Module 10
Weather monitoring for spraying operations How to assess if conditions are suitable for spraying

Bill Gordon
Key points

- Use accurate forecast information to help plan spraying activities
- Always measure and record weather parameters at the site of the application before, during and on completion of spraying operations
- Wind direction and wind speed are critical for assessing suitable conditions and potential risks
- Temperature and humidity (or Delta T value) can indicate evaporation and spray-drift risk, but can also identify potential effects on efficacy
- Always follow the label directions for appropriate conditions for spraying, including downwind buffers or no-spray zones that are related to wind speed
- Consider what weather monitoring equipment will best suit your enterprise
1. Introduction

All applicators need access to accurate weather forecast information to plan where and when to spray.

Apart from being able to anticipate when changes are likely to occur, good weather forecast information allows the operator to consider which paddocks to spray, and when, along with the logistics of keeping operations running smoothly if you need to move to different parts of the farm to continue spraying if a change in wind direction occurs.

The purpose of taking measurements of weather parameters and keeping records during spraying activities is to demonstrate what you did. The more accurate your records are, the more likely they are to be useful for management decisions, to show you complied with label requirements and demonstrate your duty of care.

1.1 Measurements and records for management decisions
Reviewing spray jobs to establish what worked well and what didn’t is important to assess suitable application parameters and weather conditions for future spray jobs. It is a good idea to follow up on each spray job and note the level of control obtained on the spray record. Recording good results is just as important as recording bad ones. These records can be useful when evaluating potential trends in efficacy, over one or more seasons.

1.2 Measurements and records for product performance issues
Where a particular product or tank mix does not perform as expected, often the manufacturer of the product will need to be contacted to evaluate the product’s performance. The first thing the manufacturer will look to is your application records, including how you applied the product and the conditions at the time of spraying. Without this information, it is unlikely you will gain support from the manufacturer to resolve the issue.
1.3 Measurements and records for legal purposes

If there is an incident of damage to a crop or other sensitive area that is suspected to have been caused by a spray-drift event, there may be two possible legal consequences. The first outcome may be a prosecution by the relevant authority under statute law. For a prosecution to occur, the alleged damage and the source need to be proven beyond reasonable doubt.

The second possible outcome is a civil procedure, where a party seeks compensation for damage or loss they allege another party caused. Civil actions for compensation are covered under common law, where the burden of proof required is not ‘beyond reasonable doubt’, but is based on the balance of probability. Under this definition the person making the claim only has to demonstrate that the alleged person or enterprise is likely to have caused the damage. The defendant then has to demonstrate they acted as a reasonable person and followed their duty of care.

As a spray applicator, having detailed spray records that demonstrate what you did and the weather conditions during the application can be beneficial in such circumstances.

Phenox damage to a cotton crop caused by spray drift. 

Photo: Auscott
2. Important weather parameters for spray operations

Weather influences the outcome of any spray job, in terms of both efficacy and spray-drift risk. Legal requirements, both on the label and in state or territory legislation, also require applicators to record weather parameters during application.

**Label requirements**

Many product labels (depending on when they were approved) include a requirement for the spray operator to measure and record wind speed, wind direction, temperature and humidity during the application at the actual application site.

Wind speed and direction are particularly important in determining the risks associated with spray drift, but will also influence how uniform the spray coverage will be.

Temperature and humidity are important for assessing potential impacts on efficacy, as they can affect the condition of target plants, the droplets after they are released by the sprayer.

To comply with the label requirement, it is best to record conditions at the start of spraying and at the end of each tank. Recording the weather conditions at regular intervals can help to identify if, or when, conditions may have changed, which can be important to meet record-keeping requirements in individual states.

**2.1 Wind speed and wind direction**

Wind speed and wind direction are probably the most important factors to consider when making the decision about when to spray and when to stop.

Spraying when the wind is away from sensitive areas is one of the most important strategies for reducing the potential for damage from off-target movement of spray droplets. Ensuring that there is enough air movement to dilute airborne droplets and minimise the risk that an inversion may be present is also key.

Accessing reliable weather forecast information is critical to planning the spraying operation. It is important to pay close attention to expected changes in wind direction and wind speed, and when these changes are likely to occur throughout the day.

Monitoring wind speed and using as many visual clues as possible while you are spraying helps to ensure that wind direction hasn’t changed as you move around the farm, or at different times of the day.
2.1.1 Wind direction

Wind direction at a specific location is not difficult to identify at a particular point in time. However, variations in topography may influence local wind direction at different places around the farm. In some locations wind direction can be different from one end of a paddock to the other. This is why it is essential to measure and record the weather conditions at the site of application.

When recording wind direction, be aware that there are variations between magnetic north, true north and grid north. It is important to be aware of which version of north your measurement is based on.

True north (the axis of the Earth’s rotation) and grid north (the top of a map) are generally within a couple of degrees of each other, depending on when the map was produced. Often the variation between true north and grid north will be indicated on a detailed map.

However, magnetic north (where a magnetic compass points) can vary by several degrees from grid north (‘north’ on a map) depending on your location, as the compass will be influenced by the Earth’s magnetic fields. The difference between the two will also be affected by the date when the map was produced.

When setting up a weather station, or taking wind direction measurements using a magnetic-compass-based instrument, be aware of the difference between magnetic north and grid north. Always record which ‘north’ has been used.

If you are using a GPS-based system to indicate direction, this should take the variations into account for you.

2.1.2 Measuring wind speed

Wind speed is often difficult to estimate, particularly when it is gusting. Record-keeping requirements on product labels state that wind speed must be measured at the site of application.

For record-keeping purposes, record the average wind speed at two metres above the ground at the application site, along with the time it was recorded. The point where you measure the wind speed should be representative of the application area and should be free of obstructions that may impact the measurement.

From an application point of view, variations in wind speed are also important, as these may affect the uniformity of the spray deposits, particularly when using medium or fine spray qualities.

As a rule of thumb the maximum wind speed (gusts) should not be more than about one-third of the average wind speed above the average wind speed.

For example, if the average wind speed at the site of application is 15 kilometres per hour, then you would not want gusts to be above 20km/h (15km/h + 5km/h).
If the operator is relying on measurements from a permanent weather station, it should be located within line of site of the sprayed paddock (generally within 2km), and not more than 5km from the site of application.

2.1.3 Bureau of Meteorology records of wind speed and direction
There are a couple of things to keep in mind when relying on Bureau of Meteorology (BoM) forecasts or records for wind speed and direction. The first is the size of the forecast area, which may not fully represent wind speed and direction at the site of application.

The second consideration is the height at which the BoM measures wind speed. Official BoM records of wind speed are generally taken at 10 metres above the ground to avoid surface turbulence.

Wind speed normally increases with height, so measurements of wind speed at 10m above the ground will be greater than what would be experienced at 2m above the ground at the site of application. Other factors such as ground cover and stubble will increase the friction at the surface, further slowing the wind speed close to the surface.

Wind speeds at 2m above the ground in a paddock with good ground cover or crop may be less than 50 per cent of a measurement taken at a height of 10m.

**TIP**
All downwind buffer distances (no-spray zones) included on product labels are based on a wind speed measured two metres above the ground.
2.1.4 Visual clues of wind speed and direction

Visual observations of what is happening outside the cab are very important while operating the sprayer. While these observations will not meet your legal requirements to measure and record the conditions, they will provide an indication that the weather parameters are either fairly constant or changing, which indicates that it is time to re-evaluate conditions.

The Beaufort wind scale is a useful guide for estimating wind speed, while windsocks and other visual aids are useful for assessing wind direction.

Table 1 The Beaufort Wind Scale.

<table>
<thead>
<tr>
<th>Beaufort scale number</th>
<th>Descriptive term</th>
<th>Units in km/h</th>
<th>Units in knots</th>
<th>Description on Land</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Calm</td>
<td>0</td>
<td>0</td>
<td>Smoke rises vertically.</td>
</tr>
<tr>
<td>1–3</td>
<td>Light winds</td>
<td>19 km/h or less</td>
<td>10 knots or less</td>
<td>Wind felt on face; leaves rustle; ordinary vanes moved by wind.</td>
</tr>
<tr>
<td>4</td>
<td>Moderate winds</td>
<td>20 – 29 km/h</td>
<td>11 – 16 knots</td>
<td>Raises dust and loose paper; small branches moved.</td>
</tr>
<tr>
<td>5</td>
<td>Fresh winds</td>
<td>30 – 39 km/h</td>
<td>17 – 21 knots</td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland waters.</td>
</tr>
<tr>
<td>6</td>
<td>Strong winds</td>
<td>40 – 50 km/h</td>
<td>22 – 27 knots</td>
<td>Large branches in motion; whistling heard in telephone wires; umbrellas used with difficulty.</td>
</tr>
<tr>
<td>7</td>
<td>Near gale</td>
<td>51 – 62 km/h</td>
<td>28 – 33 knots</td>
<td>Whole trees in motion; inconvenience felt when walking against wind.</td>
</tr>
<tr>
<td>8</td>
<td>Gale</td>
<td>63 – 75 km/h</td>
<td>34 – 40 knots</td>
<td>Twigs break off trees; progress generally impeded.</td>
</tr>
<tr>
<td>9</td>
<td>Strong gale</td>
<td>76 – 87 km/h</td>
<td>41 – 47 knots</td>
<td>Slight structural damage occurs – roofing dislodged; larger branches break off.</td>
</tr>
<tr>
<td>10</td>
<td>Storm</td>
<td>88 – 102 km/h</td>
<td>48 – 55 knots</td>
<td>Seldom experienced inland; trees uprooted; considerable structural damage.</td>
</tr>
<tr>
<td>11</td>
<td>Violent storm</td>
<td>103 – 117km/h</td>
<td>56 – 63 knots</td>
<td>Very rarely experienced – widespread damage</td>
</tr>
<tr>
<td>12</td>
<td>Hurricane</td>
<td>118 km/h or more</td>
<td>64 knots or more</td>
<td>Very rarely experienced – widespread damage</td>
</tr>
</tbody>
</table>
2.1.5 Windsocks and other visual aids

Windsocks are a useful way of assessing wind direction, and may also be useful for estimating wind speed. Some windsocks available are ‘calibrated’, so that the angle of the sock indicates wind speed. While these devices are very useful for visual observations, they are not a substitute for physical measurements of wind speed using an appropriate instrument.

The image below shows a windsock ‘calibrated’ for measurements between 3.2km/h and 19.2km/h. As an alternative visual indicator, surveyor’s tape or ribbon can be attached to an aerial or a fibreglass rod mounted on the sprayer.

2.1.6 Smoke and dust

Any visual clue that moves with the wind, such as smoke or dust, is valuable for determining how the air is moving and mixing.

It is not always practical to have a fire burning near the application site, so many operators have fitted ‘smokers’ to their sprayers, similar to those used on agricultural aircraft.

Releasing smoke in the paddock allows the operator to assess air movement from the cab.

Generally, this can be set up by using a small tank and low-capacity 12-volt electric pump to inject a paraffinic-oil-based product (such as ‘summer spray oil’) into the engine exhaust after the header pipe. Windscreen-washer kits from automotive wreckers are ideal for this purpose. Usually the systems are plumbed using fuel-grade lines and fittings.
A ‘smoker’ can be set up by injecting a summer oil or diesel into the exhaust will create large volumes of smoke wherever the sprayer is.

Photo: Graham Betts

**TIPS**

- Smoke will initially rise, but it should then move with the wind. If it continues to rise conditions may be too unstable, due to excessive surface temperatures.
- Ideally smoke will spread out and appear to dilute or disappear as it moves downwind, with some smoke returning towards the surface.
- If puffs of smoke remain intact and move slowly, the air is not mixing and moving enough to bring airborne droplets back to the surface and it may be too risky to spray.
- Releasing smoke while driving with the wind direction (e.g. wind coming from directly behind the sprayer) allows the operator to judge the wind speed relative to the speed of the sprayer at the time.
3. Temperature and humidity

Temperature and humidity can affect droplet survival (due to evaporation), as well as the ability of the product to enter or translocate within the target plant (due to stress).

Droplet survival is affected by the rate of evaporation of water from the droplets, which causes them to reduce in size. As droplets reduce in size, their ability to settle towards the ground is greatly reduced and the potential for spray drift to occur increases. To an extent, selecting large enough droplets (such as a coarse spray quality or larger) and a high enough water rate can help overcome some of the impacts of high evaporation rates.

The evaporation rate of water-based droplets can be estimated by looking at the difference in temperature between a wet bulb thermometer and a dry bulb thermometer, often referred to as ‘Delta T’.

Common Delta T values recommended for spraying are highlighted in Figure 1.

Figure 1 The relationship of Delta T to relative humidity and temperature. A common spray guideline is to spray when Delta T is between 2 and 8 and with caution below 2 or above 10.
3.1 Where to measure temperature and humidity

How and where you should measure temperature and humidity will depend on what you require the information for: is it purely for record-keeping, or is it also for efficacy and decision-making?

3.1.1 For record-keeping purposes

For record-keeping purposes, temperature and humidity should be measured in a shaded position at 1.25 metres above the ground at the site of application.

**TIPS**

- If using a hand-held weather meter in the paddock, be sure the meter has had enough time to acclimatise to the situation (especially if it has been in a vehicle).
- If mixing at the application site, leave a weather meter hanging in a shaded position so it is already acclimatised when you want to use it.
- Ensure that temperature and humidity sensors are not receiving direct radiation from the sun, as this may affect the accuracy of the measurements. It may be useful to turn the weather meter ‘side on’ to the direction of the sun, so the sensors are shaded.

3.1.2 For assessing condition of the target and decision-making

Air temperature and relative humidity at 1.25m above the ground will give an indication of droplet survival of airborne droplets. However, if the operator has selected a coarse spray quality or larger then when the wind speed is suitable for spraying more than 90 per cent of the droplets will end up on the target or on the ground, which is where droplet survival should also be assessed when evaluating potential impacts on efficacy.

**TIPS**

- When using a coarse spray quality or larger, if Delta T values in the air approach values of about 10 to 12, it is time to assess the condition of the target plants or weeds.
- If the operator compares the Delta T value measured in the air with a measurement at the target plants or weeds, this can provide information about the condition of the weeds and about droplet survival.
- Delta T values measured lower at the target than those measured in the air can indicate that plants may be transpiring, or that there is good soil moisture present, which suggest plants are not likely to be heat-stressed and droplet survival should be suitable.
4. Surface temperature inversions

During the day the sun heats the Earth’s surface, which in turn warms the air in contact with the ground. As the distance from the surface increases the air temperature normally reduces.

When an inversion is present the opposite situation exists: A layer of cool air can develop near the ground surface that is cooler than the air immediately above this layer. There are a number of ways an inversion can form, but most often they form overnight as the surface temperature cools, which in turn cools the air in contact with it, so that air temperature appears to increase with height.

**Figure 2** Typical vertical temperature profiles for a point in time during the night and day. The day profile typically cools with height and the night profile typically warms with height to a depth that constitutes the surface temperature inversion layer. The point where the temperature stops increasing is the top of the surface temperature inversion layer.

When an inversion is present it can cut an area off from the normal weather pattern (synoptic) winds. Once this situation exists, air movement in a particular area is driven by local effects, such as the shape of the landscape and drainage patterns. The air movement under inversion conditions can be quite different to the normal ‘daytime’ situation, as the air may not mix and move in the same way, which prevents airborne droplets from diluting.

When an inversion occurs close to the ground, often within 60 to 80 metres of the surface, it is referred to as a surface temperature inversion. Product labels prohibit spraying when a surface temperature inversion is present.

From the spray applicator’s perspective, it is currently too hard to predict what may happen to airborne droplets during a surface temperature inversion. There is no way to determine how far droplets trapped in an inversion may travel, or where they may land.
What we do know from Australian research is that spraying during inversion conditions at night, even with reasonable wind speeds, can increase the amount of spray that remains in the air by up to 5 times more than spraying with the same set-up during daylight hours (after the sun has risen above the horizon enough to start heating the ground to cause the air to mix due to turbulence).
4.1 Attempting to determine if a surface temperature inversion is present by measuring temperature difference over height

It is possible to determine if a surface temperature inversion exists by measuring the difference in temperature at two different heights, usually at 2 metres and 10 metres. However, this requires very sensitive weather instruments to detect a difference over a relatively short distance, and even if you can measure such a difference, it will not tell you whether it is really safe to spray.

If we consider the typical change in temperature that can occur with height above the ground, known as the adiabatic lapse rate, there are two common lapse rates quoted in scientific literature, known as the dry lapse rate and the saturated lapse rate.

Adiabatic lapse rate (dry and saturated)

In dry air: the air temperature normally drops by about 1°C per 100 metres (0.1°C over 10 metres, or 0.08°C over 8 metres).

In saturated air: the air temperature normally drops by about 0.6°C over 100 metres (0.06°C over 10 metres and 0.048°C over 8 metres).

For the purpose of this exercise, assume an average value for the lapse rate of about 0.5°C over 100 metres (0.05°C over 10 metres and 0.04°C over 8 metres). The kinds of temperature sensors required to detect a difference would need to have an accuracy of well below 0.1°C, and ideally about 0.02°C or less.

Such instruments need to be matched for accuracy, and will generally be too expensive for growers or spray applicators to consider. They may also be difficult to maintain, including regular calibration to ensure accuracy.

Warning

Even if you can detect a temperature difference over a relatively small difference in height above the surface, this will not tell you whether it is safe to spray. In fact, using temperature difference at two heights to alone provide an indication of inversion presence may actually stop an operator spraying when it may really be safe to spray (when the air movement is suitable), and will perhaps encourage spraying when it is not safe (when air movement favours droplets remaining airborne).

Determining ‘safe’ spraying conditions must take into account how the air is moving and mixing. This requires accurate measurements of several parameters (not just temperature differences with height) and sophisticated modelling of how the air is moving at a location and over a district.

Until such methods and models have been fully developed and validated, extreme caution needs to be exercised in trying to relate temperature differences over height with safe conditions for spraying.
5. Using forecast information for planning spraying activities

Applicators need to be able to anticipate the changes in temperature, humidity, wind speed and wind direction that normally occur at different times during the day and night, known as the diurnal variation, as well as the seasonal changes to the diurnal variation that may occur at their location.

**Figure 3** Relationship between temperature, wind speed and gustiness over a three-day period, Horsham, Victoria, 24 to 26 May 2007.

Accessing reliable weather forecast information is essential for planning spraying activities. The general Bureau of Meteorology forecast for inland areas of Australia has traditionally been based on a 25km² area, whereas the coastal forecasts and certain other areas tend to be a little more specific, based on a 12km² forecast area. However, this situation is rapidly changing as access to improved models becomes available. Spray applicators should always confirm the accuracy of the weather forecast for their location against measurements at the site of application.

While the available scale of the forecast area may be reasonable in many districts, in others there may be local variations in wind direction and wind speed due to landscape features. These differences need to be evaluated to determine the accuracy of the forecast at various locations, before relying on the information provided.
Longer-term records gained from having a permanent weather station on-farm are ideal for comparing forecast and historical data against to determine their applicability for your location. Weather forecast information should always be regarded as a planning tool, it is not a substitute for measuring and recording the weather conditions at the site of application.

### 5.1 Examples of weather forecasting websites for agriculture

There are a number of free services, such as those provided by the BoM, as well as some subscription-based services that utilise some or all of the same models that the BoM uses.

Some of the subscription services reduce the forecast area to areas as small as 1km², which can greatly improve the forecast accuracy for an individual farm, or for several farms.

#### 5.1.1 Free services

**BoM MetEye**

This service can provide forecasts based on your latitude and longitude, with wind speed and direction forecasts provided at 3-hourly intervals.

Another free forecasting service, provided by Syngenta, is the Agricast system.

**Output from the MetEye website**

<table>
<thead>
<tr>
<th>Forecast for Horsham</th>
<th>See text views for location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Save location</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tue. 24 May</td>
</tr>
<tr>
<td>Max (°C)</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>15</td>
</tr>
<tr>
<td>Min (°C)</td>
<td>–</td>
</tr>
<tr>
<td>Chance of rain (%)</td>
<td>–</td>
</tr>
<tr>
<td>Rainfall range (mm)</td>
<td>–</td>
</tr>
<tr>
<td>Issued 24 May 2016</td>
<td>Hide</td>
</tr>
</tbody>
</table>

**Tuesday: Cloudy.**

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>1.00 AM</th>
<th>4.00 AM</th>
<th>7.00 AM</th>
<th>10.00 AM</th>
<th>1.00 PM</th>
<th>4.00 PM</th>
<th>7.00 PM</th>
<th>10.00 PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>–</td>
<td>–</td>
<td>8</td>
<td>12</td>
<td>15</td>
<td>16</td>
<td>11</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

**Wind direction**

| –       | WSW | WNW | W      | WNW | N       | N       |

**Wind speed**

| –       | –   | 17   | 19     | 15   | 13      | 11      | 13      |

Source: BoM website
5.1.2 Subscription-based services

Many subscription-based services charge a monthly or annual fee for access, but for this price they tend to provide additional services, or an increased level of forecast accuracy for specific locations.

Before signing up to a particular service, if they offer a free trial period take advantage of this to check the accuracy of the forecast for the locations where you conduct spraying activities.

Use the trial period to regularly measure the conditions at your location and compare these to the forecast provided. During the trial period, it is worthwhile comparing various forecasting services with each other and with the free services to determine if you gain a better forecast for your location.

Some of the subscription-based services, such as Nufarm SprayWise® Decisions, provide indications of suitable conditions for spraying by highlighting parameters such as wind speed, Delta T and inversion risk.

The SprayWise® Decisions planning tool uses a traffic light system of red, green and yellow, based on the suitability of the weather conditions for spraying.

For more information about the SprayWise Decisions website, visit: www.spraywise-decisions.com.au
6. Weather-monitoring equipment

Visual clues for assessing wind speed and direction are important for monitoring weather conditions but they are not a substitute for physically measuring wind speed, wind direction, temperature and humidity at the application site.

Measurements of weather parameters should always be taken using an appropriate instrument, such as a weather meter.

6.1 Hand-held weather meters

The most commonly used instrument for measuring and recording weather data on-farm is a hand-held weather meter.

There are a variety of makes and models available, from basic wind speed or temperature sensors, through to systems that display and record wind speed, direction, temperature, humidity and Delta T.

Some of the more advanced models can log and store data, and transfer this in real time to a tablet, smartphone or computer.

6.2 Permanent weather stations on-farm

Permanent weather stations are particularly useful for capturing and recording long-term weather and climate data, which can be used to analyse on-farm trends.

Permanent weather stations at the farm or enterprise are also useful for comparing measurements with forecast data and historical records to evaluate their accuracy and relevance for your site.
Many permanent weather stations offer remote access via mobile phone or web-based access, which can eliminate the need to physically download data from the station itself. Some will also offer wireless links to a monitor in the sprayer, which can be useful if the weather station is close to the site of application.

### A well set-up and located permanent weather station on-farm

![Permanent weather station](image)

Permanent weather stations can collect long-term weather data as well as current conditions, but must be close to the application site for record-keeping purposes.

### Locating a permanent weather station

Several factors should be considered when installing a weather station on-farm. Make sure that:

- the site is representative of the area that you would be using the weather data for (consider factors such as the elevation compared to the rest of your property);
- the vegetation around the site is consistent with the wider monitoring area;
- the site is not vulnerable to flooding, fires or lightning strikes;
- the site is protected from livestock and vermin;
- the site is in an area of reliable communication (e.g. Ultra high frequency or mobile phone);
- the site is a suitable distance from structures or obstructions – as a general rule the station should be located a distance at least 10 times the height of the obstruction away from the obstruction (preferably more);
- the site is level; and
- the orientation of the station is noted, e.g. aligned with grid north or true north.
6.3 Portable weather stations
A portable weather station is usually very similar to a permanent station, but instead are usually mounted on a tripod. This means they can be relocated from one paddock to another, however, most spray operators find this process time-consuming.

6.4 Local weather station networks
Several growing areas throughout Australia have set up local networks of permanent weather stations that provide remote access for growers and subscribers via UHF radio, mobile phone or the internet.

The benefit of having access to a local network is the ability to compare wind speed and direction at various sites, which can give an indication of when a change is coming through an area. Networked stations are also useful for comparing historical data for an area with official BoM data to identify possible variations.

Users of weather data obtained from this type of network need to be aware that, depending on where they are located, they may not be regarded as being at the site of application. Hence, the spray operator still needs to measure and record conditions at the application site.

6.5 Onboard weather stations
The most useful weather monitoring instrument for spray applicators is one that allows you to measure the weather parameters in real time at the site of application – while you are driving. There are a couple of weather stations that can be mounted on the sprayer that provide live weather data while you are driving the sprayer.
For more information about onboard weather stations, go to [www.airmar.com/agriculture-irrigation.html](http://www.airmar.com/agriculture-irrigation.html) and [www.specmeters.com/weather-monitoring/weather-stations/sprayer-station/](http://www.specmeters.com/weather-monitoring/weather-stations/sprayer-station/)

On-board weather stations can provide live weather data to the operator while the sprayer is moving.

Photo: Airmar

Some sprayer manufacturers, such as John Deere, are starting to offer these onboard weather stations as options when you order the sprayer, others can be purchased as standalone, portable units that will work on any vehicle.

These systems use an in-built GPS system to determine the sprayer’s position, heading and speed, and ultrasonic sensors to gather the weather data. Using this information, the onboard stations can accurately determine the wind speed and direction, as well as other weather parameters, such as temperature and humidity, while the sprayer is moving.

**TIPS**

- When mounting an onboard weather station, make sure it is placed in a location where it can get clear airflow, and will not be impacted by obstructions or machinery exhaust emissions.
7. Weather data and forecasts for planning and conducting spraying operations

Making the most of good conditions for spraying can help to improve productivity and efficacy. The ability to access good forecast information is critical for planning spraying operations and to help predict when changes are likely to occur. Once the operator is in the paddock, access to weather data at the site of application also improves the decision-making process.

To fully plan spraying operations requires knowledge of what products are likely to be applied, what the label requirements are for downwind buffers or no-spray zones, and what sensitive areas may exist adjacent to the areas to be sprayed and within the local catchment area. Having detailed farm maps for your enterprise, and copies of what your neighbours have planted, or are planning to plant, is essential for determining how and when to spray each of the paddocks at your enterprise.

Having knowledge of likely wind direction and wind speed will help the spray applicator plan which paddocks are likely to be able to be sprayed at different times throughout the day or week. Many forecasting services can offer reasonably accurate information about wind speed and direction up to seven to eight days in advance, with the first three days of that period generally being the most accurate. Even when a forecast is provided for several days, it should still be checked for updates on a daily basis.

8. Summary

- Use accurate forecast information to help plan spraying activities.
- Always measure and record weather parameters at the site of the application before, during and on completion of spraying operations.
- Wind direction and wind speed are critical for assessing suitable conditions and potential risks.
- Temperature and humidity (or Delta T values) can indicate evaporation and spray-drift risk, but can also identify potential impacts on efficacy.
- Always follow the label directions for appropriate conditions for spraying, including downwind buffers or no-spray zones that are related to wind speed.
- Consider what weather-monitoring equipment will best suit your enterprise.