UNDERSTANDING & PREVENTING OFF-TARGET HERBICIDE MOVEMENT

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What is off-target movement?

- Movement of a herbicide away from the target area
  - Physical drift
  - Vapor drift
  - Soil movement

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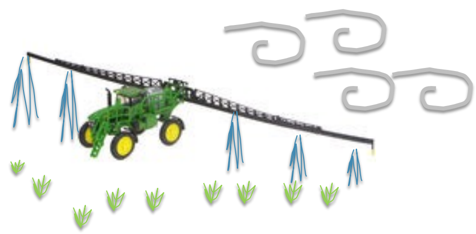
Physical/Particle drift

- Wind moves spray droplets during application
  - Herbicide never reaches intended target



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Factors affecting physical drift

1. Wind speed
2. Sprayer speed
3. Droplet size
4. Nozzle type
5. Nozzle size and spray angle
6. Spray pressure
7. Boom height
8. Drift reduction agents

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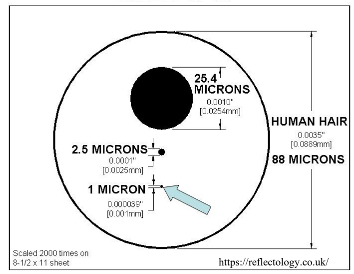
Droplet size affects drift potential

Droplet size	Diameter (microns)	Time to fall 10 ft in still air	Lateral movement in 3 MPH wind (ft)
Very fine	20	4.2 min	1,000
Very fine	100	10 s	44
Medium	240	6 s	28
Coarse	400	2 s	8.5
Extremely course	1,000	1 s	4.7



Kruger et al, 2019

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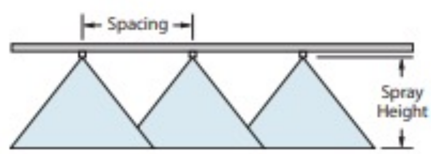
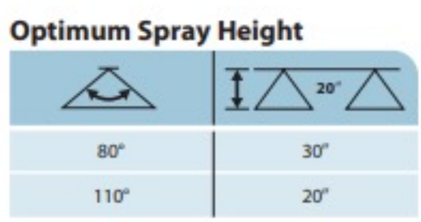
Boom height

- Wind speed increases w height above ground
- Drift increased about 1% for every 4” increase in boom height





https://www.teejet.com/literature/catalogs-bulletins.aspx

Arvidsson et al, 2011

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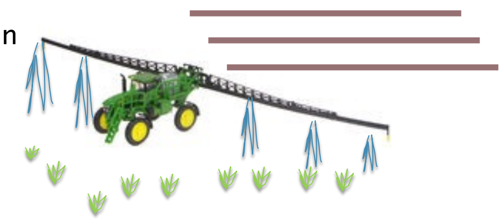
Vapor drift

- After application, herbicide on the leaf surface volatilizes (becomes a gas)
  - Vapors move with air
    - Vapors move farther than droplets
  - Some molecules are more likely to volatilize
    - Examples: dicamba, 2,4-D, clomazone
    - Can be influenced by herbicide formulation



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Physical drift vs vapor drift

Particle drift

Vapor drift

May have greater injury in low-lying areas

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Factors affecting vapor drift

- Herbicide vapor pressure
- Herbicide formulation
- Relative humidity
- Air temperature

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Molecule		Molecular weight (g/mol)	Vapor pressure at room temperature
Glyphosate		169.1	2.5×10^{-8} Pa
2,4-D		221	1.9×10^{-5} Pa
Dicamba		221	4.5×10^{-3} Pa
Treflan		335.3	1.7×10^{-2} Pa

- Larger vapor pressure (smaller exponent) = more volatile

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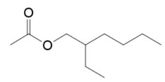
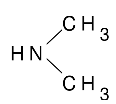
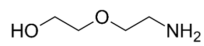
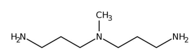
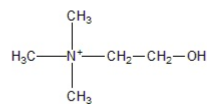
2,4-D & dicamba formulations

	Molecule	Structure	Molecular weight
More volatile	Ethylhexyl ester		113 g/mol
↑	DMA (Banvel, 2,4-D amine)		45 g/mol
	DGA (Clarity, XtendiMax)		105 g/mol
	BAPMA (Engenia)		435 g/mol
Less volatile	Choline (Enlist One, Enlist Duo)		104 g/mol

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Relative humidity

- Dicamba volatility greater at lower humidity

Table 12. Response of soybeans exposed at two humidity levels for 6 h at 30 C in closed glass jars to corn sprayed with 1.12 kg/ha of the DMA and DEOA salts of dicamba.

Dicamba formulation	Relative humidity	Soybean injury index ratings[a]
DMA	85–95	43
	70–75	55
DEOA	85–95	3
	70–75	29
	Bayes LDS 0.05	10

[a]Soybean injury index ratings: 0 = no effect, 100 = complete kill.

Behrens & Lueschen, 1979

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Temperature

- Dicamba volatility greater at higher temperatures

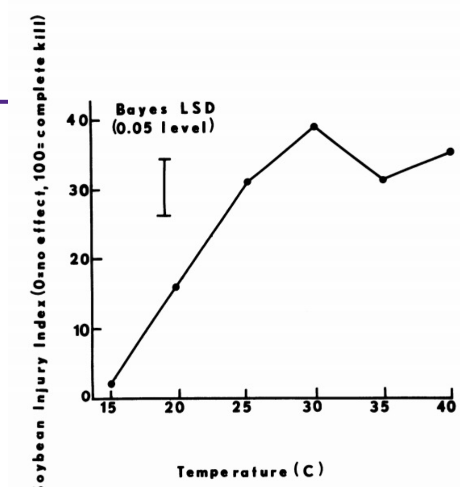

Figure 2. Response of soybeans exposed for 6 h at several temperatures in closed glass jars to vapors emitted by corn sprayed with 0.28 kg/ha of the DMA salt of dicamba.

Behrens & Lueschen, 1979

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Herbicide mobility in soil

- If a water-soluble herbicide molecule is NOT sorbed, it is dissolved in the soil solution and available for plant uptake, lateral movement, or leaching

- Also influence by soil texture and rainfall

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Herbicide mobility in soil

Product	Half life (days)	Sorption (Koc)	Solubility (mg/L)	Mobility
dicamba	10 d	2	4500	Medium
2,4-D	6.2 d	62	569	Medium
atrazine	60 d	100	33	Medium
glyphosate	47 d	24,000	15,700	Low
Valor	15 d	557	1.7	Low
Treflan	60 d	7000	0.3	Not mobile

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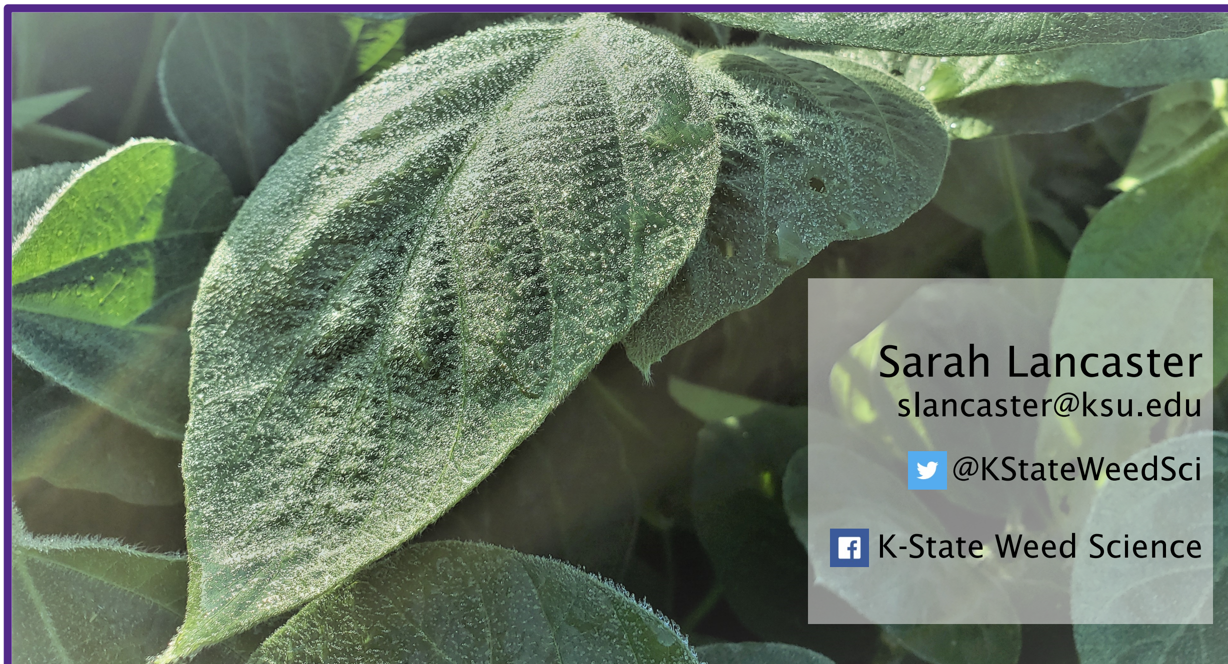

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