UNDERSTANDING SPRAY DRIFT: REDUCING YOUR RISK

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Spray drift has been a part of the agricultural landscape since the very beginning of pesticide application through sprayers. Although our ability to contain drift has improved, current application technologies are never fully able to eliminate drift. Applicator understanding of the forces involved in delivering pesticides through a sprayer is critical for proper sprayer management in drift prone conditions.

Understanding Drift

Pesticide application through spray nozzles results in droplets that as a result of surface tension are roughly spherical in shape. Droplet size is measured in microns with 1 micron = 1/1,000,000th of a meter. Small droplets, those less than 150 microns, are highly susceptible to off-site movement.

As the spray solution exits the elliptical orifice of a fan nozzle (most commonly used type today) it does so as a thin sheet of fluid moving at speeds up to 60 feet per second (49 mph). Droplets are formed at the edge of this sheet of fluid. Unless the spray particles are electrostatically charged or propelled with an air assist boom, the forces of gravity and air resistance take over quickly on the emerging droplets. Small droplets, which have less mass and greater surface area will fall much slower than larger droplets due to more friction with the surrounding air. Larger droplets which are capable of maintaining a downward velocity longer are more likely to be deposited on the intended target. How far can you "push" a droplet before gravity and air resistance completely take over? A 100 micron droplet moving at an initial velocity of 33 feet per second can only be "pushed" approximately 5 inches. A 500 micron droplet moving at the same initial velocity can be "pushed" roughly 5 times as far.

Air temperature and relative humidity at application can have a major effect on droplet size and hence drift potential during movement from the nozzle to intended target. As temperature increases and relative humidity decreases, the droplet will evaporate more quickly. As evaporation occurs, droplet diameter decreases, reducing its mass affecting both its flight time and velocity. At the other extreme of very high relative humidity, small droplets are able to maintain mass, increasing their longevity and therefore their drift distance before they evaporate. Temperature and humidity effects are greatest on small droplets and have little influence on the drift potential of 200 micron and larger sized droplets.

Managing Droplet Size

From the previous discussion it is apparent that larger spray droplets maintain velocity longer, and are less prone to drift. If that is the case, why not simply choose a nozzle which produces droplets so large that drift becomes nearly impossible? Obviously, at some point a droplet becomes so large that too few are being deposited for effective pest control. Systemic pesticides (those taken up by the plant and moved to the site of action) often perform reasonably well in larger droplets sizes. Contact pesticides however perform better in smaller droplets where coverage is essential.

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Nozzle selection is one of the most critical aspects in determining spray droplet size. The days of sprayers set up with one nozzle for all applications, all season long, are long behind us. Today we have many nozzle manufacturers producing quality products to meet application needs. When studying their charts of nozzles and data on droplet sizes keep the following aspects in mind.

Spray Pressure – It is common knowledge that increased spray pressures lead to small droplets. With fan nozzles, the spray solution emerges from the nozzle orifice in a thin sheet, with droplets forming at the edge of the sheet. Under higher pressures, the sheet of spray solution is thinner, resulting in smaller droplets being formed.

Nozzle Orifice – Choosing nozzles based on orifice sizing to meet your output needs at reasonable operating pressure will help control droplet size. Remember that the relationship between pressure and flow rate is not linear. If you need to double your output (gpa) you will need to increase your pressure (psi) by a factor of 4. As an applicator you need to be aware of the chosen orifice size. It is highly unlikely that you will be able to use the same nozzle to spray at 10 gpa in a rough ten acre field that you can comfortably spray at 10 mph and a smooth, level 150 acre field that you could spray at 18 mph.

Nozzle Spray Angle – Wider spray angle nozzles of the same orifice size and operated at the same pressure "stretch out" the same amount of spray solution into a wider sheet as it exits the nozzle. Because the volume is the same, the sheet is thinner and will break up into smaller droplets. Wider spray angles can however be operated lower to the target and still maintain proper overlap to offset some of the increased drift potential of the smaller droplets.

Role of Adjuvants

Pesticide labels will often dictate the addition of either activator adjuvants (those which enhance a pesticides performance) or special purpose adjuvants (which includes compatibility agents, drift control agents, etc.). Activator adjuvants like surfactants, crop oil concentrates and seed oil concentrates all function a bit differently, but also all reduce the surface tension of the spray solution. Reducing the surface tension is often referenced in helping the spray droplets to spread out over a greater surface area on the target. Reduced surface tension however also causes the sheet of water released from the nozzle to break into smaller droplets. Most nozzle testing is done with water only, so realize that your experience of droplet size produced may differ somewhat from nozzle manufacturer charts based on the composition of the spray solution.

Special purpose adjuvants include products like drift control additives. According to the Compendium of herbicide adjuvants, there are roughly 130 different drift control products available to choose from that fall into 3 classes:

Thickeners – these tend to be polyacrylamide or polyvinyl polymers which thicken the spray solution and increase droplet size.

Encapsulators – these products do not affect overall droplet size, but encapsulate the pesticide into droplets to help minimize evaporation losses during product delivery.

Spray Modifiers – these products tend to be vegetable oil based and intend to reduce the amount of fine driftable droplets without increasing the size of the larger droplets.