Low Volume Application of Fungicides

Nozzle selection, efficacy and effective crop coverage

Miccar Aerial operate 2 OE600 AT 401 aircraft equipped with Rotary atomizers, flow control and GPS that can deliver exactly what the article describes. Technology not water volumes are the answer to "Improving your Bottom Line." This year when planning crop protection consider the facts.

This AT-802 is equipped with 12 Micronair atomizers.The flow rate is a modest 1.03 liters/minute (0.27 gals/min) per atomizer, well within the atomizers' flow capacity.

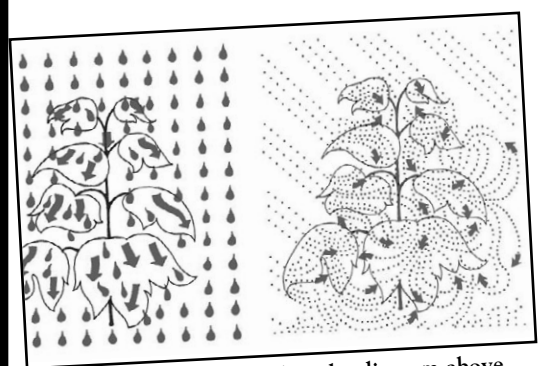

Table: 1 As illustrated in the diagram above, the larger droplets impact the upper leaves and can bounce off to end up on the ground, while the smaller more uniform droplets give improved penetration of the crop canopy and are less likely to end up on the soil.

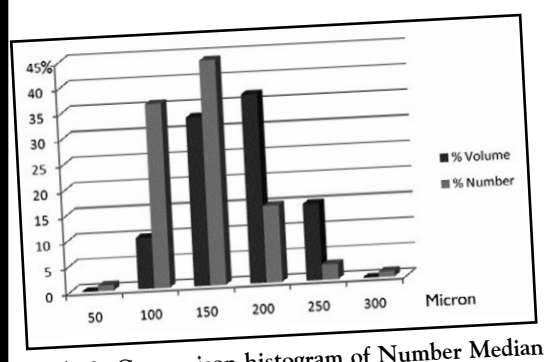

Table 2: Comparison histogram of Number Median Diameter (NMD), with Volume Median Diameter (VMD) produced with rotary atomizers.

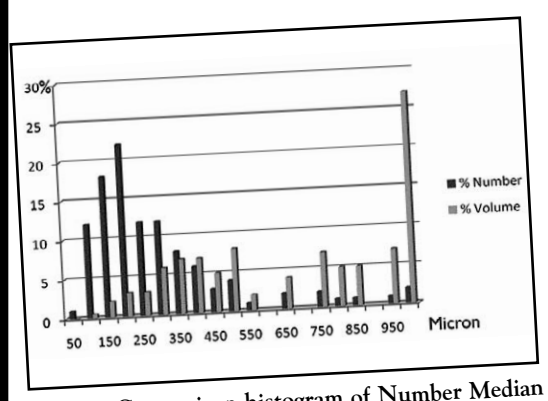

Table 3: Comparison histogram of Number Median Diameter (NMD), with Volume Median Diameter (VMD) produced with conventional hydraulic nozzles.

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Fungicide applications on soybeans moves into high gear with this new Air Tractor 802 (see photo), as it rapidly covers a 150 hectare field in western Brazil. With an application volume of 10 liters/hectare (approx 1 gpa) the AT-802 handles this large field quickly and easily with only a half load.

Some agriculturalists and entomologists mistakenly think that to achieve better coverage the applicator must increase the spray volume. Some also believe that when the crop is taller or denser the applicator must also increase the spray volume to maintain coverage of the foliage. This thinking is erroneous largely because of a lack of understanding of the physics of droplet formation and the relationships between size, coverage and deposition. Hopefully the following explanation will assist in convincing the agricultural advisors that increasing the volumes beyond the mechanical limitations of nozzles or atomizers will not result in improved coverage but rather the opposite.

During the 2007 and 2008 U.S. corn spraying campaigns, this was one of the most common application failures in that aircraft were applying fungicides with relatively few large nozzles. The use of the larger nozzles resulted in the production of larger spray droplets that failed to penetrate the crop canopy and hence the fungicide did not perform as expected in some cases.

For adequate crop coverage and penetration, it is much better to maintain the same number of nozzles (40) and utilize a smaller orifice than to reduce the number of nozzles by half.

It is widely acknowledged amongst researchers that smaller droplets penetrate the crop better than large droplets, therefore when the applicator increases the flow through a nozzle he invariably selects a larger orifice size on the nozzle and inadvertently reduces crop coverage due to the production of a coarser spectrum with larger droplets.

Many aircraft are equipped with motorized electric ball valves that adjust the flow to maintain the desired application rate/acre according to the true ground speed of the aircraft. This is an excellent device for the application of pre-emergent herbicides, however when the speed difference means a change of 10% in the flow rate this often results in "streaking" of the field when applying fungicides or insecticides since hydraulic nozzles produce much larger droplets when the spray pressure is significantly reduced. In some cases the spray pressure may change from 45 lbs/in to as low as 18 lbs/in, especially so with helicopters. The applicator should be aware of the impact of boom pressure changes on droplet formation.

One of the many advantages of rotary atomizers is that they operate within a broader range of flow rates than standard pressure nozzles. Typically, it is possible with the better designed atomizers to vary the flow ten fold (10:1) with little variation in droplet size whilst maintaining a relatively narrow droplet spectrum without producing wasteful large droplets or extremely fine droplets that may drift off the target. This variation in flow is referred to as the turn down ratio and with conventional pressure nozzle this ratio is typically only 2:1 without incurring significant changes to the droplet spectrum.

The flow rate with modern atomizers is easily changed in a few minutes. The use of relatively few atomizers is a tremendous operational advantage since this means much larger orifices than with hydraulic nozzles and therefore much less likely to clog.

With rotary atomizers droplet size is determined by the rotational speed and not by spray pressure. This makes them ideal for variable rate treatments using satellite guidance and digital treatment plans. The droplet size may be easily and quickly be changed to ensure the right droplet size for the product and weather conditions.

Another major advantage of rotary atomizers is the droplet spectrum is much more consistent than pressure nozzles, as they use centrifugal energy to break up the spray liquid rather than hydraulic. By increasing the rotational speed of the atomizer the droplet size is decreased and vice versa by reducing atomizer rotational speed the droplet size increases providing a tool to select the optimal spray droplet size for the target.

Excellent narrow spectrum for maximum coverage yet with very few droplets under 100 microns. For best results with fungicides field experience has proven that the ideal droplet spectrum for crop penetration and coverage should be between 100- 300 microns.

This is a typical broad spectrum and clearly illustrates that more than 40% of the spray volume over 350 microns will produce little or no coverage and will be wasted if used for the application of a fungicide. This graph also illustrates how meaningless it is to quote the average droplet size NMD 190 microns and VMD 235 microns.

Field tests should always be made with the actual spray product mixture because the addition of a product in water will change the surface tension of the spray mix and the formation of the spray droplets. Products that disperse in water contain surfactants that lower the surface tension of the spray. Lower surface tension of the spray mix always means production of smaller droplet sizes than water alone.

— Lower application volumes are more effective for several reasons. One important aspect is concentration. Products and spray adjuvants diluted in high volumes of water are less well retained on plant surfaces. Higher concentrations of surfactants, oils or wetting agents improves retention but also penetration of the product onto the plant foliage. This is particularly important for the activity of systemic products that are absorbed into the plant. Such spray deposits also resist weathering by rain or morning dew.
— To improve crop coverage with conventional pressure nozzles reduce the nozzle orifice size and increase the spray pressure to produce smaller droplets for better penetration of the crop.
— The lower spray volumes mean higher productivity of the aircraft, as less time is wasted refilling with water and spray runs are longer with less time lost ferrying.
— Higher aircraft productivity means fungicides can be applied at the optimal time. Correct timing of application is critical to the success of any spray application.
— Higher aircraft productivity also allows applications to be made when weather conditions are most favorable so spraying can often be finished before mid-day when the weather is usually more settled in early morning.

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