	0	0	0	0	0	1	0.5			
Mar	1	0	1	*1*	0	0	*0*	0	0	*0*	0	0	0	0	0	0	0	0	0			
	2	0	0	*0*	1	0	*1*	0	0	*0*	0	0	0	0	0	0	0	3	1.5			
	3	0	0	*0*	0	0	*0*	0	0	*0*	0	0	0	0			0	1	0.5			
	4	0	0	*0*	0	0	*0*	0	0	*0*	0	0	0	2	0	1	0	0	0			
	5				0	0	*0*	0	0	*0*	0	0	0	0	0	0	0	0	0			
Apr	1	0	0	*0*	0	0	*0*	0	0	*0*	0	0	0	0	0	0	0	0	0			
	2	0	0	*0*				1	0	*1*							0	0	0			
	3	0	0	*0*	1	0	*1*	0	0	*0*							0	0	0			
	4	0	0	*0*				0	0	*0*	1		1				0	1	0.5			
	5				0	0	*0*															
May	1	0	0	*0*	0	0	*0*	0	0	*0*	1	2	1.5				1	1	1			
	2	0	0	*0*	1	0	*1*	0	0	*0*	0	1	0.5				0	1	0.5			
	3	0	0	*0*	0	0	*0*	1	0	*1*	0	1	0.5				1	1	1			
	4	0	0	*0*				0	0	*0*							2	2	2			
		0	1	*1*	3	1	4	2	1	3	2	4	3.5	43	421	232	5	11	8	0	0	0

MAP5.WQ1

Numbers of M. persicae over 4 seasons, 1988-92; 5 histograms for map 5

SITE:		13			13			13			22			22			22			22			22			22		
NAME:		BELLANGER			BELLANGER			BELLANGER			W. LAING			W. LAING			W. LAING			W.LAING			W. LAING			W. LAING		
YEAR:		1989-90			1989-90			1990-91			1989-90			1989-90			1990-91			1990-91			1991-92			1991-92		
SAMPLE:		STICKY			LEAF			STICKY			STICKY			LEAF			STICKY			LEAF			STICKY			LEAF		
Month	wk	NE	SW	*TOTAL*	NW	SE	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*
Oct	4																											
	5																											
Nov	1																											
	2																											
	3	0	0	*0*				0	0	*0*							0	0	*0*				0	0	*0*			
	4	0	0	*0*				0	0	*0*							0	0	*0*				0	0	*0*			
	5							0	0	*0*	0	0	*0*				0	0	*0*				0	1	*1*			
Dec	1	0	0	*0*				0	0	*0*	0	0	*0*				0	0	*0*				0	0	*0*			
	2	0	0	*0*				0	0	*0*	0	0	*0*				0	0	*0*				0	0	*0*			
	3	0	0	*0*				0	0	*0*		0	*0*				0	0	*0*				0	0	*0*			
	4	0	0	*0*						*0*	0	0	*0*										0	0	*0*			
	5	0	0	*0*						*0*	0	0	*0*										0	0	*0*			
Jan	1	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*				0	0	*0*				0	0	*0*			
	2	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*			
	3	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	4	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	1	0	*1*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	5							0	0	*0*							0	0	*0*	0	0	*0*				0	0	*0*
Feb	1	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	2	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	3	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	4	0	0	*0*	2	0	*2*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	1	0	*1*	0	1	*1*
Mar	1	0	0	*0*	0		*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	1	0	*1*	1	4	*5*
	2	0	0	*0*	3	0	*3*	0	0	*0*	0	1	*1*	50	0	*50*	0	0	*0*	0	0	*0*	0	1	*1*	0	1	*1*
	3	0	0	*0*	0		*0*	0	0	*0*	0	0	*0*	160	7	*167*	0	0	*0*	0	0	*0*	0	1	*1*	1	0	*1*
	4	0	0	*0*	0	12	*12*	0	0	*0*	1	0	*1*	17	23	*40*	0	0	*0*	1	1	*2*	0	0	*0*			
	5	0	1	*1*	2	0	*2*			*0*	0	0	*0*															
Apr	1	0		*0*				0	0	*0*	0		*0*				0	0	*0*	0	0	*0*	0	0	*0*			
	2							0	0	*0*	0	0	*0*				0	0	*0*				0	0	*0*			
	3	0	0	*0*				0	0	*0*	0	0	*0*				0	0	*0*				0	0	*0*			
	4							0	0	*0*	0	0	*0*				0	0	*0*				0	0	*0*			
	5	0	0	*0*						*0*									*0*									
May	1	0	0	*0*				0	0	*0*	0	0	*0*				0	0	*0*				0	0	*0*			
	2	0	0	*0*				0	1	*1*	0	0	*0*				0	0	*0*				0	0	*0*			
	3	0	0	*0*				0	0	*0*	0	0	*0*				0	0	*0*				0	2	*2*			
	4							0	0	*0*							0	0	*0*									
		0	1	*1*	7	12	*19*	0	1	*1*	1	1	*2*	228	30	*258*	0	0	*0*	1	1	*2*	2	5	*7*	2	6	*8*

SITE:		23			21			21			21			21			21			21			33		
NAME:		FARR			MITCHELL			MITCHELL			MITCHELL			MITCHELL			MITCHELL			MITCHELL			SHEREWOOD		
YEAR:		1989-90			1989-90			1989-90			1990-91			1990-91			1991-92			1991-92			1991-92		
SAMPLE:		STICKY			STICKY			LEAF			STICKY			LEAF			STICKY			LEAF			STICKY		
Month	wk	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL
Oct	4																								
	5																								
Nov	1																								
	2																0	0	0				0	0	0
	3										0	0	0				0	0	0				0	1	1
	4										0	0	0				0	0	0				0	0	0
	5	0	0	0	0	0	0				0	0	0												
Dec	1	0	0	0	0	0	0				0	0	0				0	0	0				0	0	0
	2	0	0	0	0	0	0				0	0	0				0	0	0				0	0	0
	3	0	0	0	0	0	0				0	0	0				0	0	0	0		0	0	0	0
	4	0	0	0	0	0	0	0	0	0							0	0	0	0		0	0	0	0
	5																0	0	0	0		0	0	0	0
Jan	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	0	22	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5				0	0	0			0	0	0	0	0	0	0									
Feb	1	0	0	0	0	0	0	0	32	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2		0	0	0	0	0	0	0	0		0	0				0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mar	1	0	0	0	5	1	6			0	1	0	1	0	0	0	1	0	1		0	0	0	0	0
	2	0	0	0	0	1	1			0	0	0	0	0	0	0	1	0	1		30	30	0	0	0
	3	0	0	0	2	1	3		0	0	1	0	1				0	1	1		35	35	0	0	0
	4	0	0	0	0	2	2	0	7	7	0	1	1				1	0	1				0	0	0
	5	0	0	0							0	0	0												
Apr	1				4	0	4				0	0	0				0	0	0				0	0	0
	2				0	0	0				0	0	0				0	0	0				0	0	0
	3					0	0				0	0	0				0	0	0				0	0	0
	4				1	0	1				0	0	0				0	0	0				0	0	0
	5																								
May	1				0	0	0				0	0	0				0	2	2				1	0	1
	2				0	1	1				0	0	0				0	0	0				n/d	0	0
	3				0	0	0				0	0	0				0	2	2				0	0	0
	4										1	0	1												
		0	0	0	13	6	19	0	39	39	3	1	4	0	0	0	3	5	8	22	65	87	1	1	2

MAP6.WQ1

Numbers of M. persicae over 4 seasons, 1988-92; 6 histograms for map 6

SITE:		20			20			20			20			20			20			24			24			19			19		
NAME:		WOLFE			WOLFE			WOLFE			WOLFE			WOLFE			WOLFE			AYRES			AYRES			REDDIN/SHIRLEY			REDDIN/SHIRLEY		
YEAR:		1989-90			1989-90			1990-91			1990-91			1991-92			1991-92			1989-90			1989-90			1989-90			1989-90		
SAMPLE:		STICKY			LEAF			STICKY			LEAF			STICKY			LEAF			STICKY			LEAF			STICKY			LEAF		
Month		NW	SE	TOTAL	NW	SE	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL	NE	SW	TOTAL
Oct	4																														
	5																														
Nov	1																														
	2													0	0	0															
	3							0	0	0				0	0	0															
	4							0	0	0				0	0	0															
	5	0	0	0				0	0	0										0	0	0				0	0	0			
Dec	1	0	0	0				0	0	0				0	0	0				0	0	0				0	0	0			
	2	0	0	0				0	0	0				0	0	0				0	0	0				0	0	0			
	3	0	0	0	0		0	0	0	0				0	0	0				0	0	0	0	0	0	0	0	0			
	4	0	0	0	0									0	0	0				0	0	0	0	0	0	0	0	0			
	5													0	0	0															
Jan	1	0	0	0	0			0	0	0										0	0	0	0	0	0	0	0	0			
	2	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				0	0	0			
Feb	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0				0	0	0	0	0	0
	3	0	0	0	0			0	0	0	0	0	0	1	0	1	0	0	0	0	0	0				0	0	0	0	0	0
	4	0	0	0	0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				0	0	0	0	0	0
Mar	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0		0	0	0	0		0	0
	2	0	0	0				0	0	0		0	0	0	0	0	0	0	0	0	0	0				0	0	0	0	0	0
	3	0	0	0				0	0	0				0	0	0				0	0	0				0	0	0	0	0	0
	4	0	0	0				0	0	0				0	0	0				0	0	0				0	0	0	0	0	0
	5																														
Apr	1	0	0	0				0	0	0				0	0	0				0	0	0				0	0	0			
	2	0	0	0				0	0	0				0	0	0				0	0	0				0	0	0			
	3	0	0	0				0		0				0	0	0				0	0	0				1	0	1			
	4	0	0	0				0	0	0										0	0	0					0	0			
	5													0	0	0															
May	1	0	0	0				0	0	0				0	0	0				1	2	3				0	0	0			
	2	1	0	1				0	0	0				0	1	1				0	0	0				0	0	0			
	3	0	0	0				0	0	0				0	0	0				0	1	1				0	0	0			
	4							0	0	0																					
		1	0	1	0	0	0	0	0	0	0	0	0	1	1	2	0	2	2	1	3	4	0	0	0	1	0	1	0	0	0

SITE:		19			19			18			18			18			18			18			18		
NAME:		REDDIN/SHIRLEY			REDDIN/SHIRLEY			ALLEN			ALLEN			ALLEN			ALLEN			ALLEN			ALLEN		
YEAR:		1991-92			1991-92			1989-90			1989-90			1990-91			1990-91			1991-92			1991-92		
SAMPLE:		STICKY			LEAF			STICKY			LEAF			STICKY			LEAF			STICKY			LEAF		
Month		NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	TOTAL	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*
Oct	4																								
	5																								
Nov	1																								
	2	0	0	*0*																0	0	*0*			
	3	0	0	*0*										0	0	0				0	0	*0*			
	4	0	0	*0*										0	0	0				0	0	*0*			
	5							0	0	*0*				0	0	0									
Dec	1	0	0	*0*				0	0	*0*				0	0	0				0	0	*0*			
	2	0	0	*0*				0	0	*0*				0	0	0				0	0	*0*			
	3	0	0	*0*	0		*0*	0	0	*0*				0	0	0				0	0	*0*		0	*0*
	4	0	0	*0*	0	0	*0*	0	0	*0*										0	0	*0*		0	*0*
	5	0	0	*0*	0	0	*0*													0	0	*0*	0	0	*0*
Jan	1							0	0	*0*				0	0	0									
	2	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	0		0	*0*	0		*0*	0	0	*0*
	3	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	0	0	0	*0*	0	0	*0*	0	0	*0*
	4	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	0	0	0	*0*	0	0	*0*	0	0	*0*
	5	0	0	*0*	0	0	*0*	0	0	*0*				0	0	0	0	0	*0*	0	0	*0*	0	0	*0*
Feb	1	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	0	0	0	*0*	0	0	*0*	0	0	*0*
	2	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	0	0	0	*0*	0	0	*0*	0	0	*0*
	3	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	0	0	0	*0*	0	0	*0*	0	0	*0*
	4	0	0	*0*	0	4	*4*	0	0	*0*	0		*0*	0	0	0	0	0	*0*	0	0	*0*	0	0	*0*
Mar	1	0	0	*0*				0	0	*0*	0	0	*0*	0	0	0	0	0	*0*	2	1	*3*			
	2	0	0	*0*				1	0	*1*				0	0	0	0	0	*0*	1	7	*8*			
	3	0	0	*0*							0	0	*0*	0	0	0				2	6	*8*			
	4	0	0	*0*				1	2	*3*				0	0	0				0	6	*6*			
	5							0	1	*1*				0	0	0									
Apr	1	0	0	*0*				1	1	*2*				0	0	0				0	0	*0*			
	2	0	0	*0*				1	0	*1*				0	0	0				0	0	*0*			
	3	0	1	*1*				0	0	*0*				0	2	2				0	0	*0*			
	4							0	0	*0*				0	0	0									
	5	1	0	*1*																0	1	*1*			
May	1	0	0	*0*				0	0	*0*				0	0	0				0	0	*0*			
	2	1	0	*1*				0	0	*0*				0	0	0				0	0	*0*			
	3	0	1	*1*				0	0	*0*					0	0				1	1	*2*			
	4													0	0	*0*									
		2	2	*4*	0	4	*4*	4	4	*8*	0	0	*0*	0	2	*2*	0	0	*0*	6	22	*28*	0	0	*0*

SITE:		17			17			17			17			17			17			25			25		
NAME:		TWEDDLE			TWEDDLE			TWEDDLE			TWEDDLE			TWEDDLE			TWEDDLE			BOCIAN			BOCIAN		
YEAR:		1989-90			1989-90			1990-91			1990-91			1991-92			1991-92			1989-90			1989-90		
SAMPLE:		STICKY			LEAF			STICKY			LEAF			STICKY			LEAF			STICKY			LEAF		
Month	wk	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*	NE	SW	*TOTAL*
Oct	4																								
	5																								
Nov	1													0	0	*0*									
	2													0	0	*0*									
	3							0	1	*1*				0	0	*0*									
	4							0	0	*0*				0	0	*0*									
	5	0	0	*0*				0	0	*0*										0	0	*0*			
Dec	1	0	0	*0*				0	0	*0*				0	0	*0*				0	0	*0*			
	2	0	0	*0*				0	0	*0*				0	0	*0*				0	0	*0*			
	3	0	0	*0*				0	0	*0*				0	1	*1*				0	0	*0*			
	4	0	0	*0*										0	0	*0*				0	0	*0*	0		*0*
	5			*0*										0	0	*0*									
Jan	1	0	0	*0*				0	0	*0*										0	0	*0*	0	0	*0*
	2	0	0	*0*				0	0	*0*	0		*0*	0	0	*0*			*0*	0	0	*0*	0	0	*0*
	3	0	0	*0*				0	0	*0*				0	0	*0*	0		*0*	0	0	*0*	0	0	*0*
	4	0	0	*0*				0	0	*0*				0	0	*0*	0	0	*0*	0	0	*0*		0	*0*
	5	0	0	*0*				0	0	*0*	0		*0*	0	0	*0*				0	0	*0*			
Feb	1	0	0	*0*		0	*0*	0	0	*0*	0		*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	2	0	0	*0*		0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*
	3	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	1	0	*1*	0	0	*0*	0	0	*0*
	4	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	0	*0*	1	0	*1*	0	0	*0*	0		*0*
Mar	1	0	0	*0*	0		*0*	0	0	*0*	0	0	*0*	0	0	*0*	0	1	*1*	1	0	*1*	0	0	*0*
	2	0	0	*0*	0	14	*14*	0	0	*0*	0	0	*0*	0	1	*1*	6	0	*6*	0	0	*0*			
	3	0		*0*	8	56	*64*	0	0	*0*	0	1	*1*	0	0	*0*	0	1	*1*	0	0	*0*			
	4	0	0	*0*				0	0	*0*	0	1	*1*	0	0	*0*	0	0	*0*	0	0	*0*			
	5			*0*	8	0	*8*																		
Apr	1	0	0	*0*	6	14	*20*	0	0	*0*	2	1	*3*	0	0	*0*	4	0	*4*	0	0	*0*			
	2	0	0	*0*	0	3	*3*	0	0	*0*	4	0	*4*	0	0	*0*				0	0	*0*			
	3	0	0	*0*	4	16	*20*	0	0	*0*	2	0	*2*	0	0	*0*				0	0	*0*			
	4	0	2	*2*		11	*11*	0	0	*0*										0	0	*0*			
	5													0	0	*0*									
May	1		0	*0*		2	*2*	1	0	*1*				0	0	*0*				1	0	*1*			
	2	0	0	*0*				0	0	*0*				0	1	*1*				0	0	*0*			
	3	0	0	*0*				1	2	*3*				0	0	*0*				2	0	*2*			
	4							0	0	*0*															
		0	2	*2*	26	116	*142*	2	3	*5*	8	3	*11*	0	3	*3*	12	2	*14*	4	0	*4*	0	0	*0*