Prevention and Management of Herbicide Drift

Kassim Al-Khatib

University of California

Topics for Discussion

- Herbicide drift definition and types
- Factors affecting Drift
- Managing drift
- Herbicide injury symptoms and investigating herbicide drift damage

What is herbicide drift

- Physical movement of a herbicide through air at the time of application or soon thereafter, to any site other than that intended for
  - Unintentional exposure for humans, animals, and plants









Herbicide Drift Cost

- Reduced weed control/waste herbicide
- Damage to non-target plants
  - Replanting
  - Reduced yield
  - Delayed maturity and harvest
  - Reduced crop quality
- Contaminated food with unacceptable herbicide residues
- Livestock, natural resources, and human health/safety
- Fine and loss business
- Litigation concerns

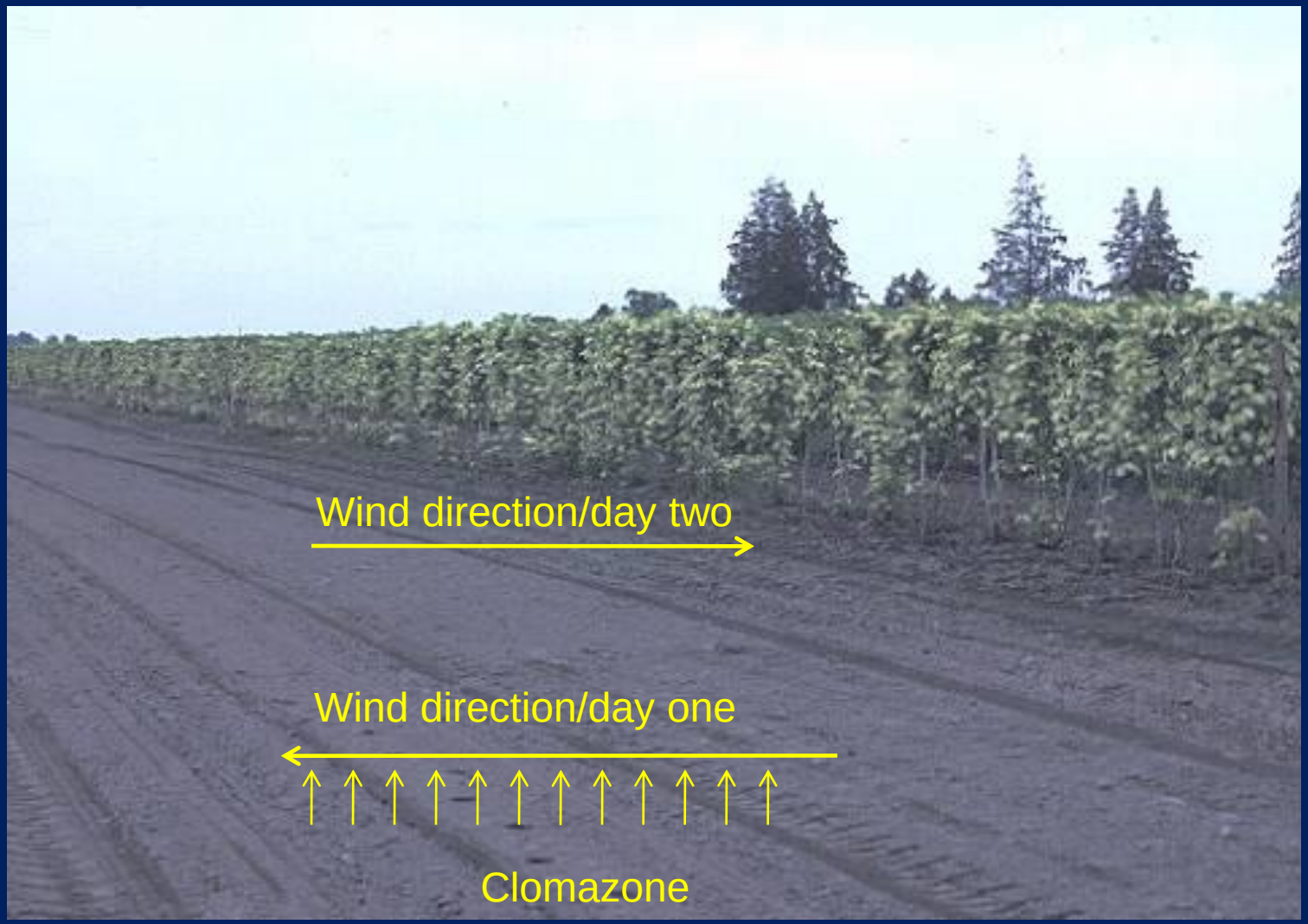
Herbicide Drift

- Volatility
- Spray droplets

Herbicide Drift Damage

- Crop/plant sensitivity to herbicide
- Plant growth stages
- Growth conditions
- Multiple hits with herbicide

Volatility Drift



Volatility Drift

Herbicide vapor pressure (Pa) at 77 F

Nicosulfuron	1.6×10^{-14}
Glyphosate	2.45×10^{-8}
Simazine	2.9×10^{-6}
2,4-D (acid)	1.9×10^{-5}
Clomazone	1.92×10^{-2}
Dichlobenil	1.33×10^{-1}
Metham sodium	3200
Water	3162

Volatility Drift

- Formulation
  - Dicamba
    - Banvel- dimethylamine salt of dicamba (Banvel)
    - Clarity- diglycolamine salt of 3,6-dichloro-o-anisic acid (Clarity)
  - 2,4-D
    - 2,4-D dimethylamine salt – less volatility
    - 2,4-D ester
      - Short chain – high volatility
      - Long chain – lower volatility

Volatility ratio: amine: long chain ester: short chain ester
1:30:330

Volatility Drift

- Weather conditions
  - Temperature 90 F
  - Relative humidity
  - Wind speed
- Soil conditions
  - Moisture

Spray Droplet Drift
Physical Drift

- Field experiments

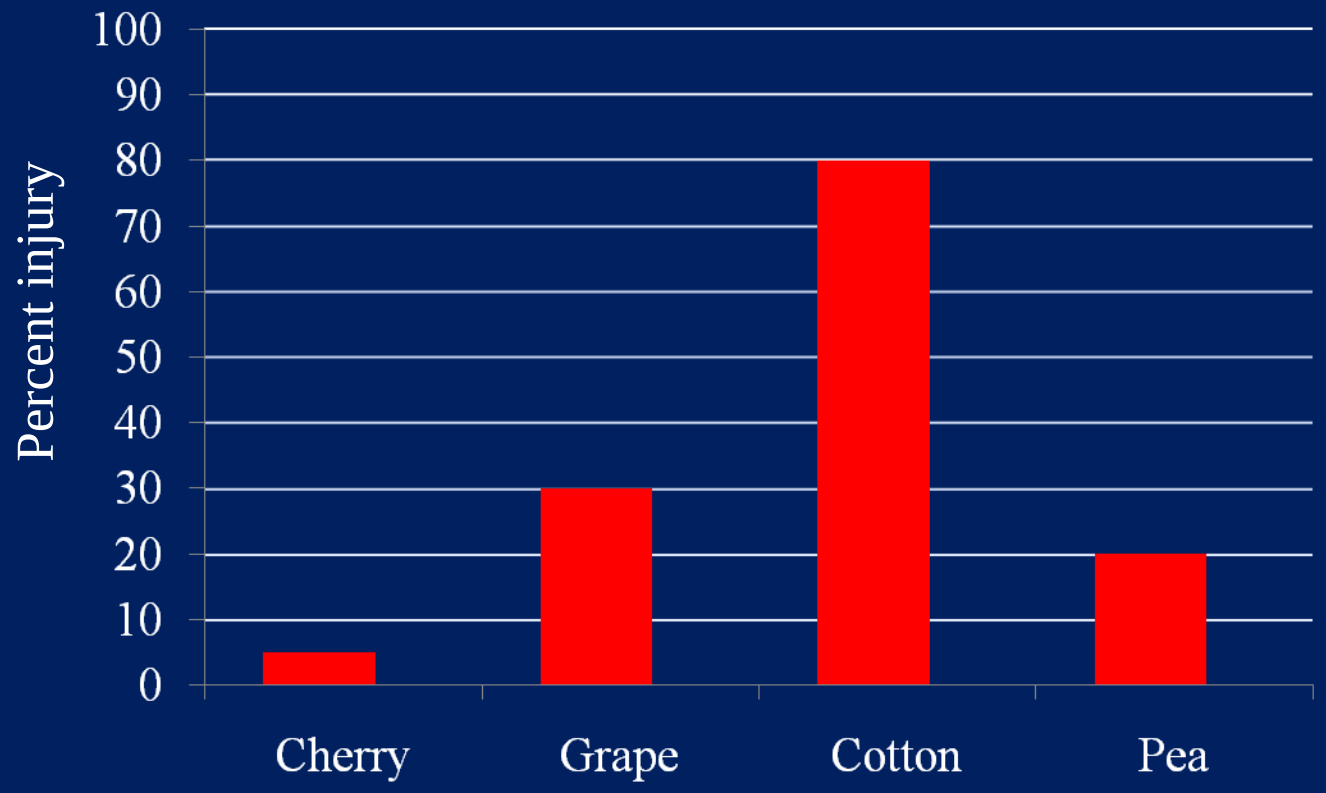
  Ground applications – up to 8% drift

  Aerial application – up to 35% drift

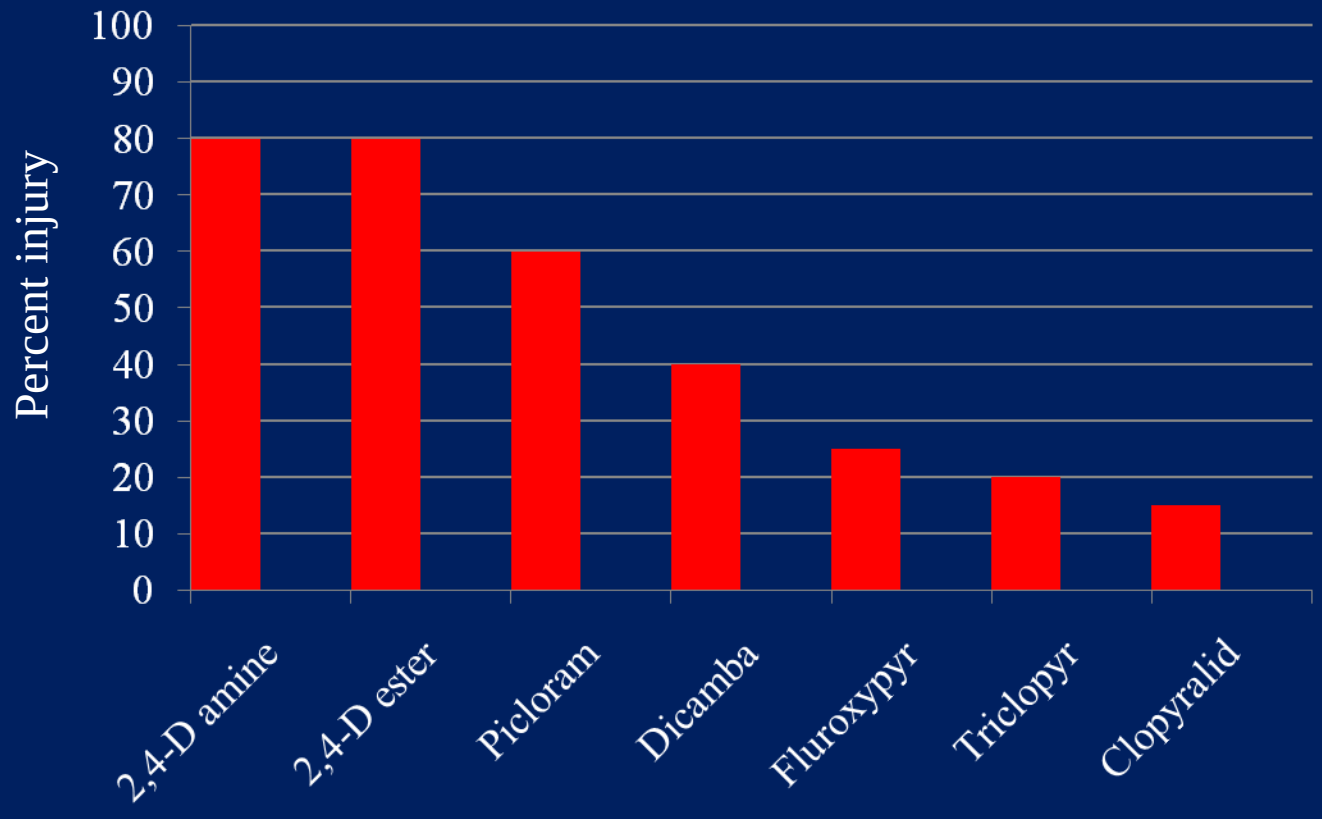
- Ag DRIFT Model

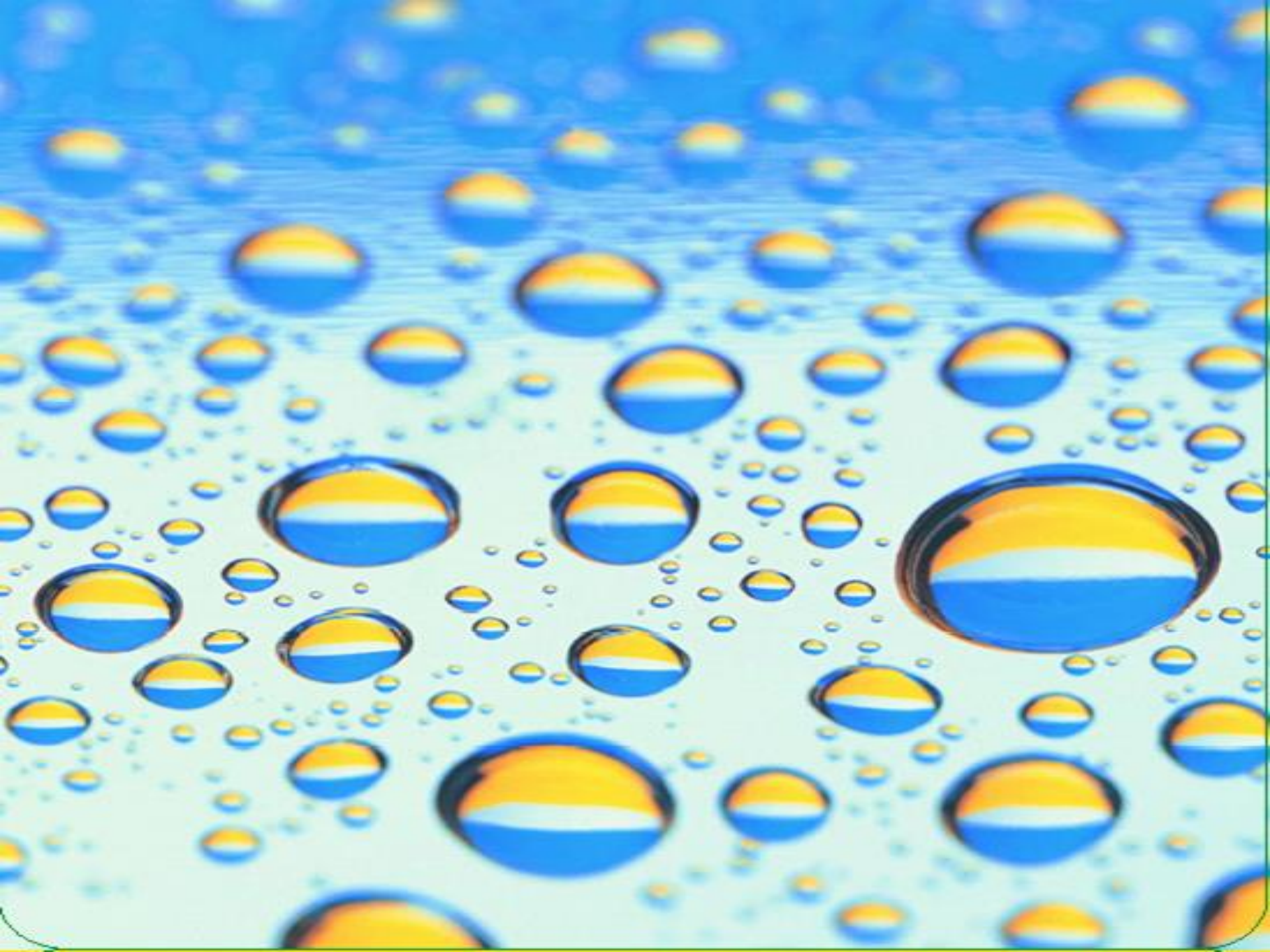
Distant (ft)	Favorable	unfavorable
1000	0.11%	<0.1%
500	0.3%	0.1%
300	0.9%	0.5%
100	3.5%	0.7%

Plant response to 1/100 2,4-D simulated drift rate 14 days after exposure



Cotton response to 1/100 2,4-D simulated drift rate 14 days after exposure





Relationship Between Droplet Size and Drift

Droplet size (microns)	Droplet life (s)	Drift distance* (ft)
20	0.64	1126
50	3.5	180
100	14	50
150	36	27
200	56	17
500	400	7

* In 10 ft fall with 3 m/h wind

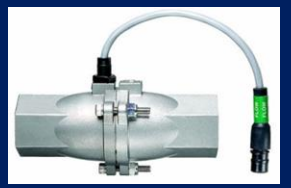
Spray Droplets Drift

- Droplet size (below 200 microns)
  - Proper Nozzle
  - Pressure
  - Spray volume
  - Constantly calibrate sprayer
  - Position nozzles to allow for wind shear in aerial application


N602KP

Sprayer Components:

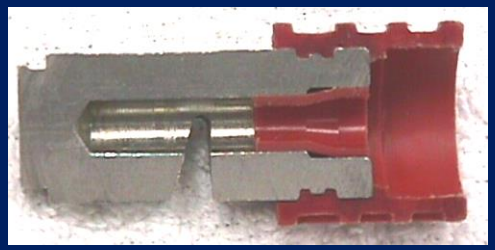
- Tanks
- Pump, Strainers, Agitation
- Pressure gauge
- Hoses, Flow control assemblies
- Electronics: monitors-computers- controllers (GPS/GIS)
- Distribution system
- **Nozzles – Not expensive but KEY!**



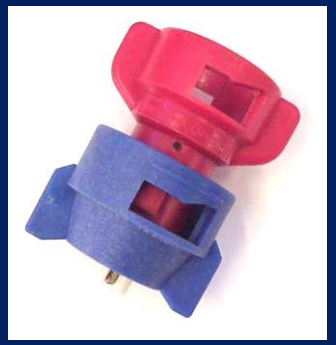
Nozzle Technology……

- Nozzles designed to reduce drift
- Improved drop size control
- Emphasis on ‘Spray Quality’

flat-fan

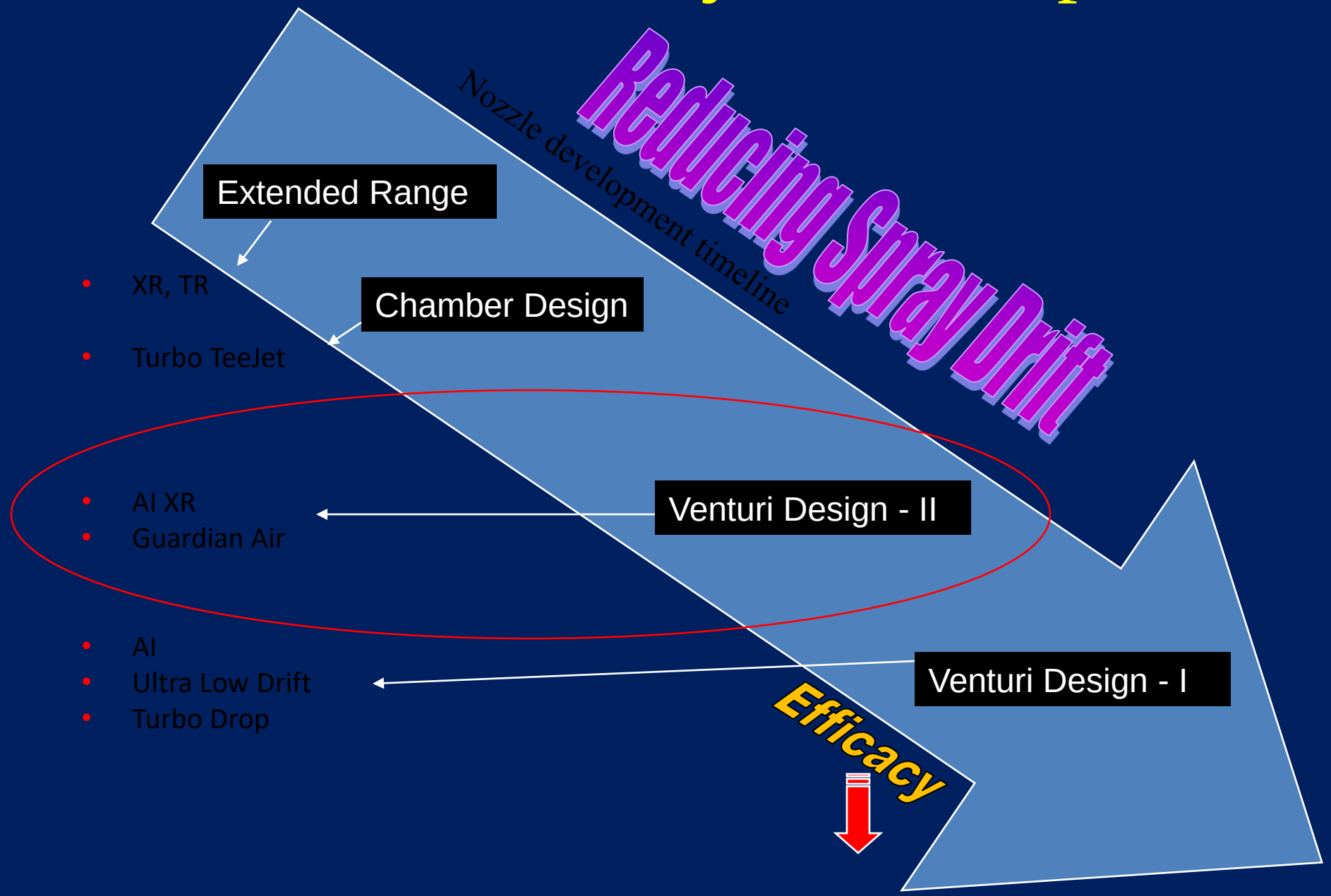


chamber



air induced

Nozzle Efficacy/Drift Slope



Calibration!!!!

The next phase!

A new concept for applicators!

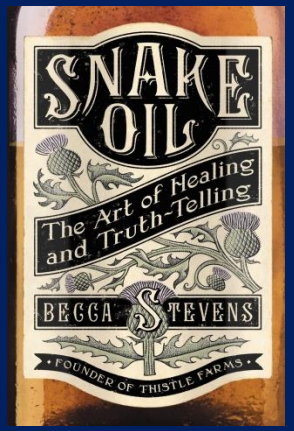
Ensuring that the spray droplet spectrum is what it is supposed to be to maximize efficacy while minimizing drift!

Spray Droplet Drift

- Weather conditions
  - Avoid high temperature and low relative humidity conditions – use drift control additives
  - Wind speeds are a minimum of 3 mph but less than 10 mph
  - Avoid herbicide application in no-wind conditions because it may indicate a thermal inversion

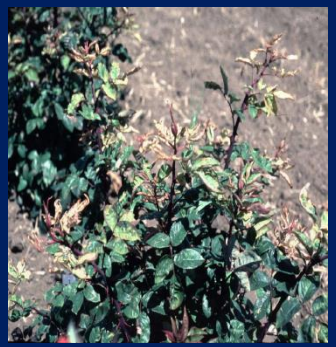
Drift Reduction Additives

- Many available!
- Not EPA regulated
- Long chain polymers
- Reduction in off-target movement
- Not all will work!!!!
- Pump shear problems
- Effect on the pattern?



Herbicide Drift Injury

- Chemical analysis
  - Cost
  - Detection levels
  - Timing
  - Residue and crop damage
- Immunoassy analysis
  - Specific
  - Qualitative
  - Available for few herbicides
- Symptoms



How to Inspect Drift Cases

- Chemical analysis
- Symptoms

Symptoms

- Cheap
- Simple
- Detection levels

Symptoms

- No positive identification
- Training
- Different herbicides may cause similar symptoms
- Herbicide symptoms may be similar to symptoms caused by biotic and abiotic stresses, nutrient deficiency, and pollutant

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Herbicide Symptoms

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- Herbicide Damage
- Modes of Action
- Herbicides (Active Ingredient & Trade Name List)
- Plants
- About Us

Contact Information

Kassim Al-Khatib
Professor
University of California, Davis

279A Robbins Hall
One Shields Avenue
Davis, CA 95616

530-752-9160 (office)
530-219-0529 (mobile)
kalkhatib@ucdavis.edu

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Mode of Action (MoA)	Chemistry	Herbicides	Plants	Symptoms
Add Mode of Action	Add Chemistry	Add Herbicide	Add Plant	Add Symptom

Sample selection from gallery:

http://herbicidesymptoms.ipm.ucanr.edu/

Strategies to Reduce Drift

- Apply IPM principles to reduce herbicide used
- Select nozzle to increase drop size
- Increase flow rates - higher application volumes
- Use lower pressures
- Use lower spray (boom) heights
- Avoid high application speeds/rapid speed changes
- Avoid adverse weather conditions
  - High winds, light & variable winds, calm air
- Consider using buffer zones
- Consider using new technologies:
  - drift reduction nozzles
  - drift reduction additives
  - shields, air-assist