Sprinkler Research Preliminary

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I: Equipment – sprinkler layout

Figure 1. Map of equipment layout for sprinkler program set up at Hinton. Figure shows pump and sprinkler locations as well as the location of the volume and pressure gauges. This was a closed loop.

Figure 2. Grid showing locations of lines, cups and sensors for a Rainbird sprinkler head with ¼ inch nozzle. All measurements are metric. The green 'X's' show the location of the poles supporting the temperature and RH sensors.

Figure 3. 300 gallon water tank and Mark III pump.

Figure 4. Flow meter and pressure gauge on stand located 10 feet from the Mark III pump.

Figure 5. Flow Meter on stand shown in Figure 4.

Figure 6. Pressure Gauge on stand shown in Figure 4.

Figure 7. Pressure gauges placed directly before and after the sprinkler head to determine if there was any drop in pressure.

Figure 8. Relative humidity and temperature sensors in protective cases measuring changes in RH and Temperature above and below the water from the sprinkler head.

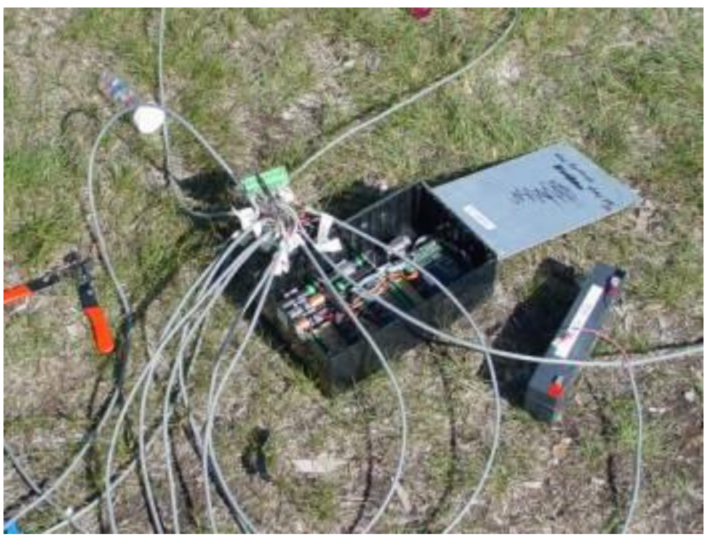

Figure 9. Data loggers downloaded temperature and RH data every second from the 17 sensors locations.

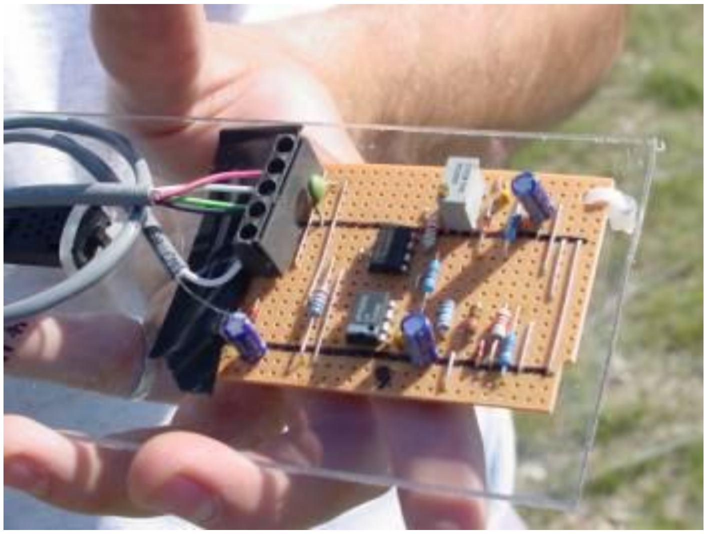

Figure 10. The circuit board and RH sensor used in the sprinkler trials.

Figure 11. A thermocouple used to gather data on changes in temperature over the study area.

Figure 12. Volume cups were spaced for equal area on eight quadrants of the compass to collect water for determining the distribution (footprint) pattern of water over the area.

Figure 13. Cups are 9 cm high with a 9 cm diameter opening. A piece of green turf was placed in bottom of cup to prevent water from splashing out. Each cup was weighed dry and again with the water to determined volume collected. Each cup is marked and placed at a specific point on the quadrant.

Figure 14. Aerial view of sprinkler research at Hinton, Alberta.

II Results:

From August 21 to August 23 a number of sprinkler trials took place in Hinton. Data was collected on the amount of water received by the ‘cups’ and how temperature and relative humidity are affected by the sprinklers. In total, two trials were run. Results will be presented showing the distribution of the water and the relative humidity profile.

Distribution

Water was collected in the cups and the amount was then converted into a mm/hour value. The data was then put into a spreadsheet to show the aerial distribution of the output (Figure 15).

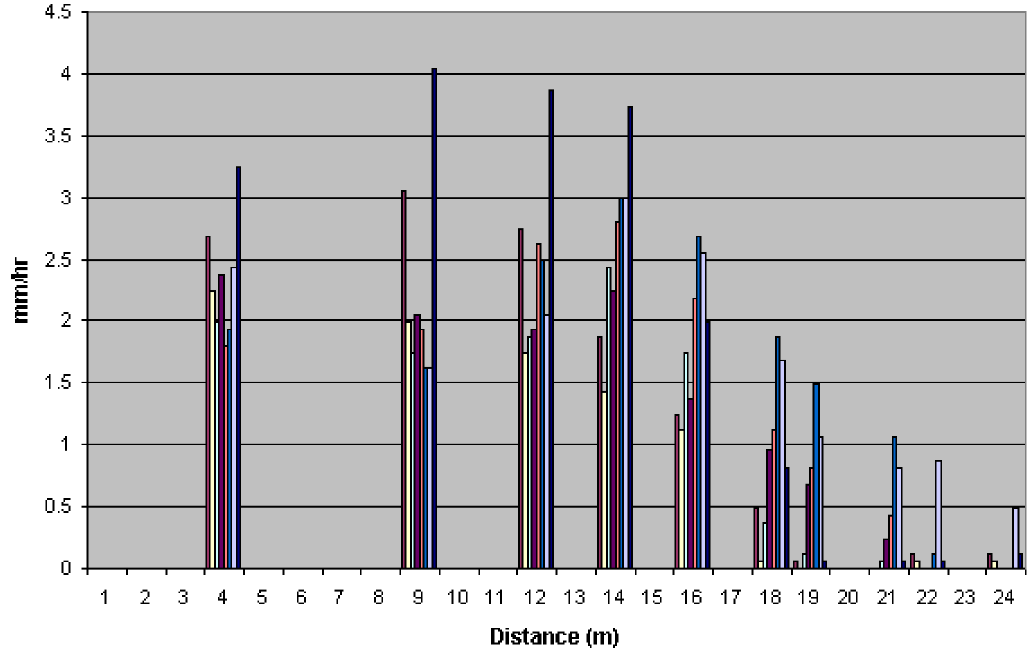

Figure 15. The distribution of water in mm/hour based on distance from the sprinkler head (m) for a trial on August 19 2002. All eight cardinal directions are represented in each distance cluster. Winds were light (<5 kmh) and variable during this trial.

The pump in this trial produced 16 gallons per minute and ran at 86 psi. Figure 15 shows a reasonably uniform distribution of water up to 16 m from the sprinkler head. Important numbers to remember for this figure are 0.6 mm/1.5 mm and 2.8 mm – the thresholds for the FFMC/DMC and DC. It is critical that the sprinkler wet the fuels sufficiently to minimise the probability of ignition. The optimum location from the sprinkler head is 14 m. The water appears to peak (maximum height) at around 13 m and then falls directly to the ground. This flight pattern would lead to a greater amount of water landing at this distance.

Relative Humidity

Figure 16 is an example of the data collected during two runs of the sprinkler on August 22. The data shows four sensors are affected by the sprinklers and show this with an increase in the relative humidity readings (%). Five sensors were not influenced by the sprinkler. The sensors that did experience a change (increase) in their readings were located at the following locations: the closet poles in the westerly direction. The sensors were at 5 and 10 feet and the 10-foot sensors were hit directly by the sprinkler stream. It would be beneficial to re-run this with the sensors above the spray level. The sensors that were not hit by the water directly did not experience an increase in RH readings.

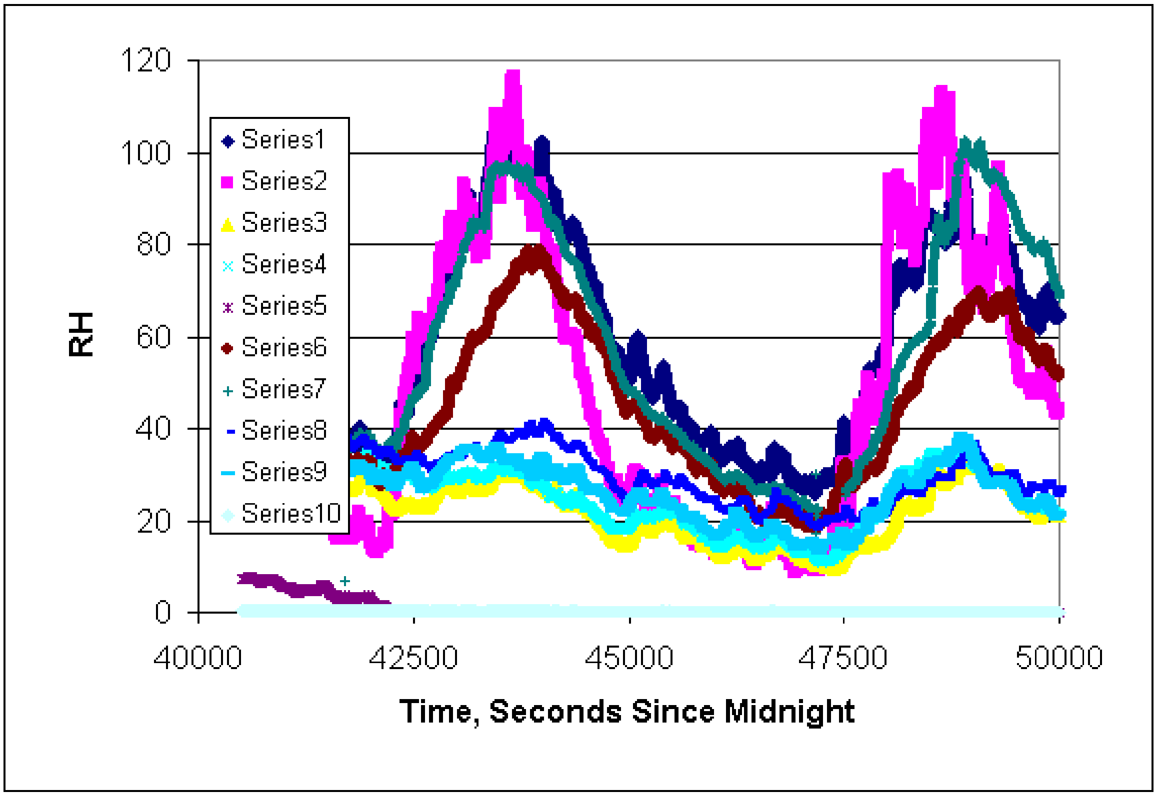

Figure 16. Relative humidity profile for two runs of the sprinkler test. Values above 100% are caused by water directly hitting the casings protecting the sensors. Direct contact with water directly on the sensors causes them to provide these readings.

Temperature - the temperature data still requires analysis.

Foam

On September 11, the WFORC tested the sprinkler system using foam for the first time. It did take a bit of tinkering to get the system working (pump had to be higher than water source, the foam had to be higher than the pump, and we found if you take the orifice out of the inductor system you get better performance), but initial results appear positive. It must be remembered that this is very preliminary work and the results should be questioned or commented on!

We ran both one and two sprinklers off 300 feet of hose from the pump. The aerial distribution of foam was very similar to that of just water (see Figure 17), although it was visually evident that foam was injected. A 'snowfall-like' appearance occurred and foam was beginning to accumulate within five metres of the sprinkler head. The mist created is similar to that of a sprinkler working in a strong breeze – although during foam testing the wind was calm.

More work is required in this area of research. Firstly, removing the orifice from the inductor system caused far too much foam to be used for any practical field use. Techniques to increase the suction pressure from the foam tank while using the small orifice requires an investigation into potential techniques such as increasing the volume of water pumped through the system.

a

b

Figure 17 a-b. The ‘snow-like’ appearance created during foam testing. The mist curtain below the main spray results from the foam.

Overall Impressions

The WFORC was surprised by the initial results of using foam in a sprinkler system, although more work is required to work out the kinks as well as in measuring the exact distribution of the foam under the same conditions that initial sprinkler testing was done. These foam tests were run at 200 psi, whereas other testing was done at roughly 80 psi. Running the sprinkler a longer period of time to see if the foam accumulates on the ground should also be tested.

The idea of the existence of a ‘humidity dome’ created by the sprinkler was not supported by these initial trials – although more work is required to substantiate this claim. In reality, the surface wind would continually move the ‘dome’ downwind away from the sprinkler. There should be an increase in humidity at the surface level due to the collection of moisture, but this height would be minimal if there was any wind at all.

As with most research – MORE WORK IS REQUIRED, although a start has been made!

Future Work

More testing is required using the temperature and RH sensors. We will reduce the probability of direct hits on the sensors to confirm or reject the existence of the 'humidity dome'.
Additional cup testing is required to develop moisture distribution footprints. This will include testing in windy conditions.
Multiple sprinkler set-up to test volume and pressure.

A variety of commonly available sprinkler heads will also be tested.

Foam and Sprinklers - will include the cup test and guidelines for the use of foam with sprinklers. This will include foam duration (time to use one can) and the effectiveness of the foam on the surface as well as foam production from a number of sprinklers.

Ignition tests will also be incorporated to determine the duration of effectiveness of the applied water or foam.

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