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OBSERVATIONS WITH HARDI WEATHER POLES, 1993

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Object

To make preliminary investigations into the accuracy and potential for the Hardi Metpole wireless weather recording system.

Summary

An investigation was made to determine the potential for the Hardi Metpole wireless weather recording system. Comparisons were carried out between the poles and the official meteorological station at Morley. Some technical problems were encountered, but overall, the Hardi Metpole system performed well. Such a system provides useful information to help growers make crop husbandry decisions.

*Not for publication without the Director's consent. This report deals primarily with only one year's work, so any conclusions given are provisional.

Observations

The two Hardi weather poles (serial number 145 - pole one; serial number 146 - pole two) were placed initially within the Morley meteorological compound in Skippers on 4 May 1993. Comparisons of the 0900 GMT readings from the official meteorological station could be made with the weather pole recordings. Both poles remained in the meteorological compound for approximately one month.

Pole one was then moved into a sugar beet crop (Brockholes) on 10 June and comparisons between the readings from both poles and the official meteorological station continued.

This pole was due to be moved after a month into a winter wheat crop, but owing to technical problems, this part of the investigation was not possible.

Problems

A number of problems with the weather poles were encountered during the investigation.

Sensors

Problems with the sensors were reported back to Hardi International A/S as they arose. During July, the sensors in the upper part of pole one started recording out of range or failed to provide data. This was remedied by exchanging the original weather pole battery packs for new ones. The data received from pole two was reliable, but occasionally no data was sent for a few hours, then recording would resume.

Pole one data recording was satisfactory but the relative humidity sensor was stuck on the maximum level from the beginning of August and did not work properly for the remainder of the investigation.

Spy program

Few difficulties were encountered when using the Spy program. However, the version used was only partly translated into english, which meant that some of the facilities available were not tried. An inability to define time periods for graphs and tables to view on the screen or for printout caused difficulties. To reach the required data for a graph, involved paging through the entire weather records.

During August, both the poles appeared to stop transmitting altogether. No data was being sent to the receiver, but the error file suggested that some signals were trying to get through. Somehow, the site setup for the two poles had been deleted from the computer program so that even though the poles were transmitting, the receiver could not recognise the signals. It is not clear how this occurred.

Use of data

On-farm decisions

Success in agriculture is dependant on the weather, so any system which can provide up-to-date and accurate meteorological records is important. Decisions have to be made daily to ensure that crops are well maintained at all times.

Having a network of weather poles is ideal when crops are some distance away, time is saved when conditions in remote areas are known (except for rainfall). From the weather data, it is possible to determine the severity of certain weather conditions, such as wind speed, which could have implications on future work.

Wind speed

Spraying is an activity which needs very precise weather conditions to comply with health and safety regulations, eg wind speed is a critical factor. Ideal wind speed for spraying can lie within a range of 3.2-6.5 km/h, equivalent to 0.9-1.8 m/s. For wind speeds between 6.5-9.6 km/h (1.8-2.7 m/s) herbicides should not be sprayed (Anon., 1991). Continual recording of wind speed enables the farmer to decide if to spray and also when to stop if the wind speed increases.

This is illustrated in Figures 1 and 2. Both show the range for spraying conditions. Wind speed was reducing during the early evening, indicating that good spraying conditions would occur in the early hours of the following day.

Figure 1. *Wind speed records on 14 June 1993 (pole two)*

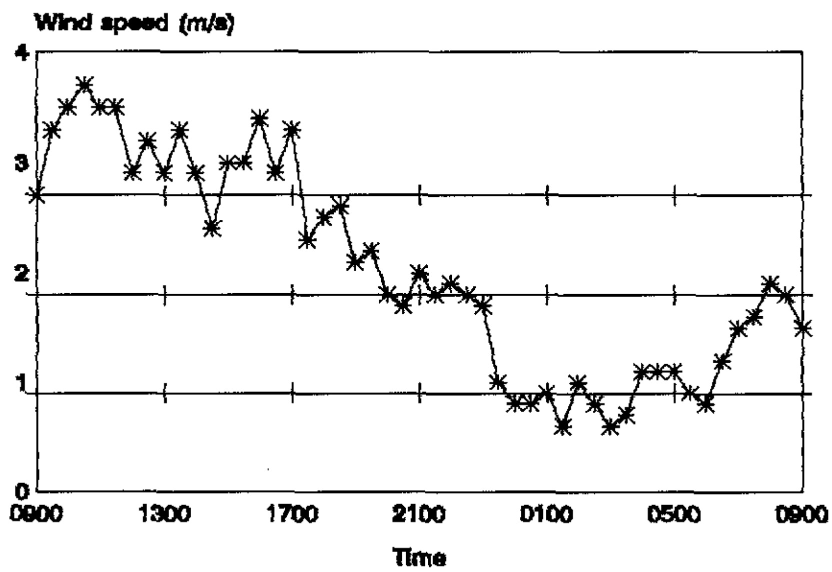
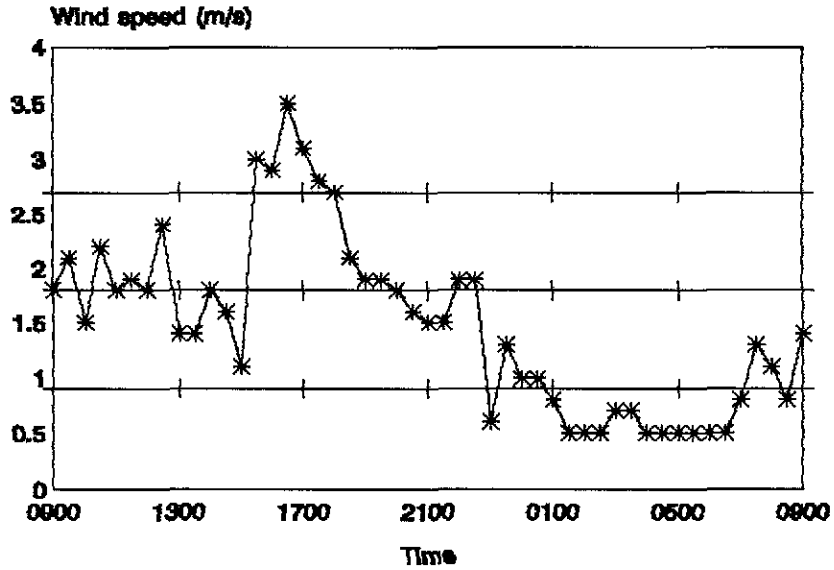


Figure 2. *Wind speed records on 24 June 1993 (pole two)*



Air frost

Knowing when crops have been subjected to air frosts can influence agronomic decisions. From the official meteorological station, a minimum temperature figure is given, but there is no indication of the duration of low temperature conditions. Figure 3 shows that the air frost during the night of 21-22 May 1993 lasted for a short period of time, whereas the official station recorded a grass minimum temperature of -1.6°C. Compare this with Figure 4, -6.1°C was recorded during the night of 19-20 October officially, and use of the weather pole data confirms the severity and duration of this frost.

Figure 3. *Air frost, 21-22 May 1993*

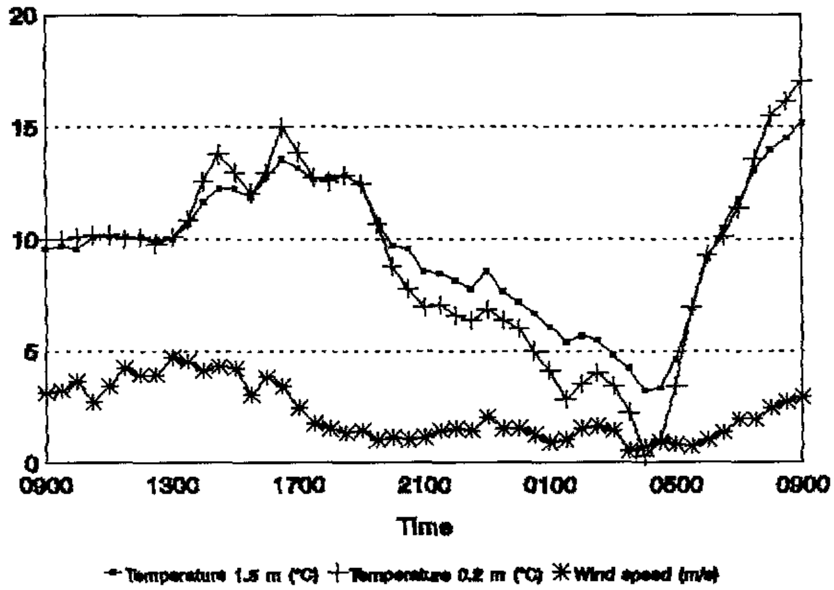
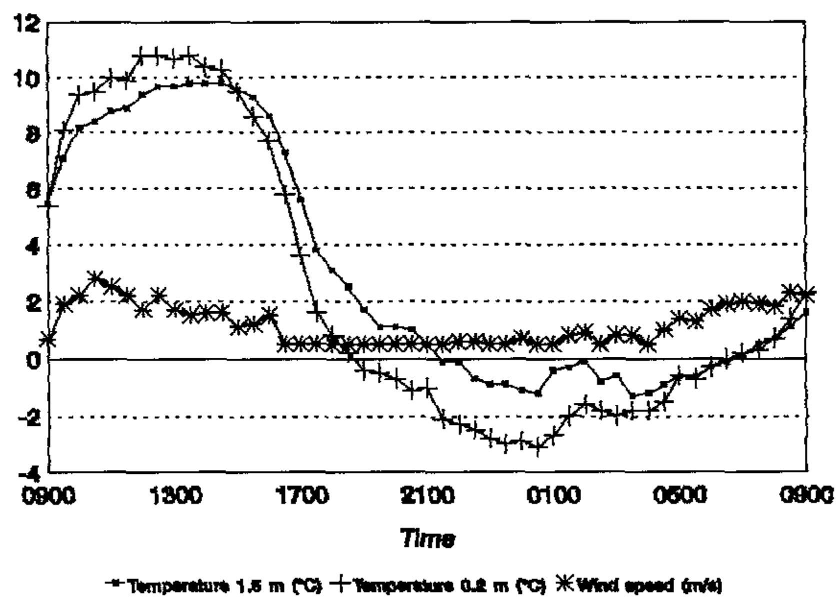


Figure 4. *Air frost, 19-20 October 1993*

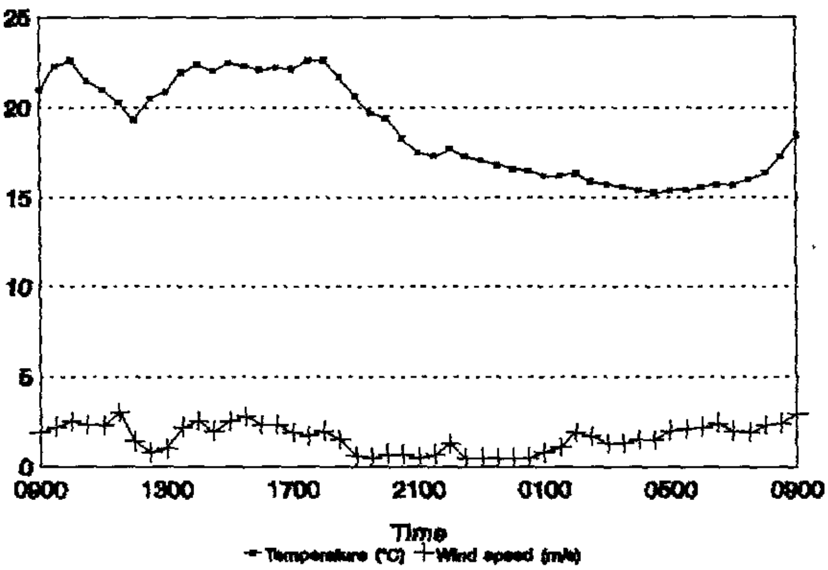


Crop protection

Many pests of crops only become a problem when certain weather conditions are met to encourage development and spread. Weather data can be used to alert growers about the potential threat and a strategy for control of the pest can be undertaken.

This year, cereal crops in the Eastern counties of the UK were threatened by an insect pest, the wheat blossom midge. The midge has very precise egg laying requirements. The eggs are laid in the evening when the temperature is above 15°C and wind speed below 10 km/h (2.8 m/s). From the data obtained by the weather poles, the exact period when the blossom midge eggs were laid could be determined (Figure 5).

Figure 5. *Wheat blossom midge egg laying conditions, 10-11 June 1993*



Forecasting

Much of the work involved in growing crops is structured to prevent the possibility of pest damage to crops. Different forecasting models are available to help plan the crop protection strategy.

Temperature day degrees can be used to evaluate a number of biological parameters, but work at Morley based on this is looking at wheat disease control. Crop growth stage and development of the wheat disease caused by *Septoria tritici* can be determined using day degrees. This combined with rainfall incidence can be used to forecast levels and severity of the disease. These can be calculated from the records produced by the weather poles, and could be extremely useful for remote trial sites. This aspect of forecasting is mentioned also in the next section on comparisons of data (page 9 of this report).

Comparisons of data

Comparisons between the weather poles and the official meteorological are difficult to make owing to differences between the records produced and some of the sensors (Table 1).

Table 1. Parameters measured by the weather systems

Weather pole	Official station
Wind velocity (m/s)	Wind direction
	Wind run
Global radiation (MJ/m)	Sunshine (h)
Relative humidity 1.5 m (%RH)	Wet bulb 1.25 m (°C)
Air temperature 1.5 m (°C)	Dry bulb 1.25 m (°C)
Relative humidity 0.2 m (%RH)	
Air temperature 0.2 m (°C)	
Soil water content -0.1 m (Vol%)	
Soil temperature -0.1 m (°C)	Soil temperature -0.1 m (°C)
Soil water content -0.3 m (Vol%)	
Soil temperature -0.3 m (°C)	Soil temperature -0.3 m (°C)
Rainfall (mm)	Rainfall (mm)
	Soil temperature -0.2 m (°C)
	Maximum temperature 1.25 m (°C)
	Minimum temperature 1.25 m (°C)
	Grass minimum temperature (°C)
	Total cloud
	Present weather
	Visibility

Air and soil temperature values are the only comparable records for both weather systems. There is some variation in air temperature and some of the soil temperatures vary greatly. However, as there was a problem with the pole sensors, it is unwise to make a more detailed comparison. Overall the records produced by the weather poles were satisfactory.

This was shown by comparing temperature day degrees calculated to determine disease risk. Weather data was collected from three different sources, the weather poles, Morley's official meteorological station and a Delta-T weather station based at the experiment site, see Figures 6-8. Even though the three systems were different and the Delta-T weather station in a different field, the day degree profiles are similar.

Figure 6. *Day degrees with rain events (pole data)*

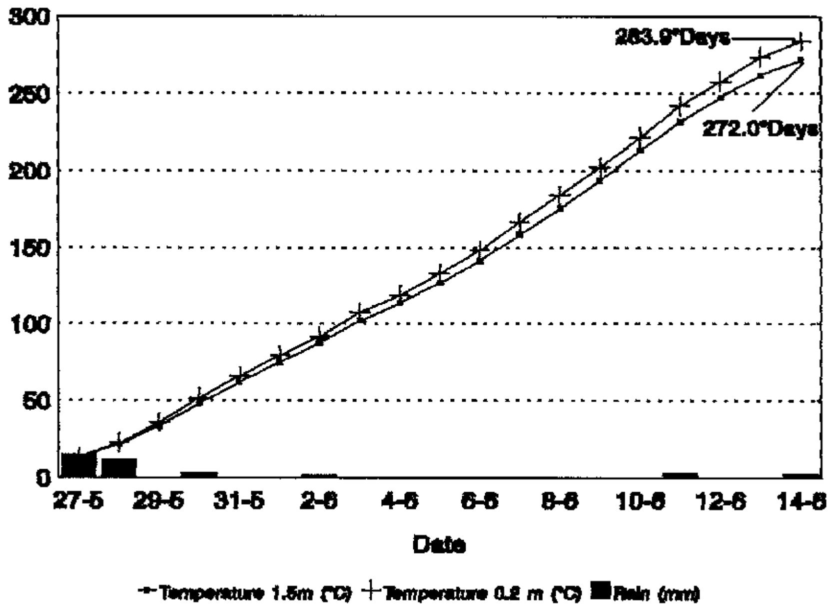


Figure 7. *Day degrees with rain events (official station data)*

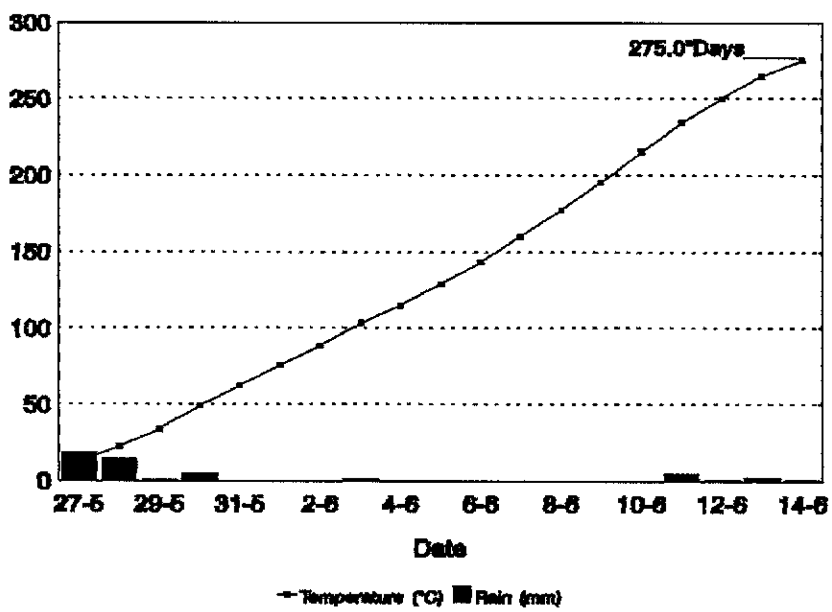
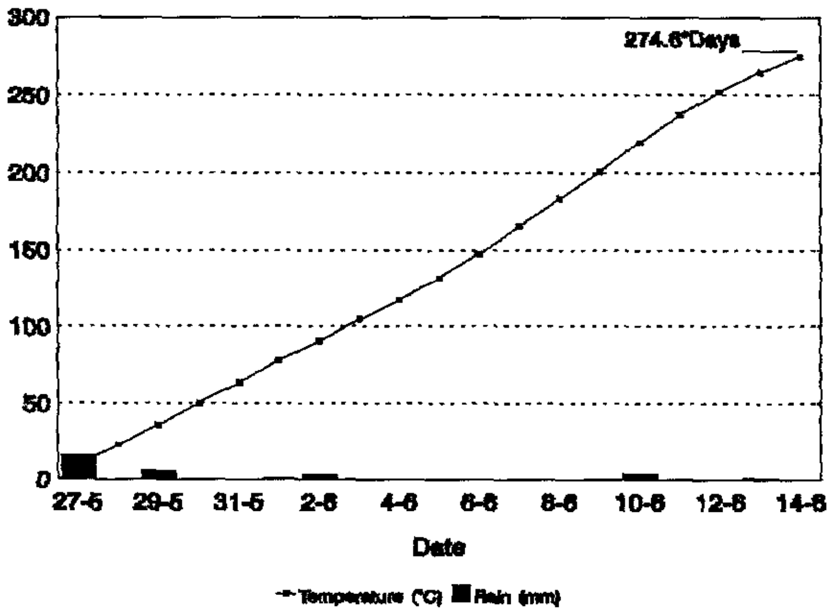


Figure 8. *Day degrees with splash events (Delta-T weather station)*



Improvements

The main improvement which is needed by the system, has already been addressed by Hardi International A/S, namely the weather pole sensors. Many of the problems encountered during the trial period will be solved by replacement of the original sensors.

There was concern about the rain gauge being linked directly to the receiver connected to the PC. It seems logical to have the rain gauge attached to the pole instead. This enables the user to determine rainfall if the pole is some distance away. There can be differences in the amount of rain over relatively short distances, and for uses such as disease risk assessment, it is important to be aware of conditions in the actual field being monitored.

Another improvement would be to have the air temperature sensor at 0.2 m moved to correspond to the grass minimum temperature of the official station. This would provide a record which is of more use to growers. Possibly a "correction" factor might be acceptable as an alternative (but poorer) option.

In the spy program, a facility to select precise dates for graphs and tables would be of enormous value. It would also be of use if radiation and surface wetness parameters were defined more clearly so that users could relate the figures recorded with definite weather conditions.

Some difficulty was experienced when moving the weather poles. This was mainly due those parts of the system which are placed in the ground, namely the soil sensors and the battery pack. Problems were encountered trying to dig holes suitable to house the underground parts of the system, especially the soil sensor part of the pole which had to be exactly the size of the unit and vertical. This also meant that removal of these parts from the holes was difficult.

One foreseeable problem may come from rodent pests. The automated weather station at Morley has had overground cables chewed by hares, which interrupts transmissions. As there will be two cables (battery pack and rain gauge) coming from the weather pole, the risk of this problem should be considered.

References

Anon. (1991).
Boom Sprayers Handbook. *British Crop Protection Council/Agricultural Training Board handbook*, 45.