Drift Causes and Control

Figure 1. This is not what crop protection should look like!

When applying crop protection chemicals, spray drift is a term used for those droplets containing the active ingredients that are not deposited on the target area. The droplets most prone to spray drift are usually small in size, less than 150 micron in diameter and easily moved off the target area by wind or other climatic conditions. Drift can cause crop protection chemicals to be deposited in undesirable areas with serious consequences, such as:

- Damage to sensitive adjoining crops.
- Surface water contamination.
- Health risks for animals and people.
- Possible contamination to the target area and adjacent areas or possible over-application within the target area.

Causes of Spray Drift

A number of variables contribute to spray drift; these are predominantly due to the spray equipment system and meteorological factors.

■ Droplet Size

Within the spray equipment system, drop size is the most influential factor related to drift.

When a liquid solution is sprayed under pressure it is atomized into droplets of varying sizes: **The smaller the nozzle size and the greater the spray pressure, the smaller the droplets and therefore the greater the proportion of driftable droplets.**

■ Spray Height

As the distance between the nozzle and the target area increases, the greater impact wind velocity can have on drift. The influence of wind can increase the proportion of smaller drops being carried off target and considered drift.

Do not spray at greater heights than those recommended by the spray tip manufacturer, while taking care not to spray below the minimum recommended heights.

■ Operating Speed

Increased operating speeds can cause the spray to be diverted back into upward wind currents and vortexes behind the sprayer, which trap small droplets and can contribute to drift.

Apply crop protection chemicals according to good, professional practices at maximum operating speeds of 4 to 6 mph (with air induction type nozzles—up to 6 mph). As wind velocities increase, reduce operating speed.*

* Liquid fertilizer applications using the TeeJet® tips with very coarse droplets can be performed at higher operating speeds.

■ Wind Velocity

Among the meteorological factors affecting drift, wind velocity has the greatest impact. Increased wind speeds cause increased spray drift. It is common knowledge that in most parts of the world the wind velocity is variable throughout the day (see Figure 2). Therefore, it is important for spraying to take place during the relatively calm hours of the day. The early morning and early evening are usually the most calm. **Refer to chemical label for velocity recommendations.** When spraying with traditional techniques the following rules-of-thumb apply:

In low wind velocity situations, spraying can be performed at recommended nozzle pressures.

As wind velocities increase up to 17 mph, spray pressure should be reduced and nozzle size increased to obtain larger droplets that are less prone to drift. Wind measurements should be taken throughout the spraying operation with a wind meter or anemometer. As the risk of spray drift increases, selecting designed to more coarse droplets that are less prone to drift is extremely important. Some such TeeJet nozzles that fit into this category are: DG TeeJet®, Turbo TeeJet®, AI TeeJet, Turbo TeeJet Induction, and AIXR TeeJet.

When wind velocities exceed 11 MPH (5 m/s), spraying operation should not be performed.

■ Air Temperature and Humidity

In ambient temperatures over 77°F/25°C with low relative humidity, small droplets are especially prone to drift due to the effects of evaporation.

High temperature during the spraying application may necessitate system changes, such as nozzles that produce a coarser droplet or suspending spraying.

■ Crop Protection Chemicals and Carrier Volumes

Before applying crop protection chemicals, the applicator should read and follow all instructions provided by the manufacturer. Since extremely low carrier volume usually necessitates the use of small nozzle sizes, the drift potential is increased. As high a carrier volume as practical is recommended.

Application Regulations for Spray Drift Control

In several European countries, regulatory authorities have issued application regulations in the use of crop protection chemicals to protect the environment. In order to protect the surface waters and the field buffer areas (examples are: hedges and grassy areas of a certain width) distance requirements must be kept because of spray drift. Inside the European Union (EU) there is a directive for the harmonization of crop protection chemicals in regards to environmental protection. In this respect the procedures that have been implemented in Germany, England and the Netherlands will be established in other EU countries in the coming years.

To reach the objectives for environmental protection, spray drift reducing measures have been integrated as a central instrument in the practice of risk evaluation. For example, buffer zones may be reduced in width if certain spraying techniques or equipment is used that have been approved and certified by certain regulatory agencies. Many of the TeeJet nozzles designed for reducing spray drift have been approved and certified in several EU countries. The certification of those registrars fits into a drift reduction category, such as 90%, 75%, or 50% (90/75/50) control of drift (see page 149). This rating is related to the comparison of the BCPC reference nozzle capacity of 03 at 3 bar.

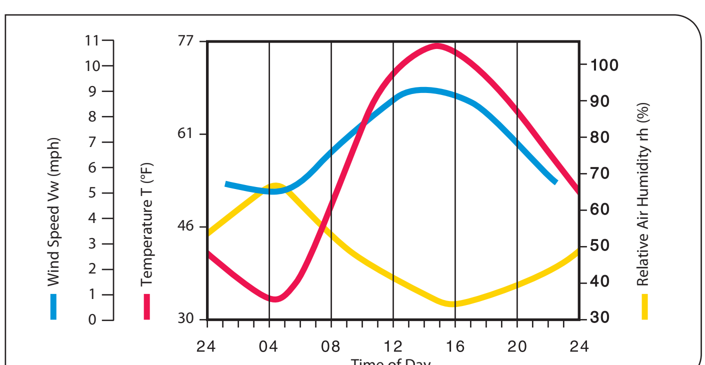

Figure 2. Development of wind velocity, air temperature and relative air humidity (example). From: Malberg

Nozzles for Spray Drift Control

Drift potential can be minimized even when it is necessary to use small nozzle capacities by selecting nozzle types that produce larger Volume Median Diameter (VMD) droplets and a lower percentage of small droplets. Figure 4 is an example showing VMD's produced by nozzles of identical flow rates (size 11003) which produce coarser droplets than an XR TeeJet and then larger droplets in sequence; TT/TTJ60, AIXR, AITTJ60, AI and TTI. TTI nozzles produce the coarsest droplet size spectrum of this group. When operating at a pressure of 50 PSI (3 bar) and 5 MPH (7 km/h) ground speed, the application rate is 20 GPA (200 l/ha). At the same time, the observation is that the VMD increases significantly from the XR to the TTI. This shows that it is possible to cover the entire droplet size spectrum from very fine to extremely coarse droplets by using different types of nozzles. While susceptibility to drift decreases when droplets become larger, the number of droplets available may lead to less uniform coverage. To compensate for this drawback and for the chemical to be effective, it is necessary to apply the optimum pressure range specified for a particular type of nozzle. If applicators comply with the parameters set by the manufacturers, they will always cover 10–15% of the target surface on average, which is not least attributed to the fact that less drift translates into more effective coverage. Figure 4 shows the VMD curves by nozzle type indicating the optimum pressure ranges for the individual nozzles which should be selected with respect to both effective drift control and effect of the chemical. When the focus is on drift control, TT, TTJ60 and AIXR are operated at pressures of less than 29.5 PSI (2 bar). Yet, where maximum effect is critical, the nozzles are operated at pressures between 29.5 PSI (2 bar) and 52 PSI (3.5 bar) or even higher in specific conditions. These pressure ranges do not apply to AI and TTI, which operate at less than 43.5 PSI (3 bar) when drift control is critical and always at 58 PSI (4 bar) and 101.5 PSI (7 bar) and even 116 PSI (8 bar) when the emphasis is on chemical affect. Therefore, for applicators to select the correct nozzle size it is necessary to consider the spray pressure at which a chemical is most effective. With this, they simply have to reduce pressure and ground speed to comply with statutory buffer strip requirements. It is down to the conditions prevailing at the individual farm (location of the field, number of water bodies, type of chemical applied, etc.) whether they should choose a TeeJet nozzle that reduces drift by 50%, 75% or 90%. On principle, applicators should use 75% or 90% drift control nozzles (extremely coarse droplets) only when spraying near field boundaries and 50% or less TeeJet nozzles in all other areas of the field.

While the classic XR TeeJet orifice provides two functions; metering the volume flow rate and distributing and creating the droplets, all other nozzle types discussed above use a pre-orifice for metering while distribution and droplet creation takes place at the exit orifice (Fig. 3). Both functions and devices relate to each other with respect to geometry and spacing and interact with respect to the droplet size produced. The TT, TTJ60, AITTJ60 and TTI nozzles force the liquid to change direction after it has passed the pre-orifice, forcing it into a horizontal chamber and to change direction again into the nearly vertical passage in the orifice itself. The AI, AITTJ60, AIXR and TTI air induction nozzles operate on the Venturi principle, where the pre-orifice generates a higher-velocity stream, aspirating air through the side holes. This specific air/liquid mix creates more coarse droplets that are filled with air, depending on the chemical used.

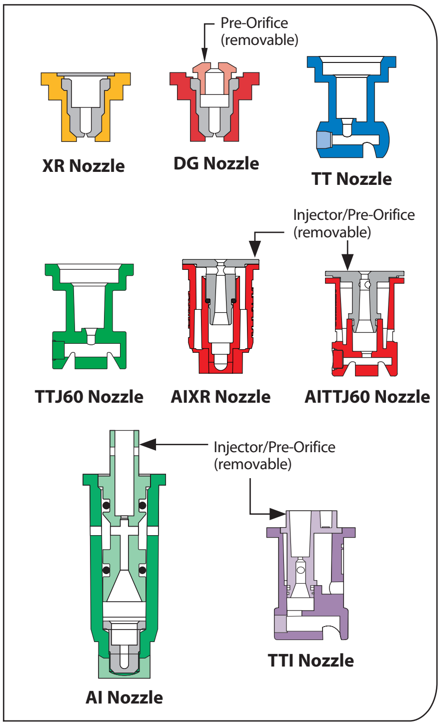

Figure 3: XR, DG, TT, AIXR, AI, AITTJ60, TTJ60 and TTI nozzles (sectional drawings).

Summary

Successful drift management centers on sound knowledge about drift contributing factors and the use of drift control, TeeJet nozzles. To strike a sound balance between successful chemical application and environmental protection, applicators should use approved broadcast TeeJet nozzles that are classified as drift control and operate these within the pressure ranges that ensure chemical effectiveness; i.e. set nozzles to 50% drift control or less. The following list shows all the relevant factors that need to be considered, optimized or applied to achieve effective drift control:

- **Low-Drift TeeJet nozzles**
- **Spraying pressure and droplet size**
- **Application rate and nozzle size**
- **Spraying height**
- **Forward speed**
- **Wind velocity**
- **Ambient temperature and relative humidity**
- **Buffer strips (or apply options that allow reducing the width of buffer strips)**
- **Compliance with manufacturer instructions**

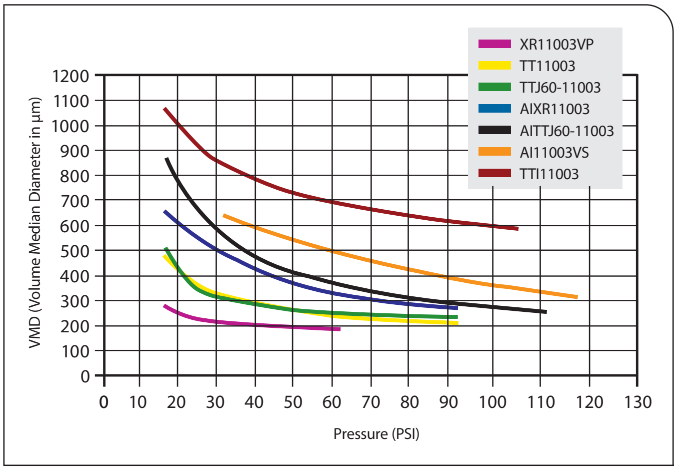

Figure 4. Volumetric droplet diameters of XR, TT, TTJ60, AIXR, AI, AITTJ60 and TTI nozzles relative to pressure

Measurement conditions:

– Continuous Oxford Laser measurement across the full width of the flat spray

– Water temperature 70 °F