Understanding Spray Deposition and Minimizing Drift

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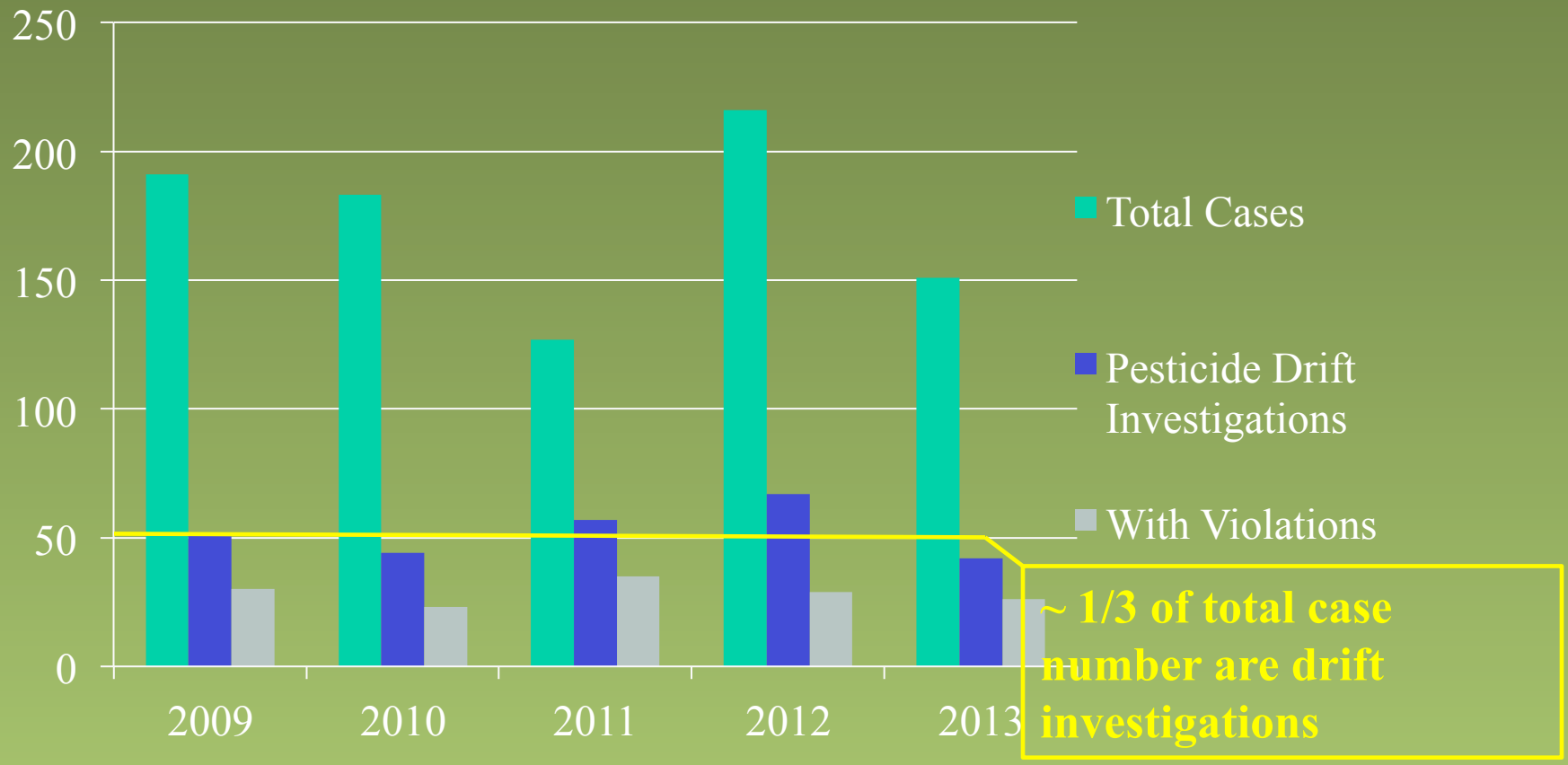
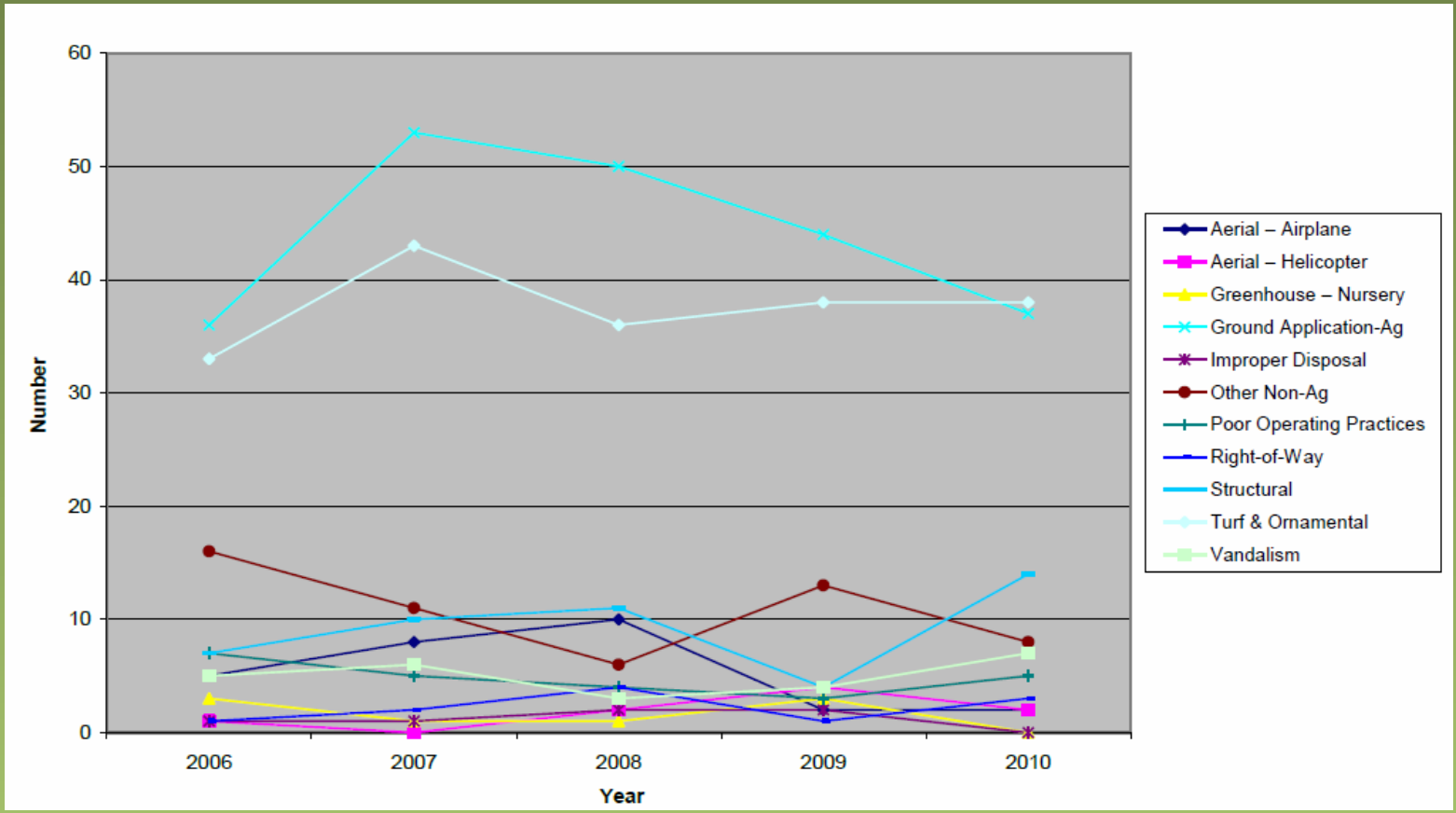
How do you want to start 2015?
Net $15/a x 60 acres
Loss of $200/a x 60 acres

WDATCP Investigations
Drift on the increase?

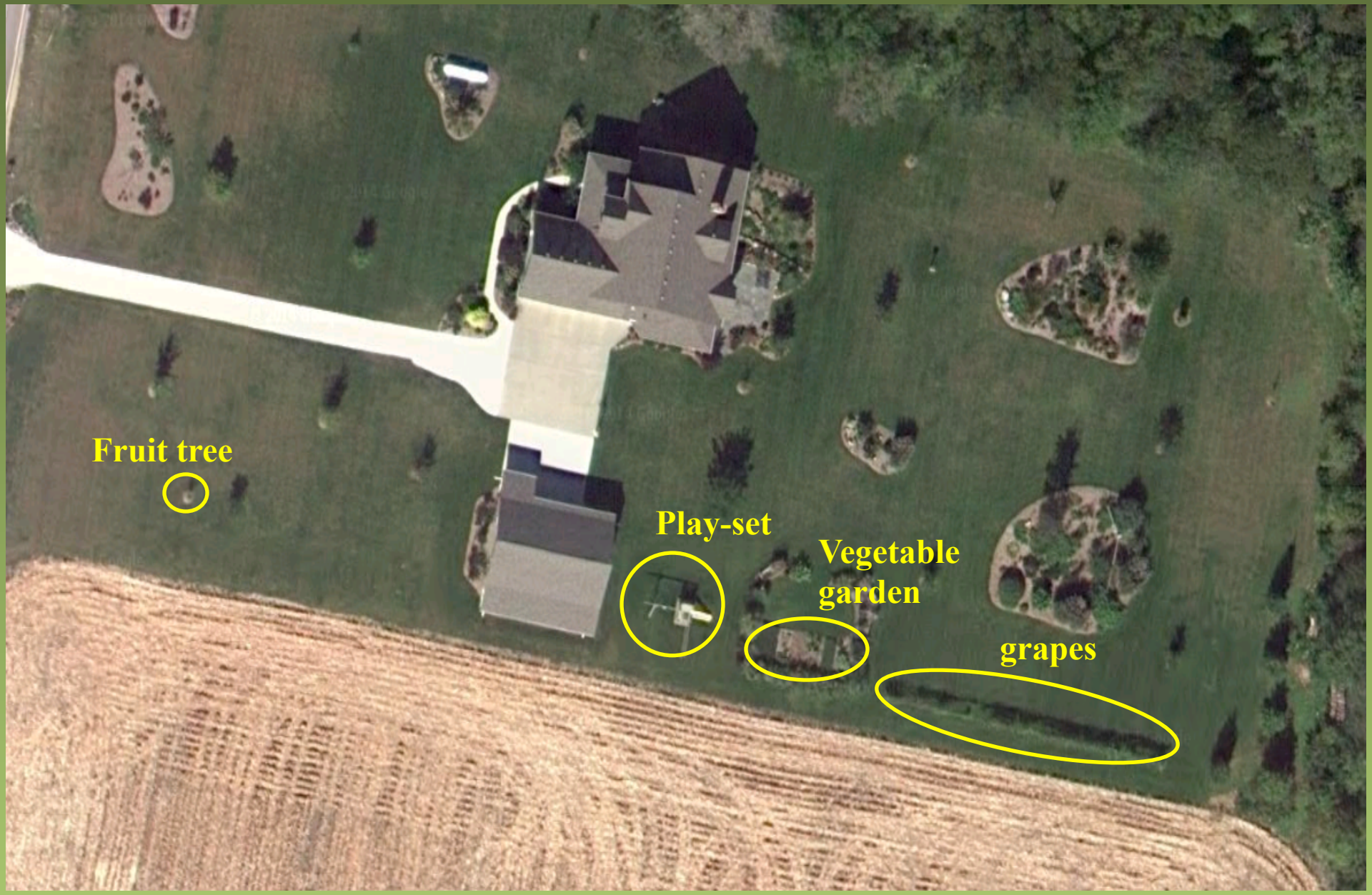


WDATCP Agrichemical Management Bureau annual report, 2009-2013

WDATCP – pesticide investigations



WDATCP Agrichemical Management Bureau annual report, 2010


Fruit tree
Play-set
Vegetable garden
grapes

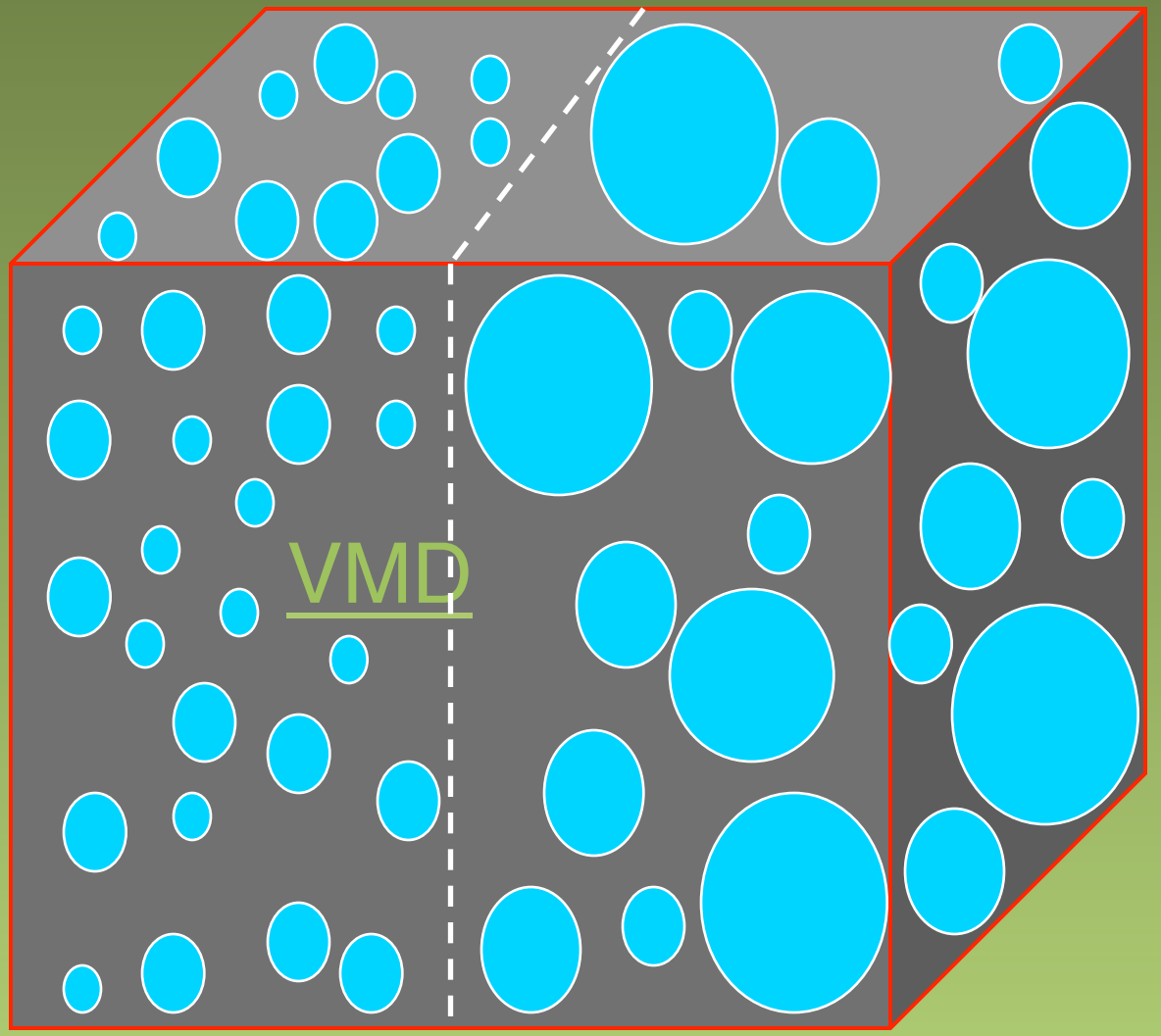
New Herbicide Resistant Crops

- Equipment (nozzle selection)
  - Spray Droplet Size
    - Measured in microns (µm = 1/1,000,000 m)
    - 1 micron = 1/25,000th of an inch
    - Paper clip = 850 microns in diameter
    - Human hair ~ 100 microns in diameter

Spray Droplet Size

Volume Median Diameter (VMD)

- the size of the spray droplet that divides the spray volume into 2 equal parts by volume



How far will particle drift go?

Droplet Diameter	50 microns	100 microns	200 microns	400 microns
				
	↓	↓	↓	↓
5 mph wind →	114 ft	42 ft	10 ft	3 ft
10 mph wind →	229 ft	84 ft	21 ft	6 ft
15 mph wind →	344 ft	127 ft	31 ft	9 ft

Droplet Production

Equipment Factors Affecting Droplet Production

- Nozzle Type
- Nozzle Size & Pressure
- Height of Release
- Sprayer Speed
- Sprayer Output

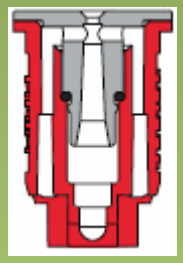
Equipment Factors - Nozzle Type

- Flat Fan

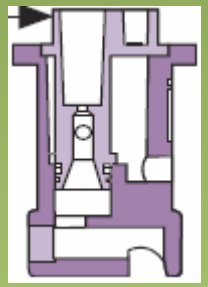
flat fan

pre-orifice flat fan

turbulence chamber



Air induction



Equipment Factors - Nozzle Size & Pressure

PSI	.1 gpm	.15 gpm	.2 gpm	.3 gpm	.4 gpm	.5 gpm
15	C	C	VC	VC	VC	EC
20	M	C	C	VC	VC	VC
30	M	M	C	C	VC	VC
40	M	M	M	C	C	VC
45	M	M	M	C	C	C
50	M	M	M	C	C	C
60	F	M	M	M	C	C
75	F	M	M	M	C	C
90	F	M	M	M	C	C

Classification

Category	Symbol	Color Code	Approximate VMD
Very Fine	VF	Red	<100
Fine	F	Orange	100-175
Medium	M	Yellow	175-250
Coarse	C	Blue	250-375
Very Coarse	VC	Green	375-450
Extremely Coarse	XC	White	>450

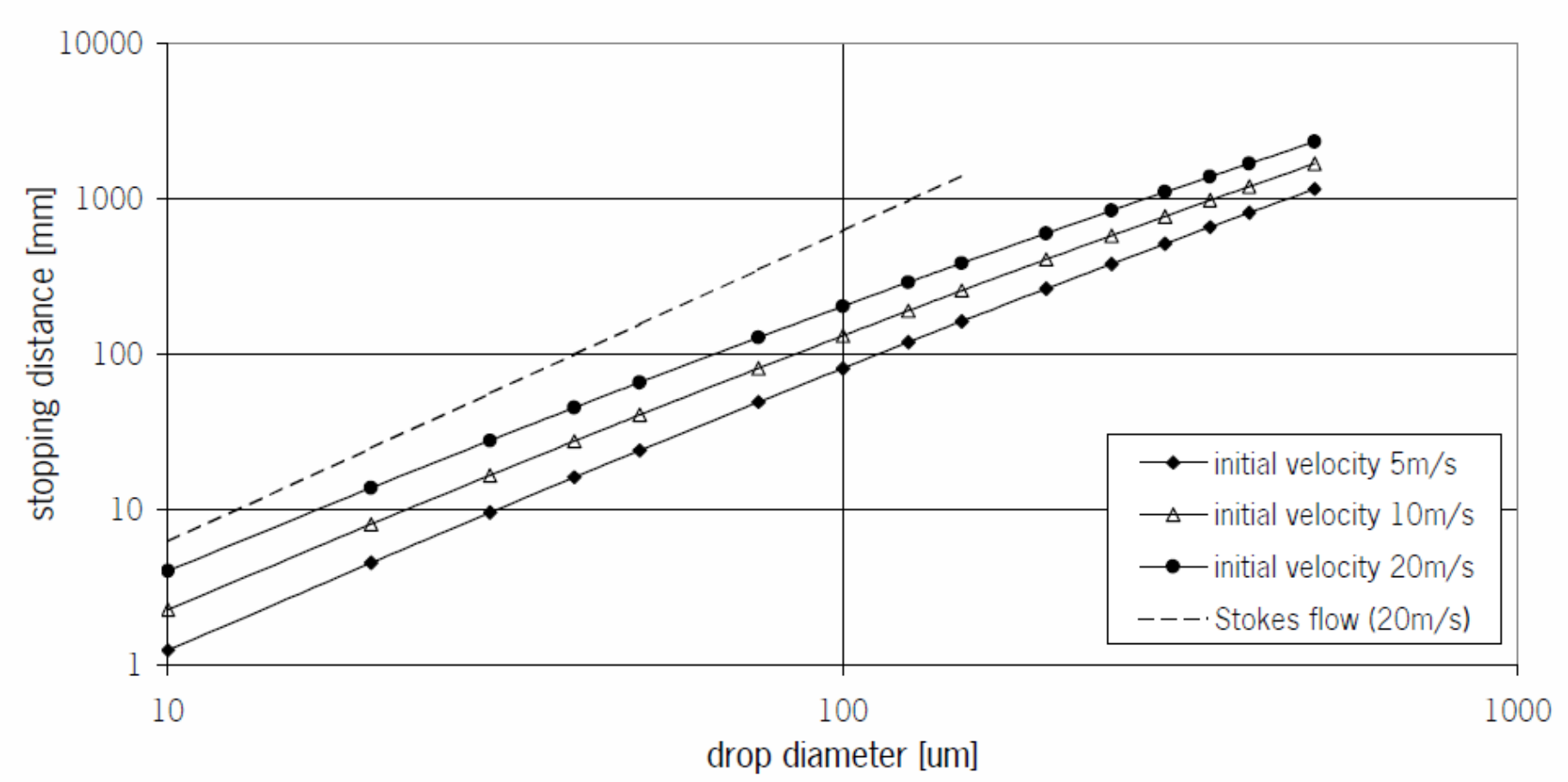
Equipment Factors

- Height of Release
  - Function of: speed & terrain
  - Spray angle

    Increase spray angle = smaller droplets,

    but…..

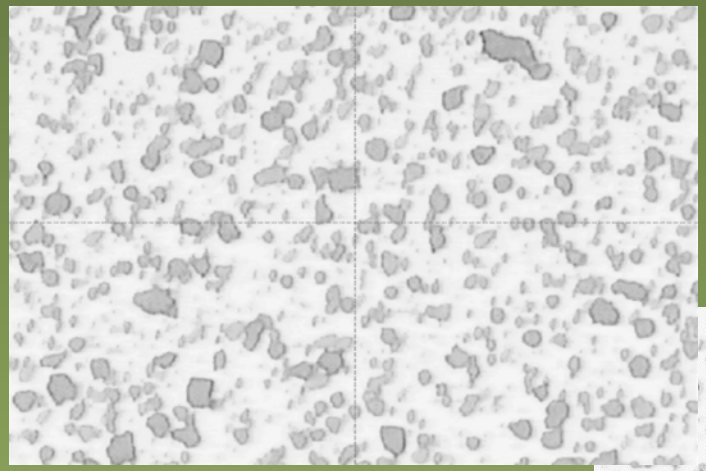
How far can you "push" a droplet



H.J. Holterman, 2003

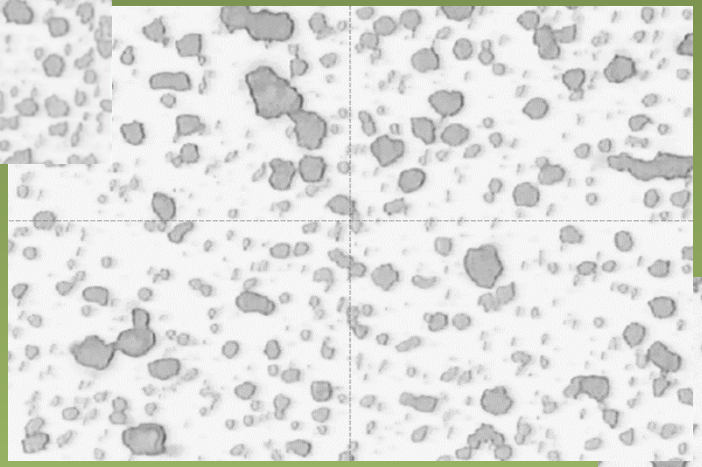
Effect of Sprayer Speed

10 GPA /5 MPH



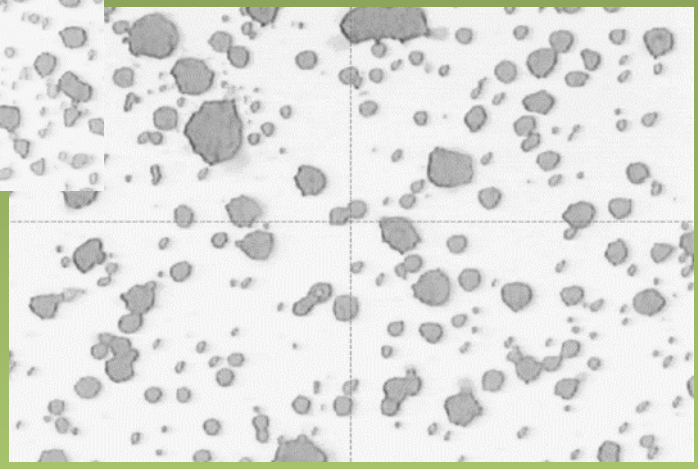
832 objects, VMD = 311
8002 20 psi

10 GPA /10 MPH



533 objects, VMD = 329
8004 20 psi

10 GPA /15 MPH

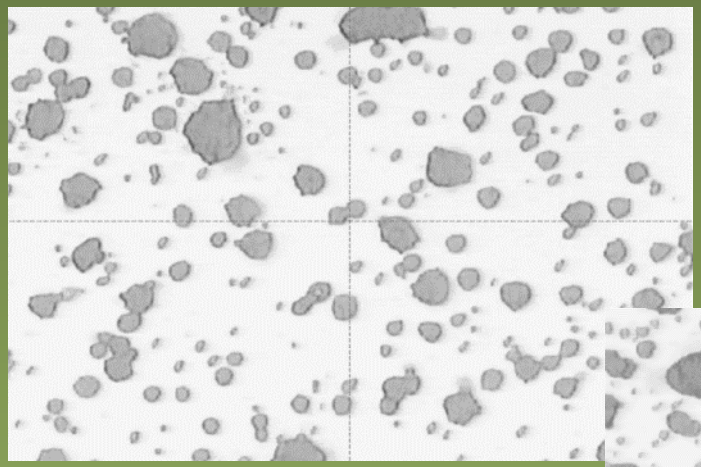


456 objects, VMD = 478
8005 30 psi

T. Eubank, 2011

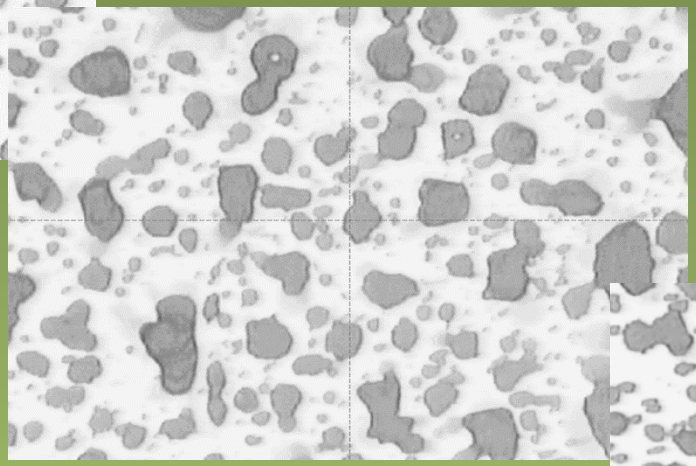
Effect of Sprayer Output

10 GPA /15 MPH



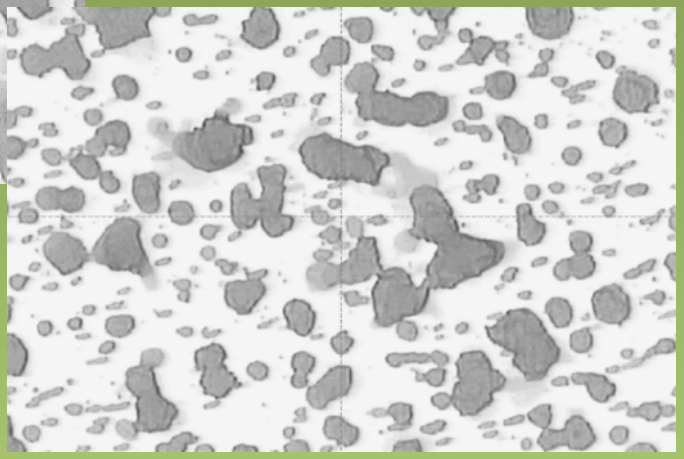
456 objects, VMD = 478
8005 30 psi

15 GPA /15 MPH



373 objects, VMD = 497
8008 28 psi

20 GPA /15 MPH



480 objects, VMD = 385
8010 31 psi

T. Eubank, 2011

Environmental Factors

- Air Movement
  - Direction & Speed
- Air Stability
- Temperature & Humidity
  - Hot / Dry Conditions ⇧ droplet evaporation
    - Greater impact on small droplets

Effect of Temp. & Humidity

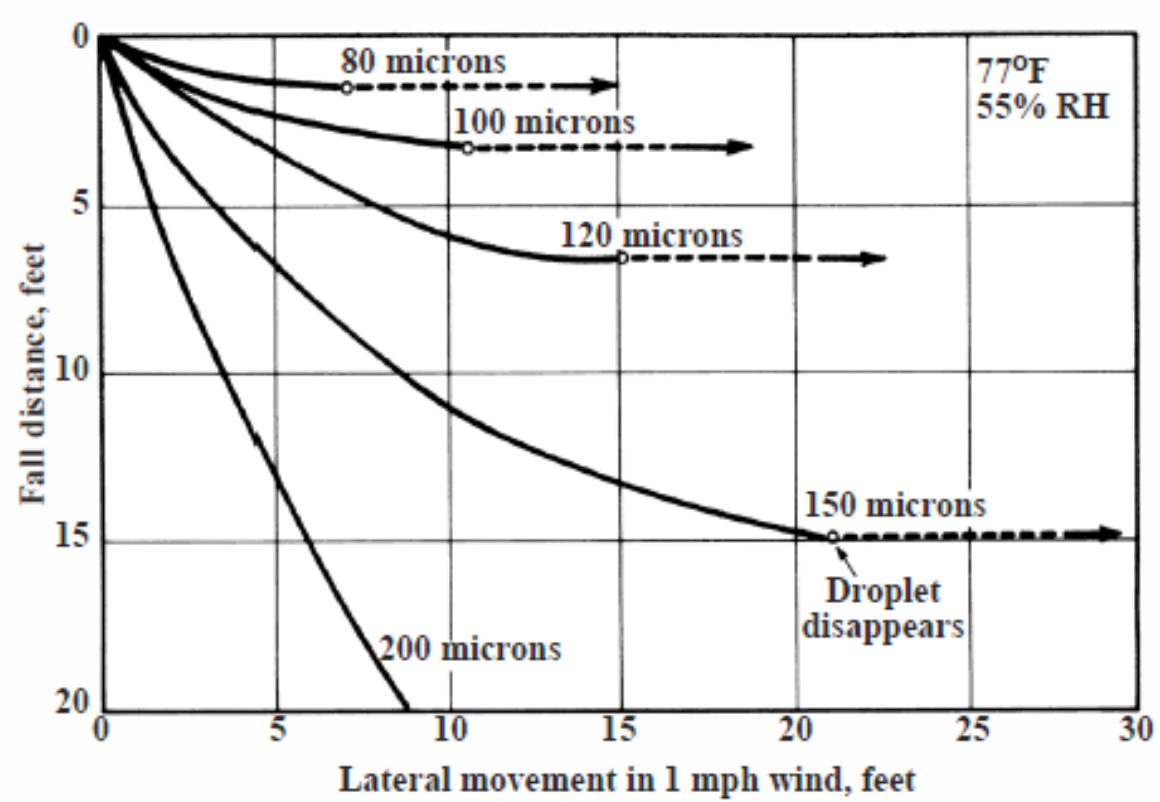


Figure 1. Lateral movement of water droplets. (Hofman and Solseg, 2004)

Spray Characteristics

- Chemical Formulation
  - Water Based (SL) – little effect
  - Clay Based (SC, FL, DF, WDG)
    - Droplet size – little effect
    - Deposition – increased
  - Emulsifiable Concentrates (EC)
    - Droplet size – increased
    - Deposition – increased due to droplet size

Spray Characteristics

- Additives

Adjuvant Type	Effect on droplet production	Effect on droplet flight
Surfactants (NIS)	Lowers surface tension, reducing average droplet size	Decreased size increases risk of evaporation
Oil Concentrates - petroleum based (COC)	Reduces droplet size	Decrease size increases risk of evaporation
Oil Concentrates - vegetable based (MSO)	Slight increase in droplet size	Minimal effect on evaporation

HSOC's

Spray Characterisics

Drift Retardants

"We use them in every tank – it's cheap insurance"

"I used to stop spraying when the wind hit 15 mph, now I keep going until it hits the low 20's"

- Compendium of Herbicide Adjuvants (11th edition) lists over 120 products

Deposition/Drift Control Agents

- "Thickeners or Viscosity Modifiers"
  - Increases the viscosity of spray solutions which in turn increases droplet size (including the very large droplets) and reduces the amount of drift susceptible fines.
  - Guar gum
  - Polyacrylamides
    - High molecular weight products greatly increase viscosity
- Do not use with air induction nozzles

Deposition/Drift Control Agents

- “Encapsulators”
  - Suspends small capsules(150-180 Micron size) of pesticide/water in the spray solution significantly reducing the amount of pesticide contained in drift susceptible fines and droplet evaporation (no overall effect on droplet size)
  - No change in viscosity

Deposition/Drift Control Agents

- Crop Oil Based Spray Modifiers
  - Not a “Thickener” or an “Encapsulator”; however it reduces drift and improve deposition by reducing the number of fine and large droplet while increases the density and therefore the velocity of the droplets.

Nozzle / Drift Control Trial

- 2014, Arlington WI
- Soybean – 30” rows
- Paraquat applied to the 2 West rows of each plot (20 GPA) using 0.4 GPM nozzles
- Multiple nozzle types, pressure, drift control comparisons
- West wind 10-12 mph

Flat Fan – 40 psi – 20 GPA wind: 11.9 mph

Flat Fan – 40 psi – 20 GPA wind: 9.9 mph
+ drift retardant

Air Induction Turbulence Chamber
40 psi – 20 GPA
wind: 9.2 mph + drift retardant

Air Induction Turbulence Chamber
40 psi – 20 GPA wind: 9.4 mph

Air Induction Flat Fan – 40 psi – 20 GPA
wind: 9.7 mph + drift retardant

Air Induction Flat Fan – 40 psi – 20 GPA
wind: 9.2 mph

Turbulence Chamber
40 psi – 20 GPA wind: 10.8 mph

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