

Latest developments & future controls of aphids on potatoes

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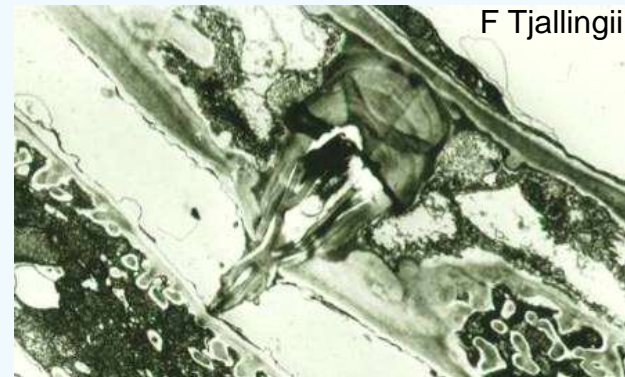
Presentation overview

- Summary HortNZ/SFF Potato aphid project:
 - effects of insecticides used on aphids for virus control
 - insecticide resistance in aphids
- Other aphid-virus control methods
- Recommendations for future research



Aphid virus vectors in potatoes

- Reliance on insecticides for control of Potato Leaf Roll (PLRV) & Potato Virus Y (PVY)
- Aphid vectors
 - Green-peach aphid
 - Potato aphid
 - Foxglove aphid
 - Melon aphid
 - Other aphid species transitory



Insecticides registered on aphids in potatoes (NZ Novachem 2007)

Organochlorine	Dimezyl 40 EC Perfekthion S
Organophosphates	Lancer, Orthene Tamaron, Monitor, Metafort Dimezyl, Perfekthion Phorate (soil)
Carbamates	Pirimor
Pyrethroids	Karate Zeon Ballistic, Decis Forte, Deltaphar
Neonicotinoids	Gaucho (seed/soil)
Azomethine	Chess

Insecticides used on 1200 ha seed – 2003-04 with Gaucho

	Number foliar applications/field		
% fields	Azomethine (Chess)	Organo- Phosphate Methamidophos	Pyrethroid (Karate)
27		5-9	
27		5-9	1-3
36	1	5-6	
9	3	3	2

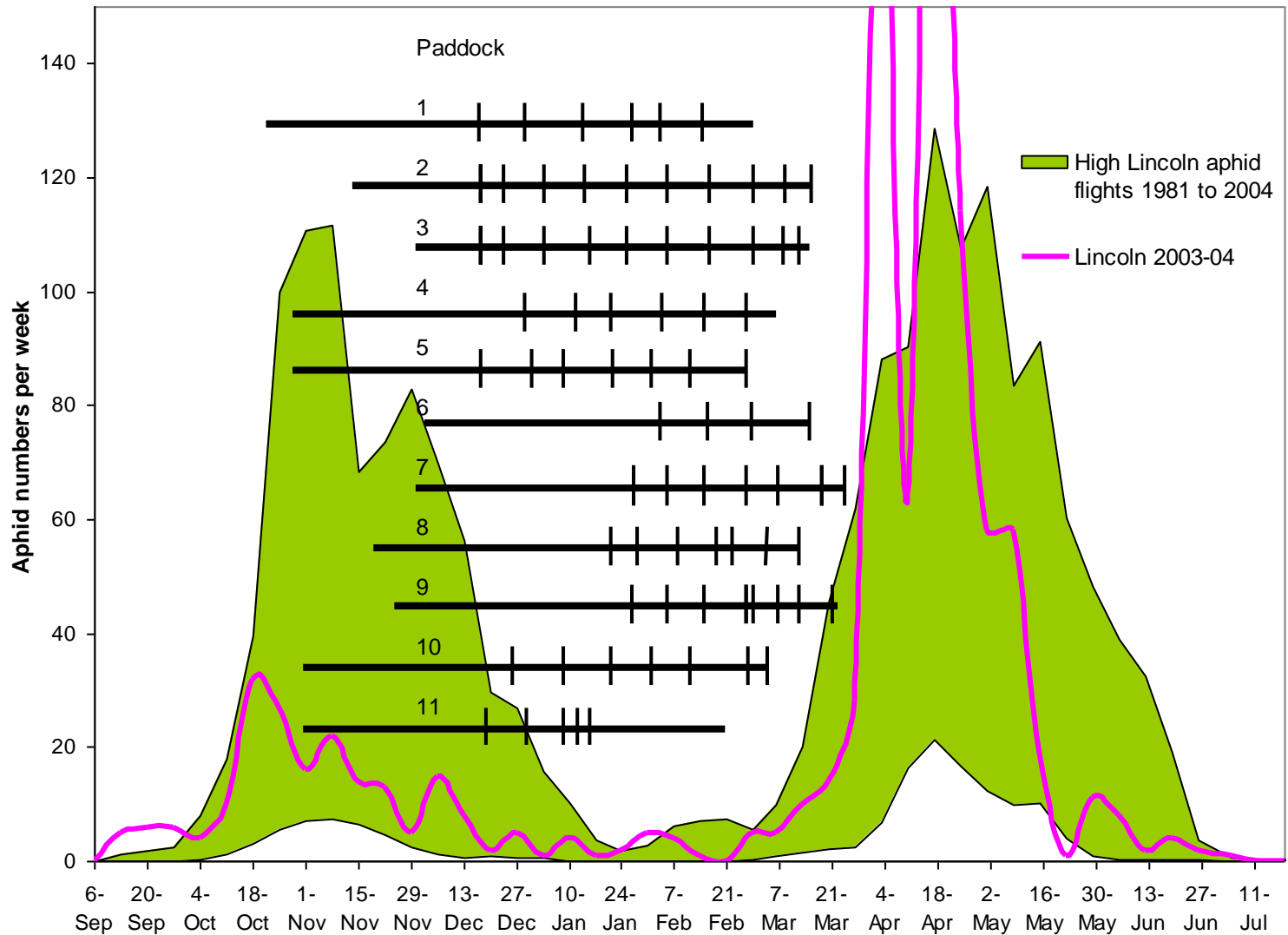
Yet virus incidence still high



Virus potato survey – 2004-05 (John Fletcher)

Virus	% of 23 crops with virus	% plants infected in infected fields
PLRV	17	4-100
PVY	43	1-100

Possible reason: Aphids not flying when insecticides applied



Possible reason: Aphids develop insecticide resistance

- 61% of green-peach aphid on potatoes in autumn 2005 carried resistance mechanism(s):
 - Elevated carboxylesterase (36%)
 - Tamaron, Pirimor, Karate
 - Modified acetylcholinesterase (24%)
 - Pirimor
 - Knock down (56%)
 - Karate
 - Low level imidacloprid resistance (10%)
 - Gaucho, Actara



Possible reason: Insecticides differ in control of the persistent PLRV

Product	Effectiveness at preventing:	
	aphid acquiring virus	Aphid inoculation plant
Gaucho, Actara	Excellent	medium
Chess	Very good	Very good
Metafort, Monitor, Tamaron	poor	very poor
Pyrethroid (Karate)	poor	high

Possible reason: insecticides are not effective against non-persistent PVY

- Short acquisition and inoculation times
- Virus transmission before aphid dies
- May kill predators/parasitoids
- May stimulate aphid migration within field
(alarm pheromones)

Insecticide trials: calendar v strategic

- Pukekohe (2-y) & Lincoln (3-y)
- Treatments
 - Gaucho seed treatment \pm
 - 5-11 x Tamaron every 10-14 days
 - 1 x Karate or Chess at aphid threshold



Five insecticide field trials - Findings

■ Repeated foliar applications of Tamaron:

- kept aphid numbers low but not always
- did not reduce virus incidence in tubers

■ Gaucho seed treatment & 1 strategic foliar insecticide :

- maintained low aphid numbers
- enhanced aphid control by predators
- virus incidence not different from untreated



- Insecticide-induced resistance in green peach aphid
- Many foliar insecticide sprays not necessary
- Change regimes to maintain insecticide effectiveness
 - Maintaining predator/parasitoids
 - Avoiding insecticides in classes to which resistance is present
 - Use no more than two repeated insecticides from one chemical
 - Reduce reliance on insecticides

Recommended calendar-based insecticide regime

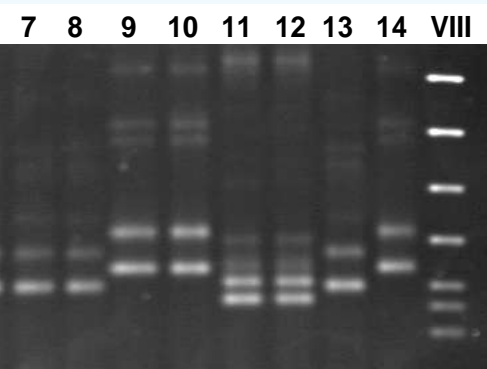
Potato crop stage	Chemical Class	Trade name	Target pest
Planting Late Oct	neonicotinoid	Gaucho Actara	Aphids
Moulding Late Dec	pyridine azomethine	Chess	Aphids
Foliage Mid Jan	pyridine azomethine	Chess	Aphids
Flowering Late Jan	carbamate	Pirimor	Aphids
80% tuber size Mid Feb	organophosphate	Tamaron etc	Aphids & tuber moth
Desiccation Early Mar	pyrethroid	Karate Zeon	Aphids & tuber moth

Foliar insecticides on seed – 2005-06 with Gaucho

	No. foliar insecticides/field				
No. fields (19)	mineral oil	Chess	Pirimor	Karate	methamidophos
1			1		4
2					5
1		1			4
1	1	2	1		1
3	1	2			5
1	1	2			2
1	2	1			4
1	3	2	1	1	2
1	3	2	1	3	1
2	3	2	3	2	
1	3	1			4
1	5	2	2	1	2
1	5				6
1	6	2	3	3	2
1	7				7

Alternatives to protection from viruses

- Monitoring for risk periods
- Strategic insecticide applications
- Oils
- New insecticides
- Barrier plants



Future: Monitoring of virus and resistance in aphids

- Yellow-bowl or suction traps
- Molecular tests on trap catch can indicate risk of:
 - insecticide resistance
 - indicate PVY risk (King et al. 2004)
- Strategic application of insecticides

Future: Strategic insecticide applications

- Gaucho/Actara seed treatment & 1-2 foliar sprays
 - timed to virus & insecticide resistance
 - determined from trap captures
- May save on number of applications @ \$80-120/ha
- Requires testing in paddock-sized trials

Future: Mineral oils?

- Low toxicity
- Prevent virus infection by aphids (altering stylet structure)
- But need to solve problems in:
 - UV-light degradation
 - not rain-fast
 - growing foliage after application not protected
 - can reduce yields

Future: Barrier plants – PVY protection

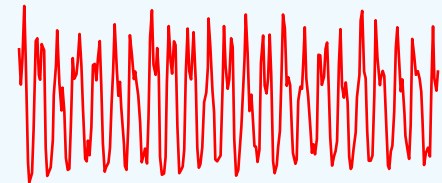
- Plants: wheat, mustard, sorghum, soybean
- Mechanisms:
 - Physical barrier
 - Virus sink
 - Camouflaging or masking potatoes
- Aphid behaviour & virus transmission studies

F. Tjallingii

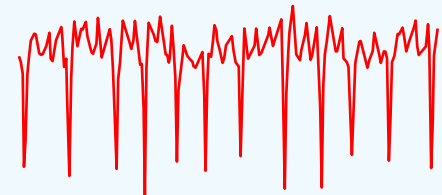


Understanding virus transmission

x y l e m feeding



p h l o e m feeding



electrical penetration resistance

Future: Barrier plants in potato crops - examples of success

Barrier plant	Mechanism	Virus reduced	Country (year) of trial
Wheat	mechanical aphid barrier	PLRV	Bangladesh 2003
Sorghum, wheat, soybean	virus sinks	PVY	USA 1996
Wheat mulch	reduced optical contrast between foliage & soil	PVY	Germany 2004

Future: New insecticide chemistries

- Actara – thiamethoxam (soil)
- Proteus - thiacloprid (aphids) and deltamethrin (tuber moth)
- Synergists with pyrethroids
 - piperonyl butoxide (in Greenseals Pyrethrum)
- Movento – spirotetramat (easy on beneficials)

Future research for industry

- Monitoring for virus and resistance risk
- Strategic application of new insecticide chemistries
- Barrier plants as virus sinks