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## **November 2013 update #4**

### **Global Warming**

The big news is that our research & development programme has effectively brought global warming to New Zealand. This has been hugely successful for both intensive crop growers and pastoral farmers. We have managed to provide all of you with almost the mildest spring temperatures on record. You had to be in Otago to get even the vaguest sniff of a frost.

As you know we are trying to beat frosts in Canterbury. We haven't had any frosts so the ability to demonstrate Heat Ranger and run an effective R & D programme to be able to provide a full schedule of operating detail and to fine tune the performance of Heat Ranger has not made the progress that we had hoped.

### **Local Heat**

In the meantime we have been doing what testing we have been able to do, made modifications to the nozzle taking advantage of Nigel Green's field experience and have redone our calculations on heat and air flows and concluded that we needed to inject more heat. We have been able to increase our gas pressure and incorporate a third feeder tube and we now have a burner that is producing 1400kW of heat and raising the temperature of the air coming out of the nozzle by between 30 – 35 degrees centigrade above ambient. That is really serious stuff. Obviously that additional energy increases our gas cost, but it also seriously enhances the frost repulsion capability when you have that amount of warm air available.

All fired ready to go and no cold air in sight. Do not get us wrong, the benefits to everybody except us, are just fantastic and we really do not want you to have to be fighting the cold, just because we now have the tool for you to do that.

### **Plan B**

Instead we have just had to settle for testing under higher temperatures and close to still air conditions. "Still air" in Canterbury, sounds like a Tui beer advertisement. Well we can report that we did get just that mix of conditions in the early hours of the 21 November. Conditions came right at 4 a.m. and we got the machine fired up at 4:15.

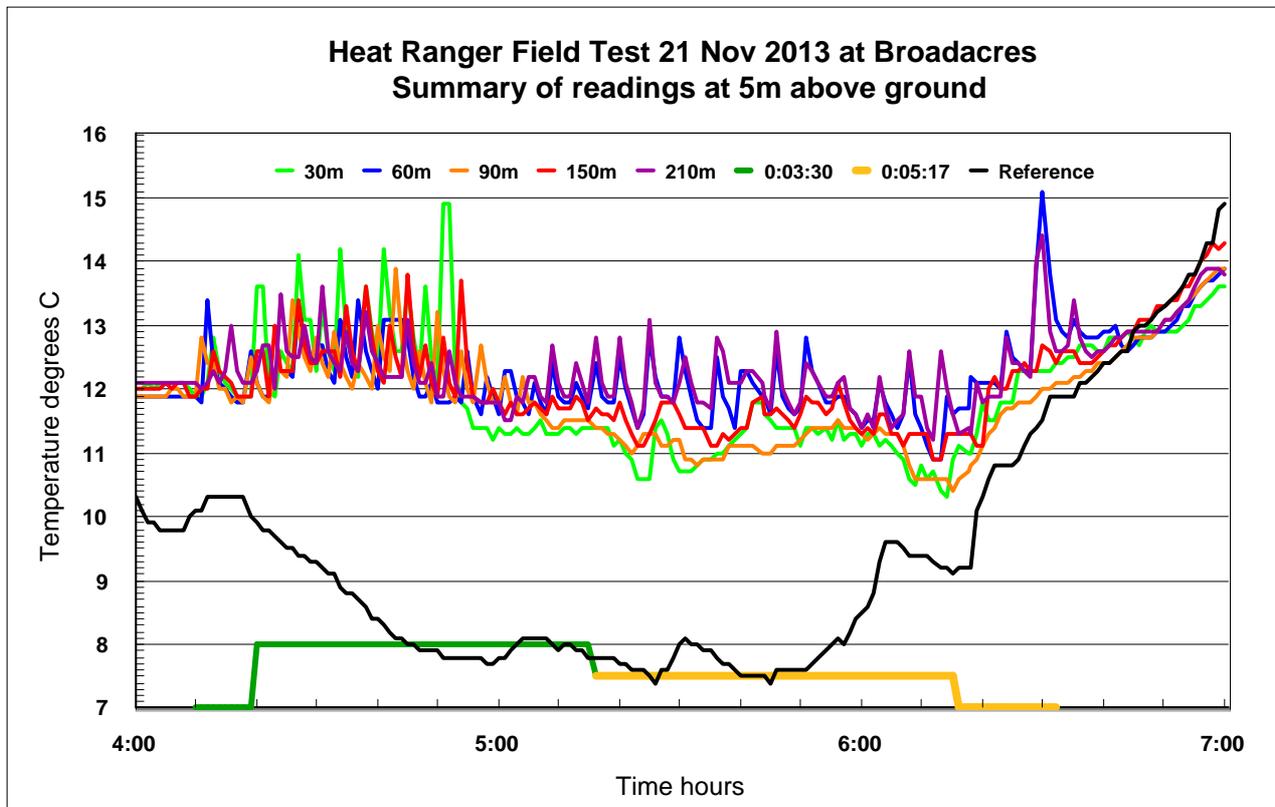
### **Two hours of quality time**

We started the single nozzle turret version at a rotation speed of 3min 30 seconds for the first hour and then slowed it down to 5min 17 secs per rotation for the next hour, by which time the sun was almost up so we slowed it to about 15 minutes.

The black currants were in full leaf and as the daylight started to penetrate, Bruce Koller could see the leaves waving in the breeze from Heat Ranger out well beyond 150m, little did he realise that they were still shaking out at 200m.

Of course this is the first field test run that we have been able to do with the Heat Ranger, with our masts correctly positioned and the natural air movement below 3km/h. Yes we had the expected teething problems with some of our additional masts not recording, but we had enough to get a pretty interesting picture.

Chart 1: temperatures 5 m above ground level (GL)



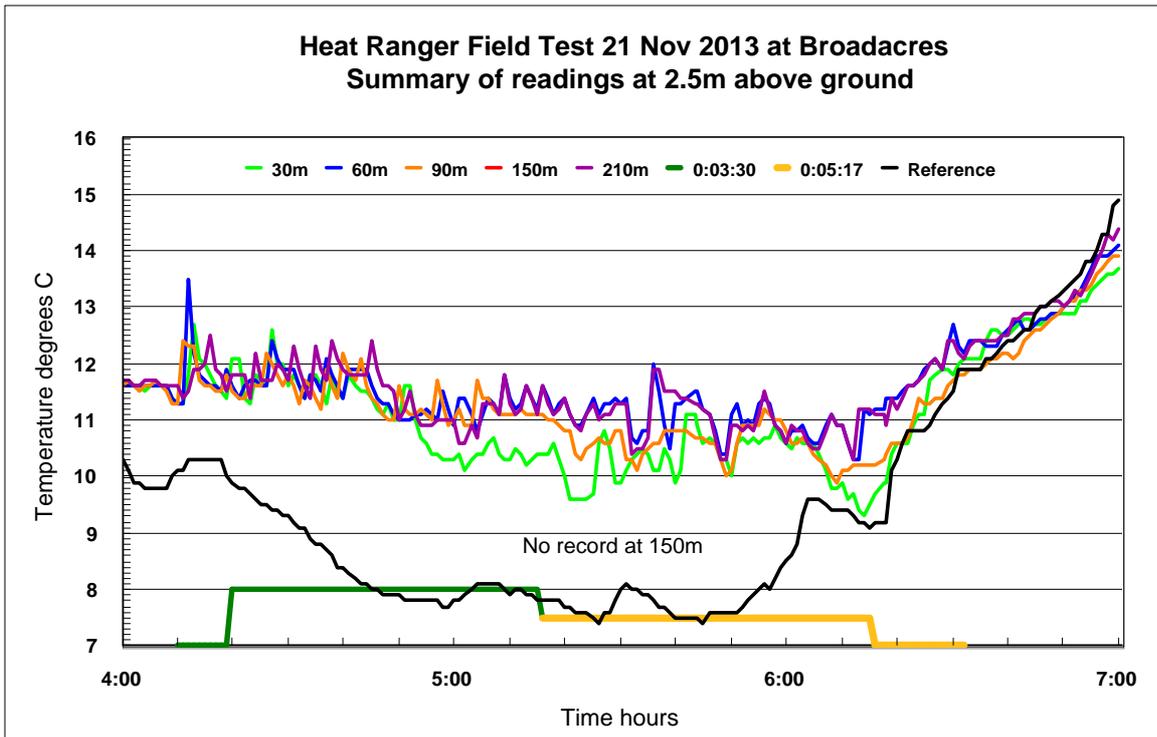
The Heat Ranger nozzle is a metre in diameter and is located between 4 and 5m above the ground. Our 5m monitoring masts are spread from 30m to 210m from the machine and we were expecting to detect the heat at between 150 to 180m, but had a mast at 210m as a precaution. Our control reference was located at 180m upwind. **(Mistake #1)** The control was too close and was affected by Heat Ranger. Fortunately we had a ground level (0.25m) reference point 400m away that was not affected, which is the Black line on the chart. Each of the coloured spikey lines above it, represent the temperatures over time and at the given distance from Heat Ranger. The straight Green and Orange lines across the bottom indicate that Heat Ranger is operating and at a rotation speed of either 3:30m per rev or 5:17m per rev.

When you compare this chart with the similar charts for the temperatures at 2.5m and 0.25m above GL respectively you can see that we have clearly achieved our objective of creating a donut of warm air immediately above the crop, without an inversion layer present.

**The machine is doing the job**

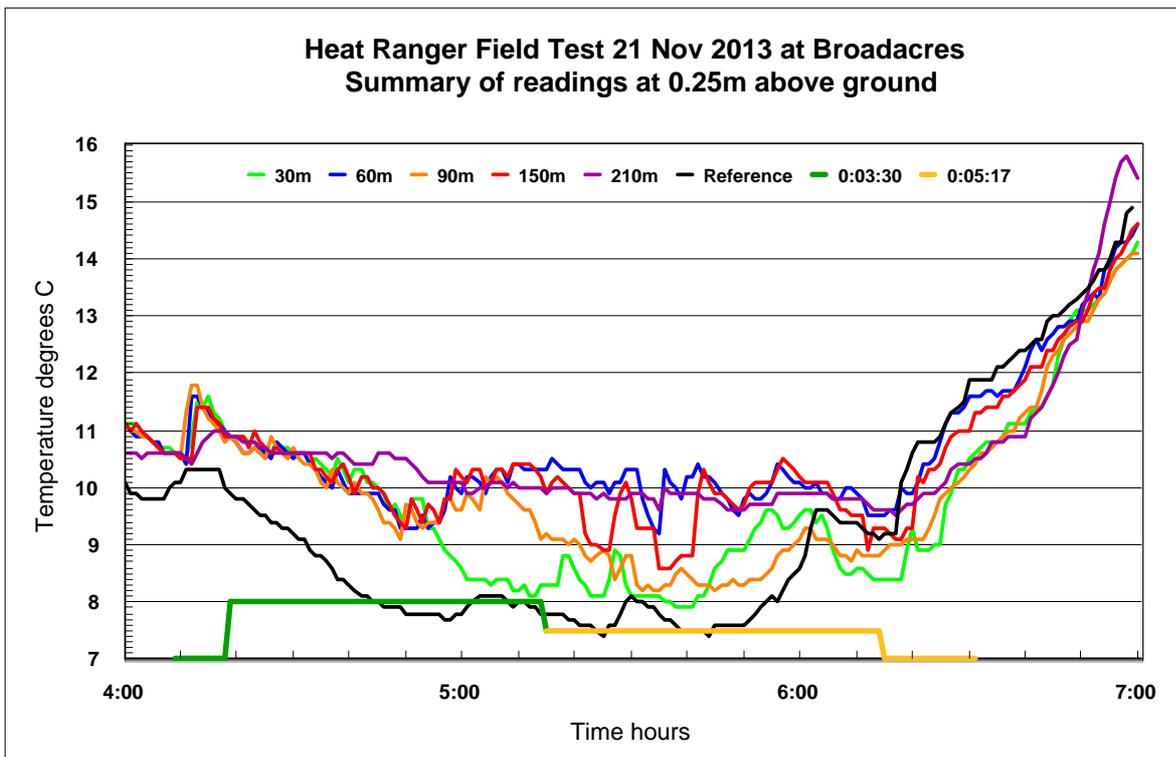
From this single test run we have confirmed that we need to start the machine about an hour before the expected frost temperature kicks in and that we are getting coverage well in excess of 150m and in this run our furthest mast was at 210m. **(mistake #2)** We should have gone further out.

Chart 2; Temperatures at 2.5m above GL

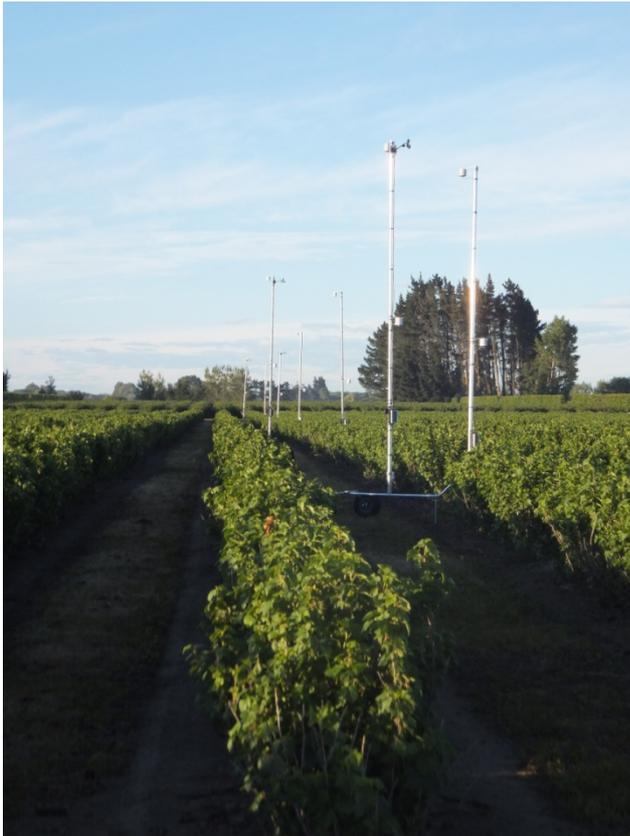


Unfortunately the temperature sensor at 2.5 m on the mast at 150m did not record. Apart from the 30m mast we have maintained a 3 degree differential even though we were only operating for 2<sup>1</sup>/<sub>4</sub> hours. Normally we would not be changing the rotation speed as it takes the machine about 10-15 rotations to establish the air whirlpools, or vortices, that provide the crop canopy protection, in fact it is quite eerie standing 180m out from the machine and having the wind swirling round you with the nozzle almost pointing directly away from you.

Chart 3: temperatures at 02.5m above GL



The picture below shows the 5m masts set out in the field recording at 1 minute intervals



On the right, Heat Ranger is stripped down, so that we can do the modifications and adjust turret configurations. You can see that Richard and Bruce are pretty pleased with the results of their nights work and they are both ready for breakfast.

We still have to confirm the machine performance in frost conditions, which we now do not expect until late April 2014. We will invite those interested to Broadacres at that time to see the machine in operation. If you let us know of your interest, we will make sure that you do not miss out on that opportunity. Hopefully we can get two or three frosts in a row.

What we do know is that Heat Ranger can produce a cushion of warm air over at least 10 ha from the one spot. We are really excited about this, especially with its proven quiet operation.

For those who have been following this development, we hope to bring you more news just as soon as we can get it.

A handwritten signature in blue ink, reading "Fred Phillips".

Fred Phillips  
Project Manager  
30 November 2013