Today's Nozzle Market – Clearing up the Confusion

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Nozzles are arguably the most important part of a sprayer. They determine to a large degree the efficacy obtained from a pesticide, the amount of drift, and the overall satisfaction an applicator receives from an application. As a bonus, they are relatively inexpensive compared to the cost of a sprayer unit, usually comprising less than 1% of that investment cost.

There has been a bit of a revolution in the nozzle business, with new design innovation, improved materials, and a larger selection of features than ever before. With this large selection, choosing the right nozzle can be challenging. Applicators must carefully determine their application goals, consider the target, the mode of action of the pesticide, the environment, and the sprayer features and capabilities before selecting a nozzle. This article is designed to assist applicators with this selection process.

What are the Best Nozzles to Use?

The main categories of nozzles are listed below to help with nozzle selection. Within each category, we find a number of manufacturers who make a similar product. Key differences are materials used (plastic, ceramic, steel), pressure ranges, and fan angles. Details on relative droplet sizes and recommended minimum water volume are identified in Table 1.

Notes on Table 1

Nozzle Type

1. ***Conventional Flat Fan*** - finest spray, reliable performance, drift prone, use at 20 to 60 psi
2. ***Pre-Orifice*** - reduce drift 50%, reliable efficacy at low volumes, use at 30 to 60 psi or higher
3. ***Low-Pressure Air Induced*** - reduce drift 50 to 70%, use at 30 to 60 psi or higher, > 4 gpa
4. ***High Pressure Air Induced*** - reduce drift 70 to 90%, use at 60 to 80 psi or higher, > 7 gpa

Min (Target) Pressure: The "Minimum" pressure refers to the lowest pressure that the nozzle should be used at. Below this pressure, the spray pattern will not be fully expanded and the nozzle will not operate properly. Manufacturer occasionally overstate the low-pressure capability of their nozzles. The "Target" pressure is determined by choosing a mid-point between the lowest and highest practical pressures for the nozzle. This mid-point provides an optimal pattern and spray quality, and also offers some room to move up or down in pressure as required when travel speeds change.

Relative Droplet Size: A simple ranking to get a sense of the relative spray quality of a nozzle of interest. For any nozzle, sprays get coarser at lower pressures and higher nominal flow rates. Check with manufacturer spray quality charts to confirm actual spray qualities.

Minimum Volume: As sprays get coarser, the amount of water required to achieve acceptable coverage (droplets per unit area) increases. This conservative estimate of minimum water volumes for adequate coverage should serve as a rough guide, which is, of course, dependent on the actual spray quality of the nozzle at the pressure it's operated at.

Table 1: Nozzle Choices, Pressures and Volume Recommendations

Nozzle	*Type*	*Air-Induced*	*Smallest Size Available*	*Min (Target) Pressure (psi)*	*Relative Droplet size*	*Minimum Volume (gpa)*
TeeJet XR	Conventional	No	0067	20 (40)	Smallest (*)	3
Hypro TR, VP, Albuz AXI	Conventional	No	01, 015, 015	20 (40)	*	3
Hardi FF	Conventional	No	0075	20 (40)	*	3
ComboJet ER	Conventional	No	0067	20 (40)	*	3
TeeJet DG	Pre-orifice	No	015	30 (50)	**	3-5
Turbo TeeJet, Hypro Guardian	Pre-orifice	No	01	15 (40)	**	3-5
Hardi LD	Pre-orifice	No	01	20 (40)	**	3-5
Hypro LD, Albuz ADI	Pre-orifice	No	015, 01	30 (40)	**	3-5
ComboJet SR	Pre-orifice	No	0067	30 (50)	**	3-5
ComboJet MR	Pre-orifice	No	0067	30 (50)	***	5-7
ComboJet DR	Pre-orifice	No	0067	30 (50)	*****	7-9
Air Bubble Jet	Low Pressure Air Induced	Yes	01	30 (60)	***	4-6
Greenleaf AirMix	Low Pressure Air Induced	Yes	005	30 (60)	***	4-6
TeeJet AIXR	Low Pressure Air Induced	Yes	015	30 (60)	***	4-6
Lechler IDK / Hardi MiniDrift	Low Pressure Air Induced	Yes	015	30 (60)	***	4-6
Hypro GuardianAIR	Low Pressure Air Induced	Yes	015	30 (60)	***	4-6
Hypro Ultra Lo-Drift	Low Pressure Air Induced	Yes	015	30 (60)	****	5-7
TeeJet TTI	Low Pressure Air Induced	Yes	015	20 (60)	******	>10
Greenleaf TurboDrop, XL	Medium to High Pressure Air Induced	Yes	005	40 (70)	****	6-8
Albuz AVI	Medium to High Pressure Air Induced	Yes	015	40 (70)	****	6-8
TeeJet AI	High Pressure Air Induced	Yes	015	40 (70)	*****	7-9
Lechler ID / Hardi InJet	High Pressure Air Induced	Yes	01	40 (70)	*****	7-9
TeeJet TwinJet	Twin	No	01	20 (40)	*	3
TeeJet DG TwinJet	Pre-orifice Twin	No	015	30 (40)	**	3-5
TeeJet Turbo TwinJet	Pre-orifice Twin	No	02	20 (40)	***	5-7
Albuz AVI Twin	Air-Induced Twin	Yes	01	40 (70)	****	6-8
Hypro TwinCap, others	Double cap	Can accommodate most nozzle types depending on need				

Some Issues to Consider

Target Type and Mode of Action

1. Grassy weeds and some broadleaf weeds (lambsquarters, kochia, cleavers) can be difficult-to-wet, meaning that larger droplets tend not to stick to their surfaces. Small plants (with just the cotyledons or one true leaf emerged) are also difficult to target with large droplets. Therefore, these require either somewhat finer sprays or higher carrier volumes.
2. Contact modes of action (Groups 6, 10, 14, 22, 27) require higher droplet densities than systemic products. Higher droplet densities are most easily achieved with higher water volumes or finer sprays.

Carrier Volumes

1. At 8 to 10 gpa, can use any nozzle successfully provided you choose the right pressure.
2. At 4 gpa and lower, limit yourself to Coarse and Medium sprays. Do not use Fine or Very Fine sprays. These are not necessary for coverage and create too much drift potential.
   a) nozzle types 1 to 3 above, check with catalogue about pressure needed to achieve Coarse quality.
   b) make sure pressure and boom height are sufficient to generate 100% pattern overlaps.

Nozzle Orientation

1. At slow travel speeds, orient nozzle forwards for herbicide work. For dense, mature canopies, penetration will be best with the nozzles pointed down.
2. At fast travel speed (15 to 20 mph), we don't have enough information to make recommendation, but research shows that:
   a) coarse sprays oriented forward had the best deposition on vertical targets.
   b) coarse sprays oriented backwards may improve patterns at fast speeds.
3. Double nozzles (one pointed forward, the other backward such as in the Hypro TwinCap) are a good idea to improve coverage on vertical targets such as wheat heads (for fusarium headblight control) or grassy weeds. In lab tests, using coarser sprays with these double nozzles significantly improved coverage, but only on exposed vertical targets (wheat heads, upper stems). Horizontal targets (most crop foliage, broadleaf weeds) did not benefit from double nozzles. In field tests, weed control was only occasionally better with double nozzles, and not by much. Low boom heights are also required to benefit from the angling of the sprays.

Travel Speeds

1. Fast travel speeds have both advantages and disadvantages, but the most important advantage is greater work rates. Disadvantages are greater dust generation, less uniform deposition (especially behind the tractor unit) and less canopy penetration.
2. On the whole, slower speeds result in a higher quality job and less drift. Travel as slowly as you can afford to given your workload.

Boom Heights

1. Lower boom heights are almost always preferable over high heights to reduce drift. For conventional nozzles with 80 degree fan angles, heights can be as low as 18” above target, 110 degree nozzles 14”. Lower heights reduce drift and improve overall targeting. Low-drift

nozzles require higher heights (an additional 6”, or enough to achieve 100% overlap) to obtain good uniformity.

2. High booms increase nozzle overlap, which can be useful for low-drift nozzles and when pressures are low and patterns begin to collapse. But high booms can increase drift potential significantly. Use the lowest boom height you can that still offers you sufficient overlap given your boom movement.
3. Automatic boom levelers are available and have been useful for suspended booms under uneven terrain. These can make low boom heights practical.

Canopy Penetration

1. Droplet size does not have as much impact on canopy penetration as carrier volume.
2. Penetration improves with slower travel speeds and higher carrier volumes for any nozzle.
3. Air assist is one of the best ways to improve penetration, more effective than the above methods.