FOUNDATION FOR ARABLE RESEARCH

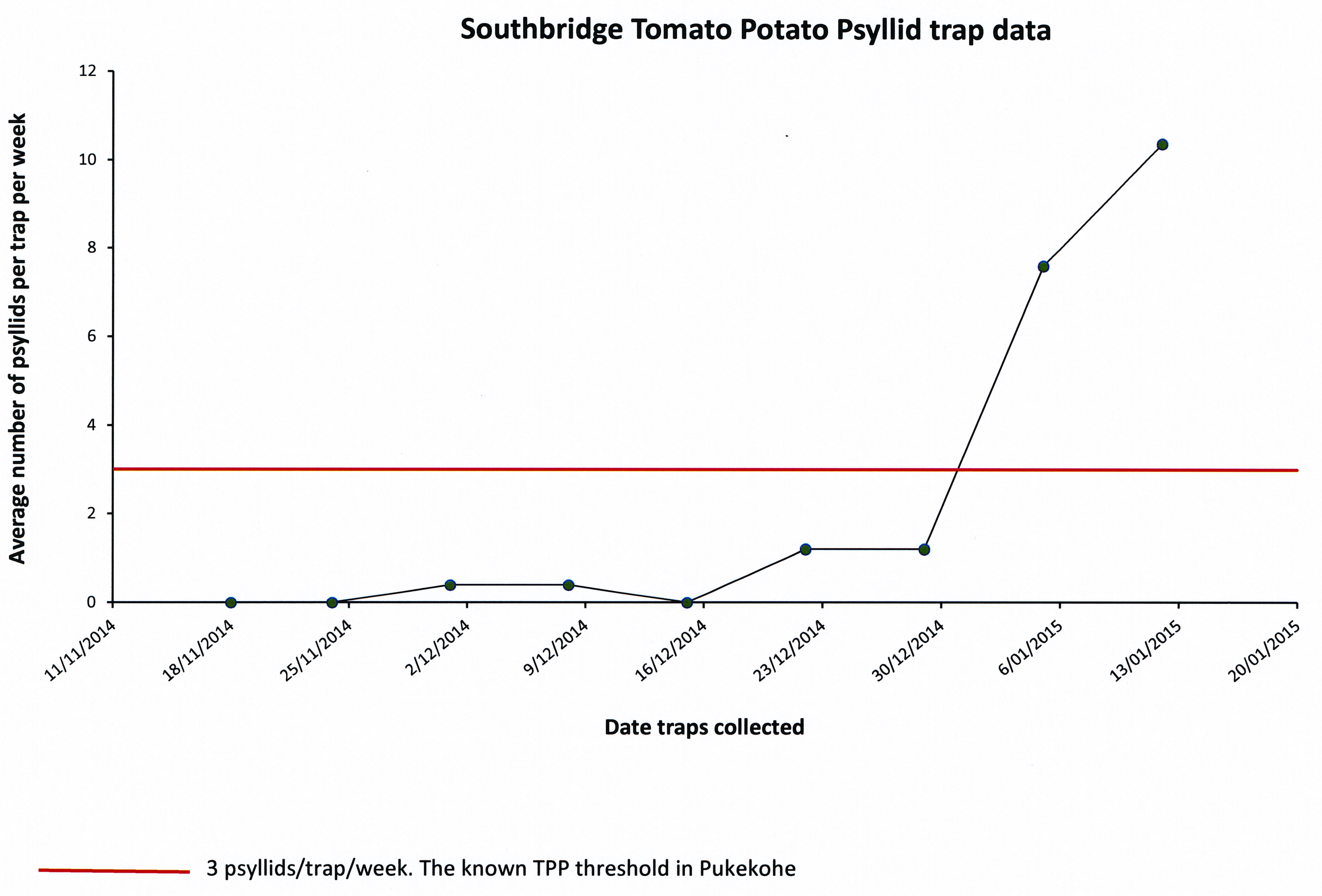
FAR

Potato Trials Tour

14 January 2015

Courtesy of Andy Bailey, Geoff Maw & Kyle Gray and Dean Pye

ADDING VALUE TO THE BUSINESS OF ARABLE FARMING


Southbridge Tomato Potato Psyllid trap data
Average number of psyllids per trap per week
0
2
4
6
8
10
12
11/11/2014
18/11/2014
25/11/2014
2/12/2014
9/12/2014
16/12/2014
23/12/2014
30/12/2014
6/01/2015
13/01/2015
20/01/2015
Date traps collected
3 psyllids/trap/week. The known TPP threshold in Pukekohe

Integrated tomato potato psyllid (TPP) management in potato in Canterbury

Jessica Dohmen-Vereijssen, Plant & Food Research

Key messages for the Canterbury area:

1. Use clean seed
2. Plant early if possible; shorter exposure to the larger summer populations of TPP
3. Use yellow sticky traps to monitor for TPP adults and aphids from planting
    a. trap height: bottom edge of trap level with the top of the crop canopy
    b. change traps weekly
4. Monitor your crops to assess whether TPP or other pests have arrived in your crop
5. Keep monitoring after starting your spray programme to:
    a. assess insecticide effectiveness
    b. assess presence of life stages of pest insects
    c. assess presence of natural enemies
    d. find 'hot spots' like other pests & diseases or other crop issues
6. Sustainably manage TPP:
    a. use selective insecticides early to maximise natural enemies
    b. maintain spray programme once started
    c. rotate different mode of action insecticides
    d. protect the crop even after desiccation
    e. use reduced spray programmes where possible (degree days, thresholds, agricultural oils, increased spray intervals)
    f. understand what your insecticides do to pest insects and natural enemies

The tomato potato psyllid (TPP) is a small insect, similar in size to an aphid. Psyllids live and feed on solanaceous plants like potato, capsicum, tomato and tamarillo, but also poroporo, boxthorn and nightshade weeds. The adults have two marked white stripes on their abdomen (Figure 1). The presence of psyllids is often given away by psyllid sugars, which are excreted by the adults and nymphs (Figure 1). All psyllid life stages can be found on host plants throughout the year, even in areas with frost. Adults are trapped on yellow sticky traps in all seasons too, which means they are active even when there are no crops around. This has affected research progress on predictive tools for TPP management.

Figure 1: Left - Two adult tomato potato psyllids and eggs on a leaf. Right - Tomato potato psyllid nymphs of different stages and psyllid sugars.

Psyllid adult and nymphs can transmit the bacterium *Candidatus* Liberibacter solanacearum (CLso) to plants. When a potato plant is infected with this bacterium, the plant will show upward rolling of leaves, yellow to purple discolouration of leaves, axillary bud proliferation, swollen nodes, aerial tubers and, in later stages, leaf chlorosis (Figure 2). For the tubers, there is a delay in sprouting and emergence and the vascular tissues show browning. Frying of chips from infected tubers results in variable patterns of light and dark stripes, streaks and blotches; the zebra chip (ZC) symptoms (Figure 2). This makes the tubers unsuitable for processing.

Sustainable management of psyllids

The arrival of TPP has led to a significant increase in regular applications of insecticides in the potato industry. These spray practices are not only costly but are likely to have a negative impact on the environment and natural enemies, while increasing the potential for insecticide resistance in TPP and other pest insects such as aphids and potato tuber moth. Also, ZC can still be found in potato tubers, thus the insecticide-based strategy is not completely efficacious in terms of disease elimination.

For seed crops aphids are a problem too, because of transmission of viruses. These crops are sprayed frequently as there is a low tolerance for TPP and aphids. Research on sustainable psyllid management has not been conducted in seed crops yet and no best-practice can be recommended. However, a new non-spray management option is now available in the form of mesh covers (see presentation on 'Control of TPP and blight with mesh crop covers').

Figure 2: (L) Foliar symptoms related to tomato potato psyllid feeding and bacterial infection. (R) Zebra chip symptoms (darkening of the vascular tissues and blotching) in chips after frying (stars indicate zebra chip 'positive' chips, the other chips are not showing zebra chip symptoms). Photos: Jessica Dohmen-Vereijssen.

Although ZC is not as important in fresh or table potatoes as these are not processed, a reduction in yield has been observed as well as larger numbers of small tubers. Also, severe ZC affects the taste and texture of the cooked potato.

Research on TPP management has so far mainly focussed on process crops, as ZC affects this end use the most. Most research on sustainable TPP management has been conducted on the North Island. From recent research in Canterbury, it is obvious that each potato growing region needs a tailored suite of management tools. Not only because of the difference in climatic conditions, but also because of the different potato end-uses. Results from a field trial in the 2013-14 season in Canterbury showed that marketable yields comparable to weekly spraying could be achieved with 40% fewer insecticide applications. This will be further tested in the 2014-15 season.

Control of TPP and blight with mesh crop covers

Charles Merfield, BHU Future Farming Centre

Can we use zero foliar insecticides and fungicides in potatoes?

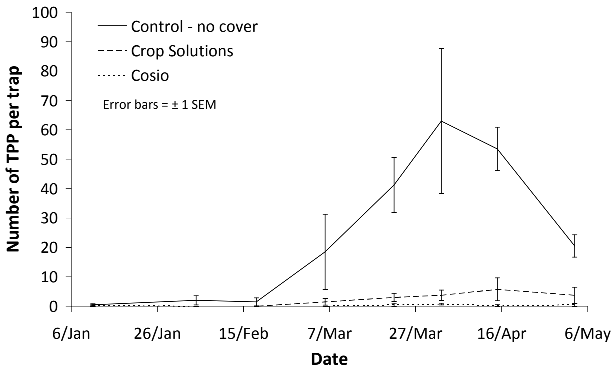
Agrichemical management of tomato potato psyllid (TPP) continues to improve with better timing of sprays based on predicted and measured TPP populations, plus the use of biorational insecticides that are less toxic to beneficial insects that help control TPP. However, even though fewer sprays are being used, ideally TPP could be controlled non-chemically, e.g. through biological control by parasitoids such as *Tamarixia triozae* or entomopathogenic fungi sprays. Another non-chemical approach is physical control, and mesh crop covers are the leading physical control of crop pests in European field crops.

What are mesh crop covers?

Mesh crop covers are akin to fly screens on windows, but for field crops. They are a woven mesh of fine plastic threads, like fishing line, that when laid over the crop creates a physical barrier, to stop pest reaching the crop, just like fly screens keep insects out of the house. Some 100,000 ha of mesh is in use in Europe with 100s ha on individual farms. It is now the only means of controlling root fly on turnips and swedes as there are no legal and effective chemicals left. They are also the opposite of frost cloth, which aims to increase temperature under the nets, mesh crop covers are designed to have the minimum effect on the under sheet microclimate - with a 1°C average increase typical.

Control of TPP and blight with mesh crop covers

Field experiments over two seasons at the Future Farming Centre, have shown that mesh is highly effective at keeping TPP off crops and significantly increasing yield against a null control, especially when taking into account that TPP also causes tuber size to decrease as well as yield.



	Control	Mesh
Total yield, tonne / ha	35	43
Percent increase over control	0%	23%
Percent of tubers > 125 g	38%	70%
Marketable yield of tubers >125g tonne / ha	13	30
Percent increase over control	0%	125%

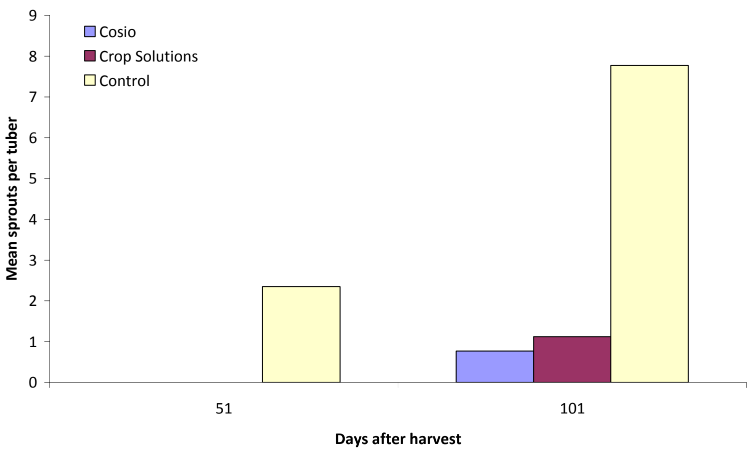
Organic growers using mesh in Canterbury and Hawke's Bay, have also been achieving excellent TPP control using mesh. In addition, a surprise finding was that mesh gives a high level of potato blight control (see below). The causal effect for this has not yet been determined, but it is clear that it is not due to temperature and/or humidity effects as there was zero difference in Smiths Periods under mesh and in the uncovered controls in the BHU trial.

It is speculated that the blight control is due to a 'spectral filter' effect where the mesh changes the types of light (blue, green, UV etc.,) that hit the crop. This effect has been used in Europe and Israel since the 1990s to control both fungi and insect pests in polytunnels. As mesh is a physical barrier, it is akin to a broad-spectrum insecticide, in that it will stop any pest that is too big to get through the mesh holes. As mesh hole size goes down to 0.3 mm mesh can keep out pests as small as thrips. Mesh is therefore also able to control the other main potato pests: aphids and tuber moth. The photo above shows covered potatoes on left (green) and uncovered on right (brown) 2013 season in Hawke's Bay

Mesh for seed potato production

While tuber moth is only a problem in the North Island and aphids are well managed in food crop potatoes, the latter are a major problem in seed potato production as they spread viruses. 100% control of aphids in seed potato crops would be ideal to eliminate virus spread, however, due to the nature of aphids and chemical control, this is impossible. In comparison, mesh crop covers, can offer 100% control of aphids (and all other potato insect pests) so it is considered that there is major potential to use the mesh in seed potato production to achieve a significant reduction in virus levels and also the damage caused to tubers from TPP feeding on the foliage (see below) as well as from zebra chip caused by *Candidatus* Liberibacter solanacearum.

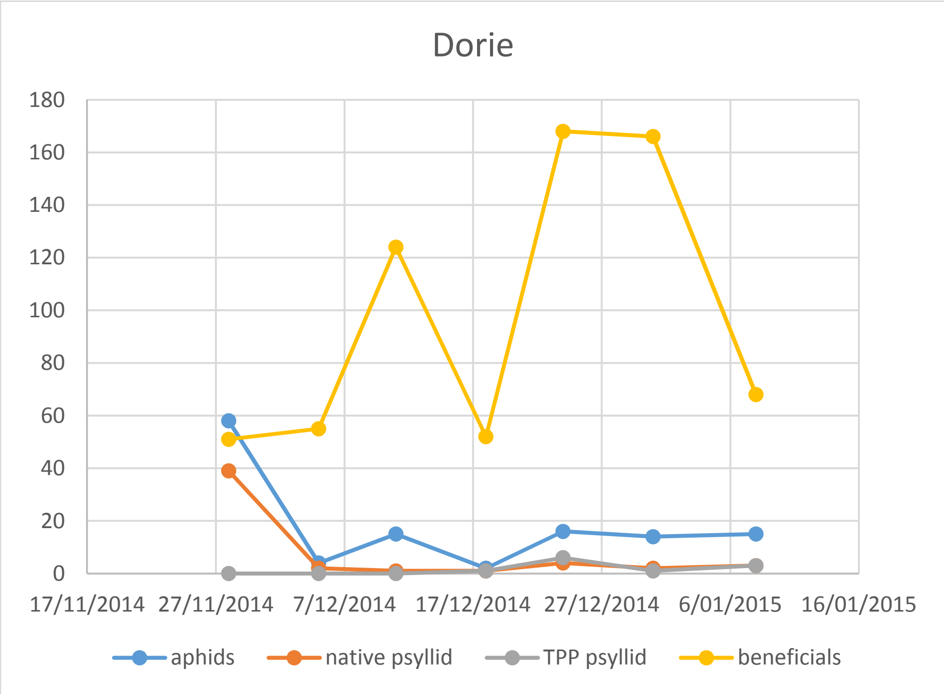
(L) Normal sprouts on mesh grown tubers (R) 'whip-tail' sprouts from TPP infested tubers.

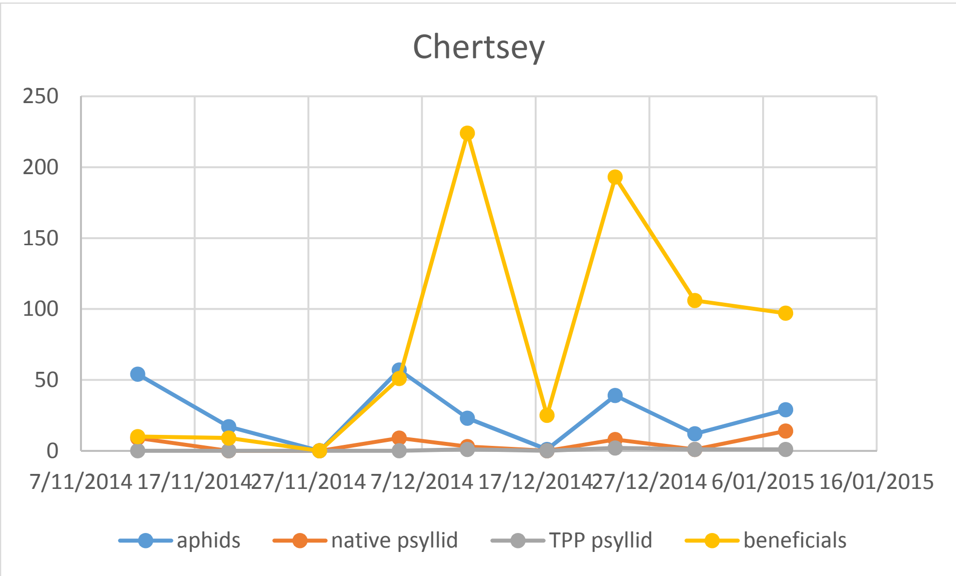


(R) Sprouting rates.

In addition, to ensure complete of aphid and TPP control in the first and second generations biological control agents such as the Cleobora and Dusky ladybirds can be introduced under the mesh to mop up any pests that manage to infiltrate the mesh.

Insect Monitoring Dorie and Chertsey – 2014-15





Irrigation on Potatoes

FAR Code P14-01
Location Geoff Maw, McCrorys Road, Dorie

McCrorys Road

401	5		301	2		201	7		101	1	
402	3		302	6		202	3		102	2	
403	6		303	1		203	4		103	3	
404	4		304	3		204	6		104	4	
405	2		305	7		205	1		105	5	
BUFFER			BUFFER			BUFFER			BUFFER		
406	7		306	5		206	2		106	6	
407	1		307	4		207	5		107	7	

40m run of potates

Trt #	Treatments
1	nil
2	Replace 33% ET
3	Replace 66% ET
4	Replace 100% ET
5	Replace 100% of ET until end of canopy expansion the replace 50% of ET
6	Replace 50% of ET until end of canopy expansion the replace 100% of ET
7	Replace 100% of ET until tuber set then 0% of ET for 1 week then again replace 100% of ET

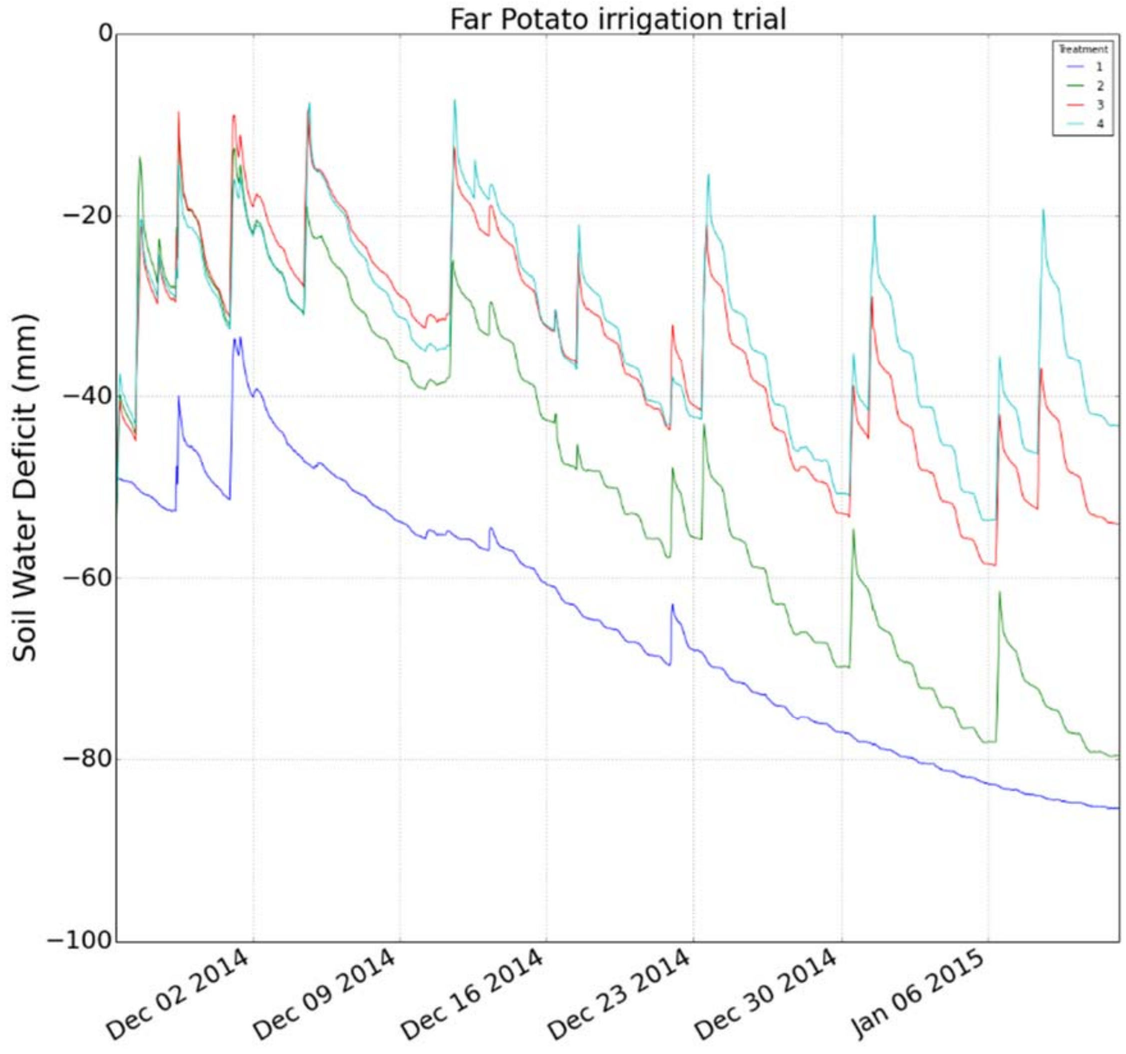
TDR soil moisture sensors information and data

Alexandre Michel, Plant & food Research

Four out of seven treatments are monitored with soil moisture sensors known as TDRs. These are automated sensors that measure [volumetric] soil water content hourly. The difference between measured soil water content and field capacity (estimated according to soil type and characteristics) represents the soil water deficit. This soil water deficit shows how dry the soil is, and is used to determine the amount of irrigation to apply. The four treatments that are monitored consist of:

- Treatment 1: rain fed only (no irrigation)
- Treatment 2: replace 33% of soil water deficit
- Treatment 3: replace 66% of soil water deficit
- Treatment 4: replace 100% of soil water deficit

Below is a graph showing the soil water deficit per treatment as at Monday 12th January (morning). Each peak that reduces the soil water deficit corresponds to a rainfall event (not many and not strong this year) or an irrigation event. When a lot of water was needed for irrigation, the application has usually been split in two rounds (thus avoiding water run-off or leaching).

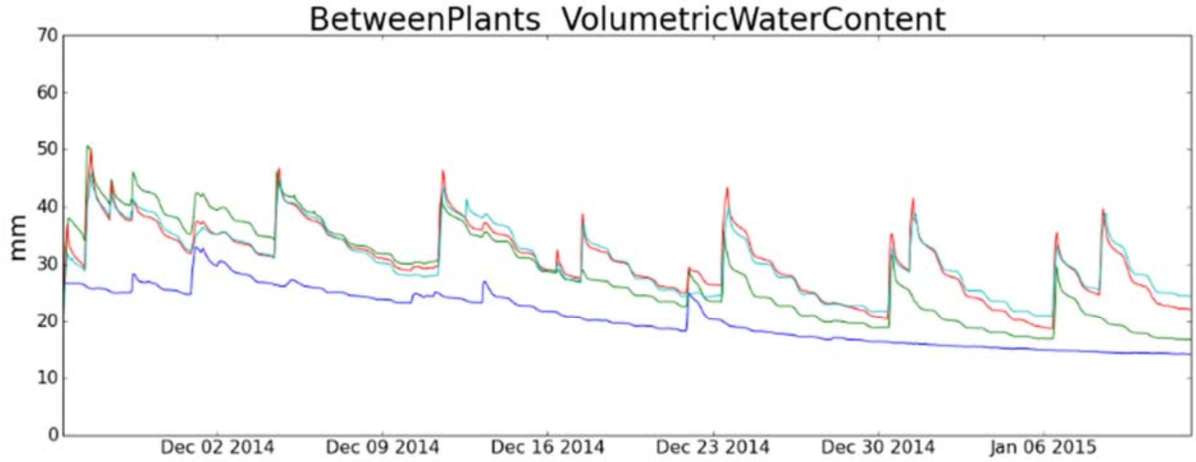


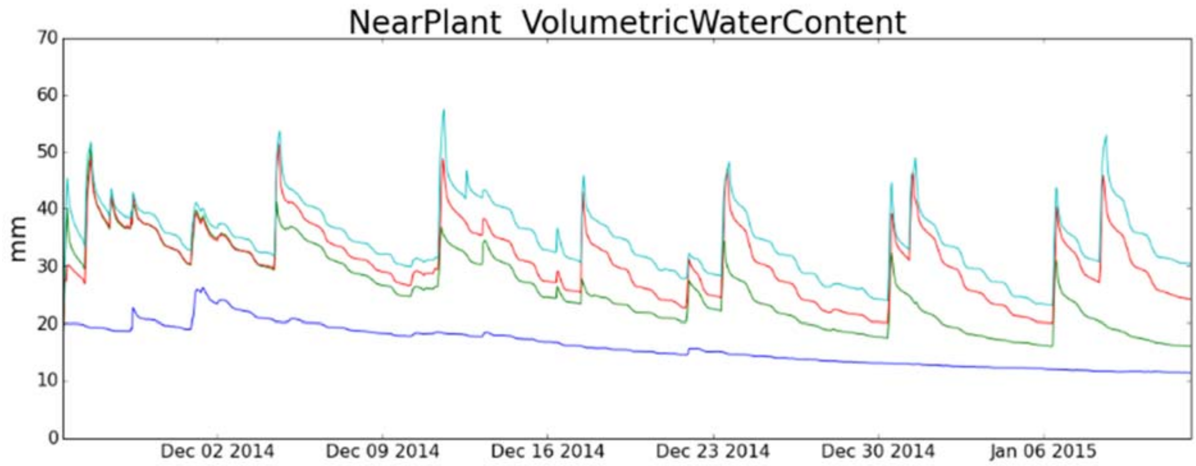
There are four TDR sensors per plot which are positioned differently around the plants as follows:

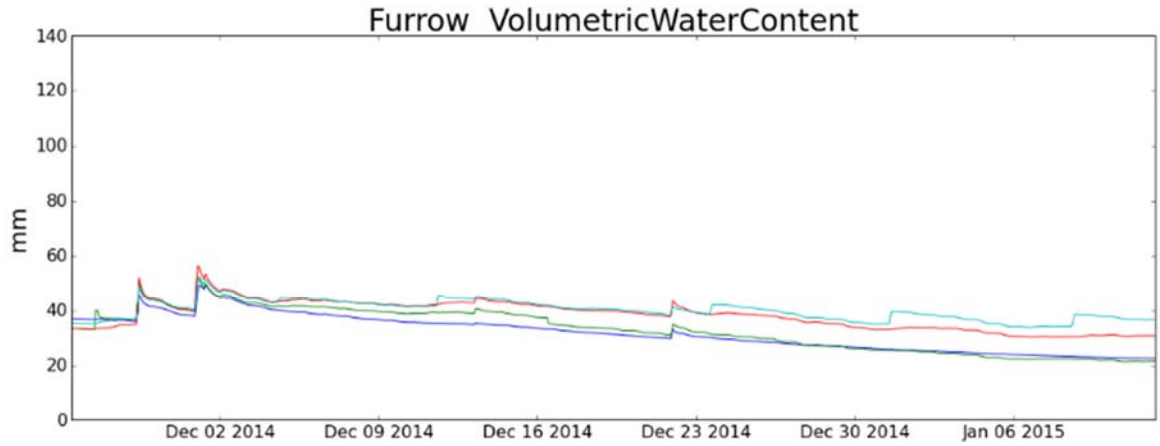
- 1 sensor between plants within the ridge monitoring 0-30 cm (0 being top of the ridge)
- 1 sensor near plants within the ridge monitoring 0-30 cm (0 being top of the ridge)
- 1 sensor in furrow measuring 30-60 cm (30 being top of furrow)
- 1 sensor under the ridge monitoring 30-60 cm (levelled with furrow)

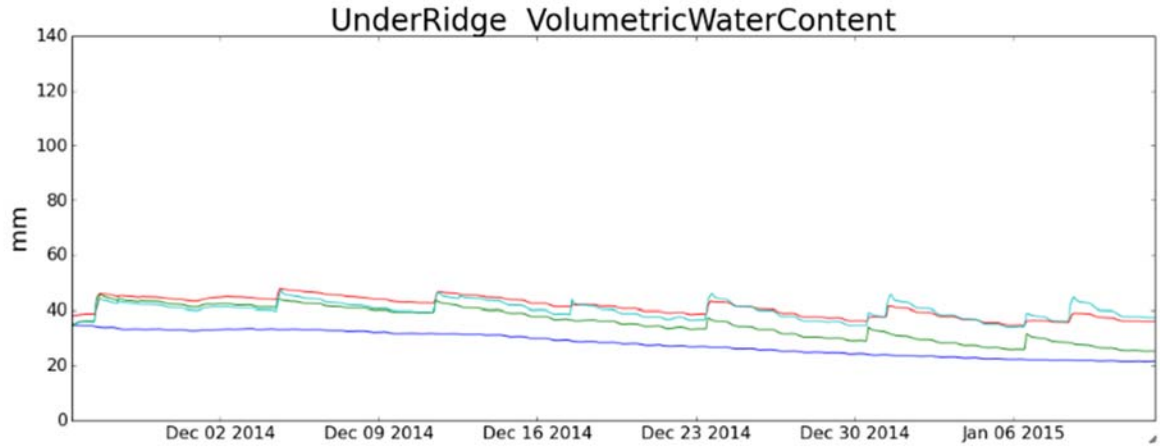
The following graphs show the soil water content for each treatment and position of the TDR.

From the current data, water extraction by the plants seems to be limited to within the ridges, with little water extraction apparent below the ridges or within the furrows. Irrigation also seems to affect mainly the top of the ridge and the furrow.






Furrow VolumetricWaterContent
mm
140
120
100
80
60
40
20
0
Dec 02 2014
Dec 09 2014
Dec 16 2014
Dec 23 2014
Dec 30 2014
Jan 06 2015


UnderRidge VolumetricWaterContent
mm
140
120
100
80
60
40
20
0
Dec 02 2014
Dec 09 2014
Dec 16 2014
Dec 23 2014
Dec 30 2014
Jan 06 2015

Potato yield gap 2014-15: Crop Variability

Sarah Sinton, Plant & Food Research

In the 2011-12 growing season, a Plant & Food Research survey of 11 Canterbury potato crops showed that several biotic and abiotic factors probably contributed to within-crop yield variations of between 30 to 90 t/ha. This broad survey only allowed assessments in an easily accessible part of each paddock, where a permanent observation plot was set up and monitored. At each visit (every 10 days during crop growth) observations the vicinity of the plot were made to identify any unusual growth. However, most of each crop was not evaluated.

In the 2014-15 season, Plant & Food Research and CropLogic have accessed ground and aerial imaging information for three crops (each ~ 25 ha) to assist with mapping yield variability across whole paddocks. The ground imaging uses electrical conductivity (EC) to identify soil zones which may have differences in soil water holding capacity or soil chemistry, and one series of measurements is usually taken in each crop at the end of winter before cultivation. The aerial images are obtained with an unmanned aerial vehicle (UAV) and infrared camera, to measure crop reflectance as an indicator of plant health. These aerial images are being taken every 7-10 days and will be used to help identify the type and extent of any problem areas in the three crops.

At crop emergence eight observation plots (8 rows by 10 m) were set up in each crop, where neutron probe tubes and logging 'Aquacheck' soil moisture monitors (every 30 mins), weather stations (one per paddock) and automatic rain gauges have been installed. Data from the plots and instruments will be used to calculate potential yield and track crop water use.

The plots are well separated through each crop, and their locations are loosely associated with groupings of the original EC values. Every 10 days, four plants are excavated from each plot and taken back to the lab for health assessments. Neutron probe readings to 80cm depth are also taken. Walking from plot to plot helps to observe a large area of each crop and any areas of unusual growth are investigated and mapped using a handheld GPS.

This programme of crop monitoring will link on-ground diagnoses of plant ill thrift with patterns/colours showing on the UAV images at similar observation times. For example, dry corners and edges in the three crops where the irrigator has missed are currently causing some plants to show drought symptoms. By checking on the images, we will be able to characterise this particular yield-limiting factor to possibly assist future management.

Project update:

Potato viruses S and *X* were present to varying levels in the three crops at emergence. Herbicide damage was evident at this stage, and there were a few missed rows at planting, with double ups and misses. Up to early January 2015, the three crops have been reasonably healthy above ground, although herbicide damage is still showing in recently emerged leaves. *Rhizoctonia* stem canker has been present since emergence, so far with high incidence but low severity. *Spongospora* root galls are showing up in one crop. Strong winds and hot weather have stressed all three crops.

The yield gap team (Sam Wilson, Farhat Shah and Alex Michel) on a recent field visit.

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