Factors affecting pesticide drift

Minimizing potential drift is a primary responsibility of every applicator. Despite conscientious efforts, about one to three applications per Iowa county each year result in drift complaints investigated by the Iowa Department of Agriculture and Land Stewardship. With increases in high value crops, urban sprawl, and public concern, and the higher costs of pesticide applications drift management is extremely important.

Some of the basic principles affecting drift include:

- Nozzle type affects droplet size and drift potential
- Reducing nozzle operating pressure and increasing nozzle size reduces drift
- Lowering boom height (but still maintaining proper nozzle overlap) reduces drift
- Higher wind speeds increase drift distances, and wind direction influences areas affected
- Dead calm conditions (e.g., atmospheric inversion) allows small droplets to drift
- Temperature and relative humidity affect droplet evaporation

Numerous studies confirm that droplet size–as affected by equipment selection and application technique–and weather conditions are the most important factors affecting drift potential (Spray Drift Task Force, 1997). It is assumed that readers of this publication have a good understanding of the basic principles involved in drift. If more background information is desired, consult literature such as Pringnitz et al. (2001), the introductory section of nozzle manufacturer catalogs, or equipment and drift sections of other pesticide training materials.

Spray applicators are often under pressure to apply in a narrow window of time during less than ideal wind and weather conditions. Completing all applications when wind speeds are in the optimum range of 3 to 10 miles per hour (mph) can be challenging. Drift potential is greatest at field borders and may affect different situations such as non-glyphosate tolerant crops, other sensitive crops, farmsteads and gardens, or passing cyclists, all of which may be in close proximity to the application.

The objective of this publication is to illustrate factors affecting drift distances during ground spray application conditions. Summaries of several studies are listed and a physical model is used to approximate drift for close distances.

An individual nozzle releases a range of droplet sizes. Figure 1 diagrams the effect of temperature and relative humidity on droplet size and movement. Table 1 lists the distances different sized spray droplets travel at various wind speeds. Larger droplet sizes should be strongly considered under low relative humidity (r.h.), high temperatures, or higher wind speeds as the potential to move off target and drift is higher under these conditions.

Evaporation of Droplets

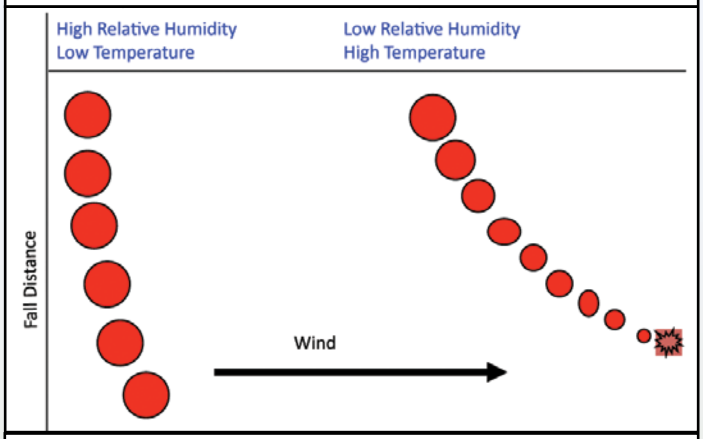

Figure 1. Effect of temperature and relative humidity on droplet size and movement.

Droplet sizes (microns)	5 mph wind	10 mph wind	15 mph wind	20 mph wind
100	24 feet	48 feet	72 feet	96 feet
200	9	18	26	35
400	5	9	14	18
500	4	7	10	14
600	3	6	9	12
Boom height: 3 feet				

Table 1. Distances different droplet sizes travel under various wind speeds.

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Nozzle selection and boom height play an important role in drift management. Figure 2 illustrates the effect two different boom heights have on spray droplet movement. The spray boom was set up with 8004 flat-fan nozzles delivering 20 gallons per acre at 40 psi pressure. A spray boom inadvertently operated at approximately 2 times suggested height for proper spray overlap increases drift potential by about the same amount. The effect that application height has on drift increases with increasing wind speed and decreasing droplet size.

A Texas study (Spray Drift Task Force, 1997) measured drift with an approximate 10 mph crosswind from four passes of a 45-ft boom (180-ft swath). Figure 3 illustrates the percentage of the full application rate that was collected downwind at 25 and 80 feet with two different nozzle types. The 8004 flat-fan nozzles were used at 40 psi with a 10 mph wind and the hollow-cone nozzles were used at 55 psi with an 11 mph crosswind. Noticeably less drift occurred with the flat fan nozzles used at a lower pressure.

A Tennessee study (Bui et al., 1998) measured drift from a single pass of a 35-foot boom and crosswind conditions of 5 to 10 mph. Size 8002 flat-fan nozzles were used at 25 psi with a (relatively high) 4-foot boom height. Collected spray drift was variable at distances from 20 to 80 feet downwind, but generally ranged from 1% at 20 feet to 0.5% at 60 to 80 feet. This study reinforces the importance of having adequate buffer distances between spray applications and sensitive areas.

Approximate drift distances for a percentage of flow exiting a nozzle can be calculated using physical principals such as air drag from wind and evaporation rate due to air temperature and relative humidity (Zhu et. al., 2005). Figure 4 shows the effects of crosswind speed and air temperature and humidity on potential drift. Although only about 1% of spray volume drifts 25 feet from the nozzle in a 10 mph crosswind in cool weather, about 8% drifts 10 feet from the nozzle in a 15 mph crosswind. Warm, dry air common during summer postemergence applications increases drift distances of smaller droplets.

Summary tips for reducing spray drift

Know and use basic equipment principles to increase droplet size and minimize drift potential (e.g. low-drift nozzle selection, increasing nozzle size and reducing pressure, minimizing boom height). Use application knowledge to decrease drift potential in marginal wind and weather conditions. Know before spraying what is across fence lines and property boundaries.

Additional tips to consider include:

- Reduce ground speed (with spray controller reducing operating pressure) around field boundaries
- Avoid spraying close to a sensitive area in adverse wind and air temperature conditions or wait until conditions improve
- Evaluate distance to a sensitive area and relative effects of wind speed and adjust spray operation accordingly

Effect of Boom Height vs. Drift Potential

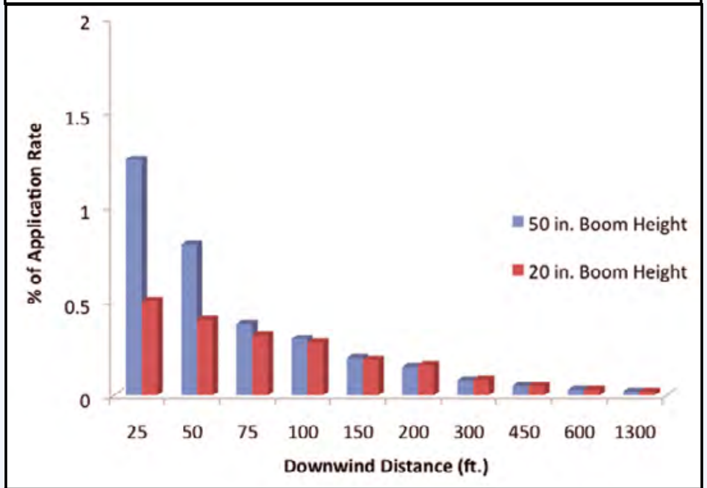

Figure 2. Effect of boom height on the distance a percentage of an application rate will drift.

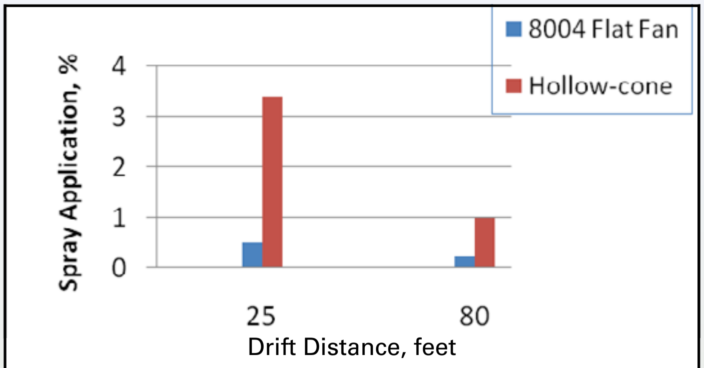

Figure 3. Comparison of drift distances with two different nozzles.

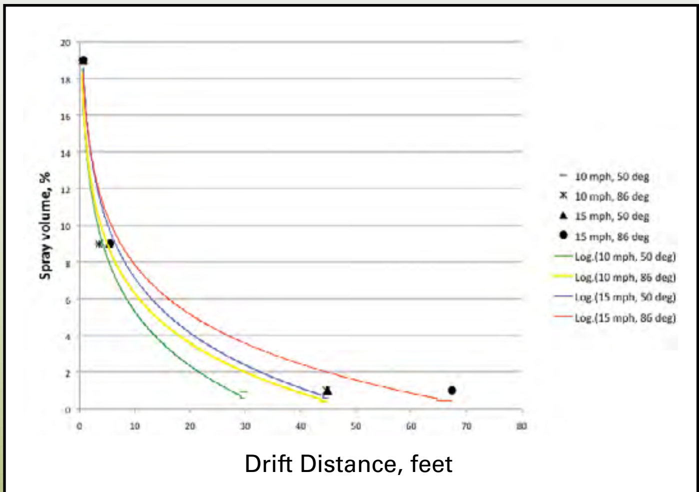

Figure 4. Effects of crosswind speed and air conditions (80% r.h. at 50 degrees; 40% r.h. at 86 degrees) on drift distance for percentage of spray volume exiting an 8004 flat-fan nozzle at 40 psi.

References

Bui, Q. D., A. R. Womac, K. D. Howard, J. E. Mulrooney, and J. K. Amin. 1997. Evaluation of samplers for spray drift. Transactions of the American Society of Agricultural Engineers. 41(1):37-41.

Pringnitz, B. A., H. M. Hanna, and J. Ellerhoff. 2001. Selecting the correct nozzle to reduce spray drift. IPM-68. Iowa State University Extension. Ames, IA.

Spray Drift Task Force. 1997. A summary of ground application studies. Environmental Protection Agency.

Zhu, H., R. D. Fox., and H. E. Ozkan. 2005. DRIFTSIM: Predicting drift distances of spray droplets. Bulletin 923. Ohio State University Extension. Columbus, OH.