A7. SPRAY AND VAPOR DRIFT

Refer to NDSU Extension Circular A-657, "Herbicide Spray Drift" for additional information. Risk of off-target herbicide movement and injury to non-target plants depends on the susceptibility of the plant to the herbicide applied. In general, POST herbicides that are highly phytotoxic at low rates (2,4-D, MCPA, Banvel*, Tordon, glyphosate, and all ALS herbicides have the greatest potential for damaging non-target plants.

Wind velocity and direction: Apply when wind direction is away from susceptible plants, during low wind speed, and in the absence of temperature inversions. Vertically stable air (temperature inversion) occurs when air near the soil surface is cooler or similar in temperature to air above the crop. Normally, air near the soil surface is warmer than air above the crop. Warm air rises and cold air sinks, which causes vertical mixing of air and dissipation of spray droplets. Small spray droplets can be suspended in stable air, move laterally in a light wind, and affect plants more than two miles downwind. Inversions can be identified by fog or dust from a gravel road.

Boom height: Adjust boom as close to the target as possible while maintaining uniform spray coverage. Choose nozzles with a wide angle as opposed to narrow angle nozzles.

Herbicide formulation: Dimethyl amine (dma) formulations of dicamba and ester formulations of 2,4-D and MCPA may volatilize at 70 to 90 F and cause plant injury from vapors. Amine formulations of 2,4-D and MCPA are non-volatile at high temperatures. Soil surface temperature is much warmer than the air. Herbicide vapor can drift farther and over a longer time than spray droplets. Volatile herbicides should not be used near susceptible plants.

Spray shields: Cones around nozzles reduce drift by 25 to 50% and spray shields that enclose the entire boom reduce drift by 50 to 85%. Spray shields should not be used as a substitute for other drift control techniques but as a supplement to drift reduction.

Drift control: Increase droplet size to reduce drift by by increased by reducing spray pressure, increasing nozzle orifice size, using special drift reduction nozzles, including additives that increase spray viscosity, and orienting nozzles rearward on aircraft.

Drift-reducing nozzles: Sprayer nozzles designed to reduce spray drift increase spray droplet size and reduce the number of small droplets. The two primary types of flat-fan drift-reducing nozzles are pre-orifice and air-induction (venturi) designs.

Pre-orifice nozzles: Pre-orifice nozzles (Drift Guard and Turbo TeeJet) regulate the liquid flow rate prior to the exit orifice causing a pressure drop in the nozzle resulting in fewer fine spray droplets. Use Drift Guard nozzles at a pressure range of 30 to 60 psi. The Turbo TeeJet design combines pre-orifice technology with a turbulence chamber to produce a flat-fan spray pattern that greatly reduces the amount of spray in fine droplets. Use Turbo TeeJet nozzles at a pressure range of 15 to 90 psi (30 psi to maximize average droplet size).

Air-induction (venturi) nozzles include AI TeeJet, TurboDrop, Lurmark, Spraymaster Ultra, and Lechler. Each nozzle has a distinct design but use a pre-orifice to regulate the flow rate and a large exit orifice. Venturi nozzles include an air-induction assembly that incorporates air into the stream, thereby forming air-filled droplets that shatter upon impact improving spray coverage and retention of large droplets. The air-induction system operates more efficiently at higher spray pressures (60 psi) and, in contrast to standard flat-fan nozzles, the droplet size spectrum of venturi nozzles is not greatly influenced by this pressure change.

Drift reduction research. The greatest reduction in spray drift occurred with air induction or Turbo TeeJet nozzles operated at low pressure (20 psi). Drift Guard nozzles reduced drift but produced fine droplets that result in greater spray drift than air induction or Turbo TeeJet nozzles. The following table compares droplet size data for various sprayer nozzles (Univ. of Tennessee Agric. Experiment Station, Bull. 695).

Nozzle	Pressure	Droplets <191 um	VMD*
	(psi)	(%)	(µm)
Extended Range 8002	40	65	154
Drift Guard 8002	40	32	292
Turbo TeeJet 11002	40	32	271
Turbo TeeJet 11002	15	19	393
TurboDrop 11002	60	10	520

*VMD = volume median diameter = diameter in which 50% of the spray volume is in droplets smaller than, not an average droplet size.

% of small spray droplets (<191 µm) is the best indicator relating to spray drift. Air induction nozzles (TurboDrop) produced the largest spray droplets and the fewest number of fine spray droplets compared with other nozzles. The data in the table also illustrates the importance of using low spray pressures to maximize the drift-reducing potential of Turbo TeeJet nozzles.

Herbicide performance. Weed control from most POST herbicides, including contact herbicides of Aim and paraquat*, were similar when applied through drift-reducing nozzles or standard flat-fan nozzles. Weed control from Reflex applied with drift-reducing nozzles was slightly less.

In most cases, drift reducing nozzles will produce sufficient spray coverage to maintain effective weed control. Total spray coverage will decrease as droplet size increases, but the number of drops delivered to the target weed will generally still be sufficient for excellent weed control with drift-reducing nozzles.

	Spray Volume		
Spray Droplet Diameter	5 gpa	10 gpa	20 gpa
(µm)	— drops per square inch ----		
200	720	1440	2880
300	214	428	856
400	90	180	360
500	46	92	184

A spray volume of 5 gpa from drift reducing nozzles will produce large droplets (500 µm) to theoretically produce 46 drops/sq. inch, which should be adequate to cover even small target weeds. Research at NDSU supports the premise that herbicides applied at 2.5 gpa spray volume with drift-reducing nozzles provide weed control similar to herbicides applied with standard flat-fan nozzles.

Large spray droplets may bounce off leaves upon impact resulting in poor droplet retention. Spray adjuvants applied with POST herbicides improve droplet retention and deposition. NDSU research has found that spray retention is similar for drift-reducing nozzles and standard nozzles when herbicides were applied with NIS or MSO type adjuvants.

For maximum drift control without affecting herbicide performance, use air induction type nozzles at more than 60 psi or Turbo TeeJet nozzles at less than 30 psi. Contact herbicides, hard-to-wet weed species, and small target weeds are examples where drift-reducing nozzles may reduce herbicide performance. Weed control with drift-reducing nozzles may be better than with conventional nozzles when environmental conditions favor lateral droplet movement. Go to http://www.ageng.ndsu.nodak.edu/spraynozzles to compare spray nozzles.