PART 5: How to Select the Appropriate Nozzle

Section A: Nozzle Types:

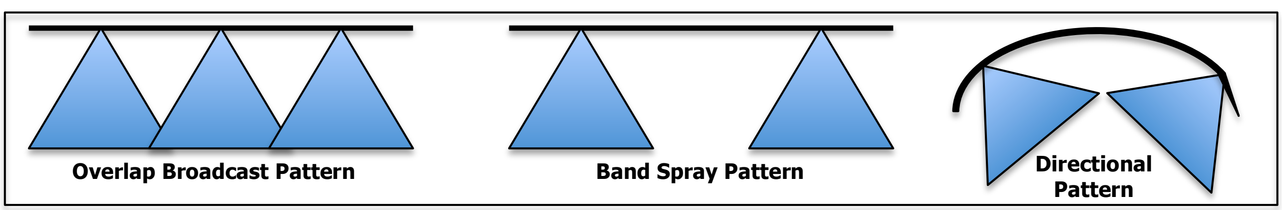
There are a variety of nozzle types that can be used for the application of products to the field. The factors for the determination of the nozzle to be used are: the product that is being applied, the rate at which the tractor is going, and the drift tolerance. These are accompanied by the recommended PSI, the droplet size and the spray pattern desired. The table below shows the general types of nozzles.

Table 3: Nozzle Types For Use on Field Crops

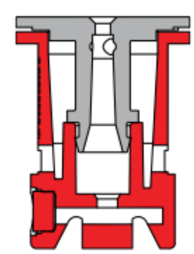
Type	Suggested Use	Recommended PSI	Spray Pattern Type
Hollow Cone	Most contact insecticides and fungicides; post-emergence banding of herbicides	60 PSI and above: below 40 psi if for weed control	Circular – light applications in center, fine droplets
Flat Fan	Pre- and post emergence herbicide and some insecticides and fungicides	15-60 psi, not over 40 psi for weed spraying	Fan-like pattern of medium droplets
Even-Flat	Banding herbicides, insecticides, fungicides	20 to 40 psi	Uniform coverage across spray pattern, medium droplets
Flooding Flat	Pre- and post emergence herbicides where drift is hazardous	10-20 psi for max drift control; below 30 psi otherwise	Fan-like, coarse droplets, numerous enough for weeds
Full Cone, Raindrop	Pre-plant soil incorporated	10-30 psi, never over 40 psi	Full cone or hollow cone (with Raindrop); large droplets

Source: Bulletin 827: Corn, Soybean, Wheat and Alfalfa Field Guide. The Ohio State University Extension, College of Food, Agricultural, And Environmental Sciences. 2014 p205

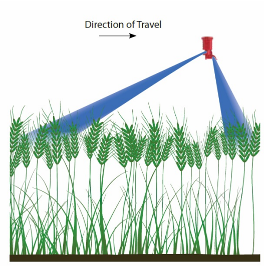
Included in the decision about which nozzle will be used is the pattern that is desired. A broadcast pattern overlaps where as the banded spray pattern does not. This can be adjusted on the boom by height and by spacing. Additionally, a directional pattern can be achieved with the boom as indicated in the diagram below or it can be accomplished with the nozzle itself.

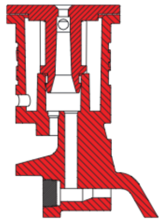


Air induction nozzles create air bubbles in the droplet. This air bubble causes the droplets to shatter on impact, providing improved coverage.



Twin Spray Venturi Air Induction Nozzle

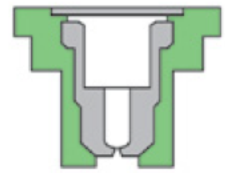




Asymmetric Twin Spray Venturi Air Induction Nozzle

Asymmetric twin spray nozzles feature a spray pattern downward for canopy penetration and another sprayed horizontally for canopy/seed head coverage.

Extended Range Flat Fan Nozzles provide excellent spray distribution over a range of pressures. Low pressure can reduce drift and high pressure can increase coverage.

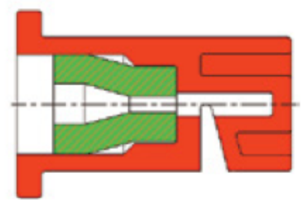


Extended Range Flat Fan Nozzle

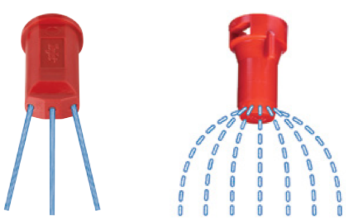
Pre-Orifice Flat Fan Nozzle

Pre-Orifice Flat Fan Nozzles reduce the operating pressures internally and produce larger droplet sizes than the conventional flat fan nozzles. Fewer droplets are produced, resulting in excellent spray pattern uniformity and a reduction in drift.

Flooding Nozzles produce a wide angle flat fan pattern. Pressure changes affect the width of the spray pattern more than with extended range flat fan nozzles. Well suited for soil applications especially when applying a mix of fertilizers and herbicides.



Flooding Type Nozzle



Fertilizer Nozzle Spray Patterns

Fertilizer Nozzles provide a solid stream and are offered anywhere from 1 to 7 or more individual streams. This allows it to be applied more directly to the soil surface where it is needed, minimizing foliar coverage.

Reading Questions

1. What factors are necessary to make the proper choice in nozzles?

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2. Why is it important to have the appropriate nozzle?

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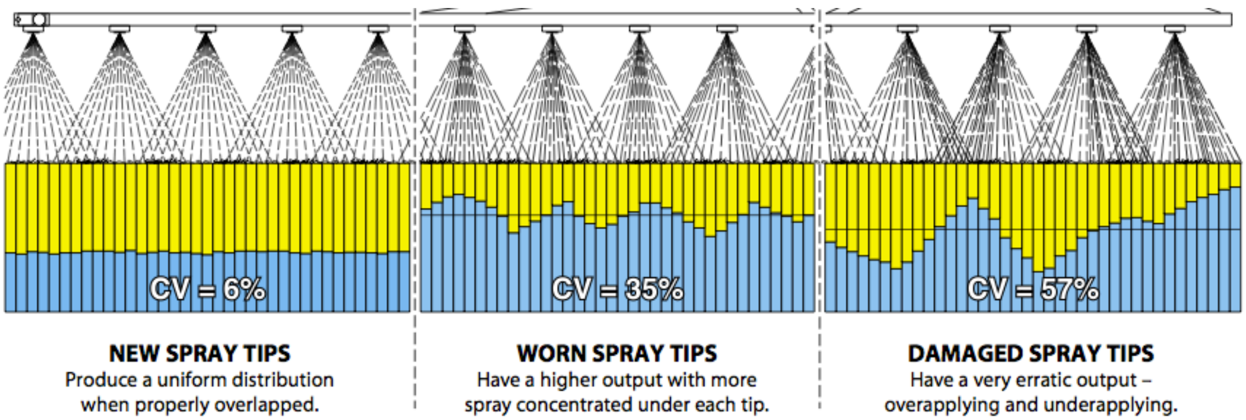
Section B: Over and Under Application:

It is important for a farmer to have the correct application of the product on the field. Boom height, PSI and nozzle spacing can be different for each nozzle and the farmer wants to make sure that the sprayer is applying the product where s/he wants the product where it is needed. The **coefficient of variation** is a way to illustrate the spray nozzles application rate. This addresses both environmental concerns as well as the overall price margin of the operation. Over application can be caused by improper spacing, improper height, or worn out/damaged nozzles.



Reading Questions

1. Why would a farmer be concerned with the coefficient of variation?

2. What can be done to make sure that the application rate is what the farmer wants it to be?

Section C: Spray Drift:

There are two types of **spray drift**, which is defined as the movement and deposition of spray particles through the air to non-target locations. The first is when the product is moved away from the target because of air currents. This is known as **particle drift** and can be caused by wind, temperature inversions near the soil, or increased speeds of the spraying vehicle. **Vapor drift** is the second, and is caused by the evaporation and later the deposition of spray particles in non-target areas. This can be caused by temperatures over 77°F and low relative pressure.

There are low drift nozzles. But, spray drift can be controlled by: lowering the operating speed, lowering the boom, using larger droplets and an awareness of weather conditions.

Reading Questions

1. What causes the two types of spray drift?

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2. Why should a farmer be concerned with spray drift?

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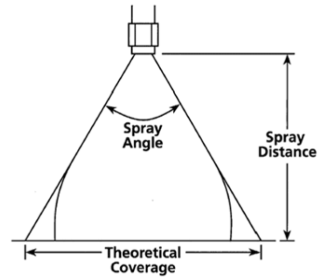
Section D: Spray Tip Geometry

The **spray angle** is the projection that comes out of the spray tip. This is important as a farmer looks at the desired coverage of the product. Spray tip geometry is based on the assumption that the spray angle remains the same throughout the entire spray distance. In actual practice, this does not happen due to the effects of gravity. Spray coverage will vary based on operating pressures, spray height and nozzle spacing.



Reading Questions

1. What would be the theoretical coverage of a spray tip that has a 90° angle and is 20 inches off the ground?

2. What would be the theoretical coverage of a spray tip that has a 110° angle and is 30 inches off the ground?

3. What could be done in order to increase the theoretical coverage of the sprayer?

Section E: The Outflow

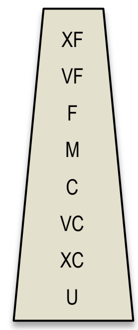
Spray Pressure:

Even spray pressure across the boom is critical for the right application rate. Each product is designed to be applied at a certain rate per acre, which corresponds to gallons per minute. Changes in pressure or failure to follow manufacturer's recommendations will affect the nozzle flow rate. The flow rate determines the spray angle and coverage area, which will affect the efficacy of the product. Higher pressures decrease the droplet size and therefor influence the spray drift. To understand the changes in pressure as it pertains to the rate at which the product is being applied one can use the following equation, where GPM=gallons per minute:

$$\frac{GPM1}{GPM_2} = \frac{\sqrt{PSI_1}}{\sqrt{PSI_1}}$$

Droplet Size:

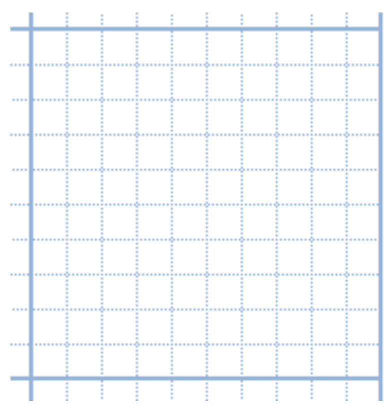
A nozzle's spray pattern is made up of many droplets of varying sizes. These are measured in microns. There are 25,400 microns in one inch. Droplets are classified into categories that are standardized for the industry. This allows for a comparison between nozzles. They range from e*xtremely fine* to *ultra coarse.*



Finer droplets are used for contact applications because they cover leaf surfaces much better. Mid-range droplets are used for contact and systemic herbicides, insecticides and fungicides. And coarse droplets are used for systemic herbicides and pre-emergence soil applied herbicides.

Reading Questions

1. Create a graph that illustrates the change of flow (10 – 90 PSI) from the spray nozzle if you increase the PSI by 10.



2. Why would farmers want to have larger droplets applied to the production environment?

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3. Why would farmers want to have a smaller droplet being applied?

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