The chemical control of agricultural pests, weeds and plant diseases is a critical aspect of successful crop production, especially when no-till is practised. Chemical control is one of the high input costs of the total farming system. It is therefore important that it is done in an efficient and cost-effective way.

In practice, the aim of an effective pesticide application is to apply the pesticide as evenly as possible on the target area.

The main reasons for unsatisfactory results are usually ineffective application techniques, the condition of the sprayer and unfavourable climatic conditions. It is also quite often that spray equipment and application methods do not always keep up with the practical recommended requirements, and therefore lead to unsatisfactory results.

**Know your sprayer**
It is essential to know the sprayer components, to maintain and clean the sprayer and, very importantly, to calibrate the sprayer.

Calibration starts with the chemical product label, for example how much water to use and the chemical dose rate to apply. After that follows the correct nozzle choice, spray height and speed.

When spraying pesticides, sufficient spray coverage on the plant leaves is essential for good control. The spray volume will depend on the crop density and the type of crop. Droplet size also plays a role in good spray coverage.

**Characteristics of different nozzle types**

**Droplet behaviour**
Good droplet coverage is achieved by forcing a pesticide mixture under pressure through the orifice of a nozzle to deliver a suitable spray pattern. The spray pattern consists of small and large droplets.

As a guide, the following application parameters can be used:

**Droplet size**
Droplet size is very important. Good coverage is directly dependent on the droplet size and not necessarily on the spray volume applied.

Smaller spray volumes applied at smaller droplet sizes will be more cost-effective and will give better coverage. However, smaller droplets can be blown away by strong wind and are more susceptible to evaporation.

Droplets are classified into the following sizes:

- <50 micron = aerosol
- 51 - 100 micron = mist spray
- 101 - 200 micron = fine spray
- 201 - 400 micron = medium spray
- >400 micron = coarse spray
Aerosols are mostly used to control flying insects, while mist spraying is ideal for the spraying of crops with a very low spray volume (5 to 50 l/ha). For ultra-low volume, mist spray is applied at spray volumes of less than 5 l/ha. Fine to medium droplet sizes are normally recommended at 50 - 300 l/ha spray volumes. Course spray, mainly for weed control, is used at spray volumes of more than 200 l/ha.

Droplet sizes are measured in VMD (volume median diameter) and NMD (numeric median diameter). Spraying equipment usually delivers a range of droplet sizes. The relation between the two measures (VMD/NMD) indicates the variation of droplet sizes within a spectrum of droplets. The closer the proportion to one, the more homogenous the droplets are in sizes.

In practice, water-sensitive paper can be used to get a visual droplet size spectrum of the droplet sizes delivered.

**Influence of evaporation**
The volume of a droplet determines its surface area which is exposed to the environment. The smaller the droplet, the larger the exposed area. A larger exposed area causes higher evaporation. Droplet sizes decrease with the increase of evaporation and makes it more sensitive to wind drift.

An increase in air temperature, as well as a decrease in relative humidity, increase the speed of evaporation and decrease the lifetime of a droplet. This will result in bad coverage when spraying.

The practical application of this well-known theory is not to spray at midday when it is hot; instead, spray early in the morning or later in the afternoon.

**Influence of drift**
The use of pesticides, especially where herbicides are used on specific identified areas, does cause problems when drift takes place to non-target areas.

Drift results in decreased spraying efficiency and precipitation of chemicals in non-target areas, contributing to pollution and contamination of the environment.

The drift problem can be limited by spraying with larger droplets, and to refrain from spraying on windy days.

**Climatological guidelines for spraying**
For effective chemical application, the following conditions are important:

- Stop spraying if there are sudden blasts of wind, or if the wind speed is higher than 15 km/h in the case of insect or plant disease control. When spraying, avoid wind speed higher than 8 km/h.
- Application must be stopped when the wind direction changes in the direction of a susceptible crop.
- Stop spraying if there is a difference of 8°C between wet and dry bulb temperatures, to minimise evaporation.
- Plants which are wet with dew, rain or irrigation water must not be sprayed.
- When using systemic pesticides, it is important that the bottom parts of the plants are thoroughly wetted with the spray solution. (In most cases, the action of pesticides is to move upwards in plants.)
- Do not spray wilted plants.

The efficient spraying of chemicals is influenced by many factors and it is therefore important to consider all the relevant conditions which may have an impact on the outcomes.