Minimizing the Risk of Drift: Synthetic Auxin Herbicides on Soybean and the Factors that Lead to Off-target Movement

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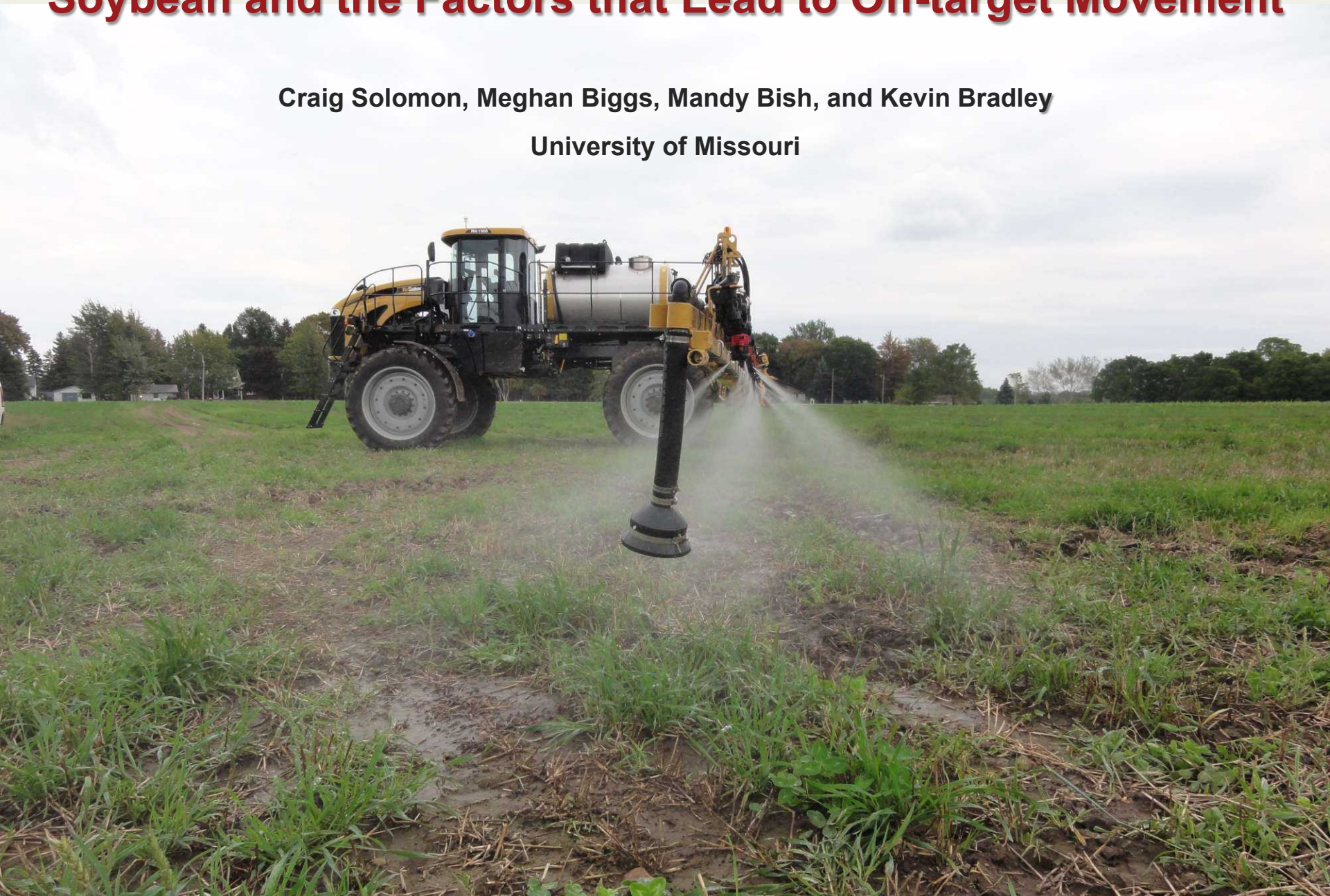


Background

- 2,4-D- and dicamba-resistant soybean varieties have been deregulated
- Once approved in China, these varieties will be commercially available in the U.S. and will likely lead to an increased use of synthetic auxin herbicides, such as 2,4-D and dicamba
- Off-target movement of 2,4-D and dicamba is a major concern and can affect many crops, fallow land, turfgrasses, pastures/rangelands, and vegetables
- Common causes of off-target movement include tank contamination, application during high wind speeds, and volatilization of the herbicide

Background

Common symptoms of off-target movement of 2,4-D and dicamba on soybean include leaf cupping, stem and leaf epinasty, cracked/swollen stems, chlorosis, and necrosis.

Objectives

Understand the effects of driftable fractions of 2,4-D or dicamba on non-resistant soybean when applied at the V3 or R2 stage by measuring:

- Visible soybean injury
- Height reduction
- Yield & yield components

Materials & Methods

- Duplicate field trials were conducted during 2011 & 2012 at Bradford Research Center in Columbia, MO
- Weedar 64 (2,4-D amine) and Clarity (dicamba) were applied at driftable fractions to V3 or R2 soybean
- Each herbicide was applied using a boom designated only for that active ingredient
- The treated soybean were analyzed 2 and 4 weeks following treatment

Soybean Response to Driftable Fractions of 2,4-D or Dicamba When Applied at the V3 Stage

		% Visible Injury		Soybean height (% non-treated control)		
		2 WAT*	4 WAT*	2 WAT*	4 WAT*	# days maturity delay
Herbicide	Rate oz/A	V3	V3	V3	V3	V3
2,4-D amine	0.0008	2	1	96	103	0
	0.008	1	1	102	101	0
	0.08	1	0	99	101	0
	0.8	3	0	94	99	0
dicamba	0.0008	21	10	89	94	0
	0.008	28	9	85	90	3
	0.08	32	9	79	75	3
	0.8	44	12	80	74	5
Nontreated	----	1	0	100	100	0
LSD (0.05)	----	18	5	6	6	1

*WAT = weeks after treatment

V3 Application, Non-treated Control – 14 days after treatment

V3 Application, 0.8 oz/A 2,4-D amine – 14 days after treatment

V3 Application, 0.0008 oz/A dicamba – 14 days after treatment

Soybean Response to Driftable Fractions of 2,4-D or Dicamba When Applied at the R2 Stage

		% Visible Injury		Soybean height (% nontreated control)		
		2 WAT	4 WAT	2 WAT	4 WAT	# days maturity delay
Herbicide	Rate oz/A	R2	R2	R2	R2	R2
2,4-D amine	0.0008	0	0	102	103	0
	0.008	0	1	100	100	0
	0.08	0	0	101	101	0
	0.8	0	0	95	98	0
dicamba	0.0008	15	17	94	89	0
	0.008	17	16	93	85	0
	0.08	14	15	86	77	1
	0.8	18	14	74	62	24
Nontreated	----	0	0	100	100	0
LSD (0.05)	----	9	3	4	4	1

R2 Application, Non-treated Control – 14 days after treatment

R2 Application, 0.8 oz/A 2,4-D – 14 days after treatment

R2 Application, 0.0008 oz/A dicamba – 14 days after treatment

Soybean Yield and Yield Components in Response to Driftable Fractions of 2,4-D or Dicamba

Herbicide	Rate oz/A	Yield (bu/A)		Seeds per pod		Pods per plant		Weight (g)/100 seeds	
		V3	R2	V3	R2	V3	R2	V3	R2
2,4-D amine	0.0008	65	65	2.22	2.33	45	55	16.77	16.62
	0.008	65	66	2.27	2.22	45	53	16.68	16.83
	0.08	67	65	2.26	2.2	49	48	16.63	16.66
	0.8	65	66	2.23	2.2	51	45	16.88	17.25
dicamba	0.0008	62	63	2.17	2.06	45	42	16.23	18.11
	0.008	64	61	2.17	2.07	50	43	16.35	18.35
	0.08	63	56	2.16	2	45	39	16.44	17.73
	0.8	62	21	2.2	0.64	50	13	16.35	18.99
Nontreated	----	65	65	2.27	2.27	48	48	16.7	16.7
LSD (0.05)	----	4	4	1.12	0.14	8	6	0.37	0.89
LSD (0.05)	----	4		0.13		7		0.68	

Conclusions

- Greatest visible injury on soybean was noted 2 weeks following the V3 application of dicamba

- Visible injury **did not correlate** with yield loss

- Highest maturity delay and lowest soybean yield were observed following 0.8 oz/a dicamba application at the R2 stage

Off-Target Movement of Synthetic Auxin Herbicides

- Non-resistant soybeans **are not the only crops that will be affected** by off-target movement of synthetic auxin herbicides.

- Tomato and grapes as well as many other crops are sensitive to driftable fractions of 2,4-D and dicamba.

- Three factors that will likely play significant roles in off-target herbicide movement are:
  -improper tank clean out
  -physical drift due to wind
  -herbicide volatility

Off-Target Movement: Tank Clean Out

Tank Contamination will likely play the largest role in off-target movement of synthetic auxins.

8 fl. oz of a tank solution that included dicamba left in a 1200 gallon spray tank will result in **significant foliar injury** to a subsequent non-DR soybean field…but **not necessarily yield loss!**

~2/3 to 6 gallons of dicamba solution left in the 1200 gallon spray tank will result in **significant yield loss** to a subsequent non-DR soybean field.

Off-Target Movement: Tank Clean Out

Equipment Cleanout Demonstration following dicamba application (Bradford Research Center, 2014)

Non-treated control

Yield: 48 Bu/A

Single Rinse with Water

37 Bu/A

Double Rinse

1st rinse water;
2nd rinse ammonia

44 Bu/A

Triple Rinse

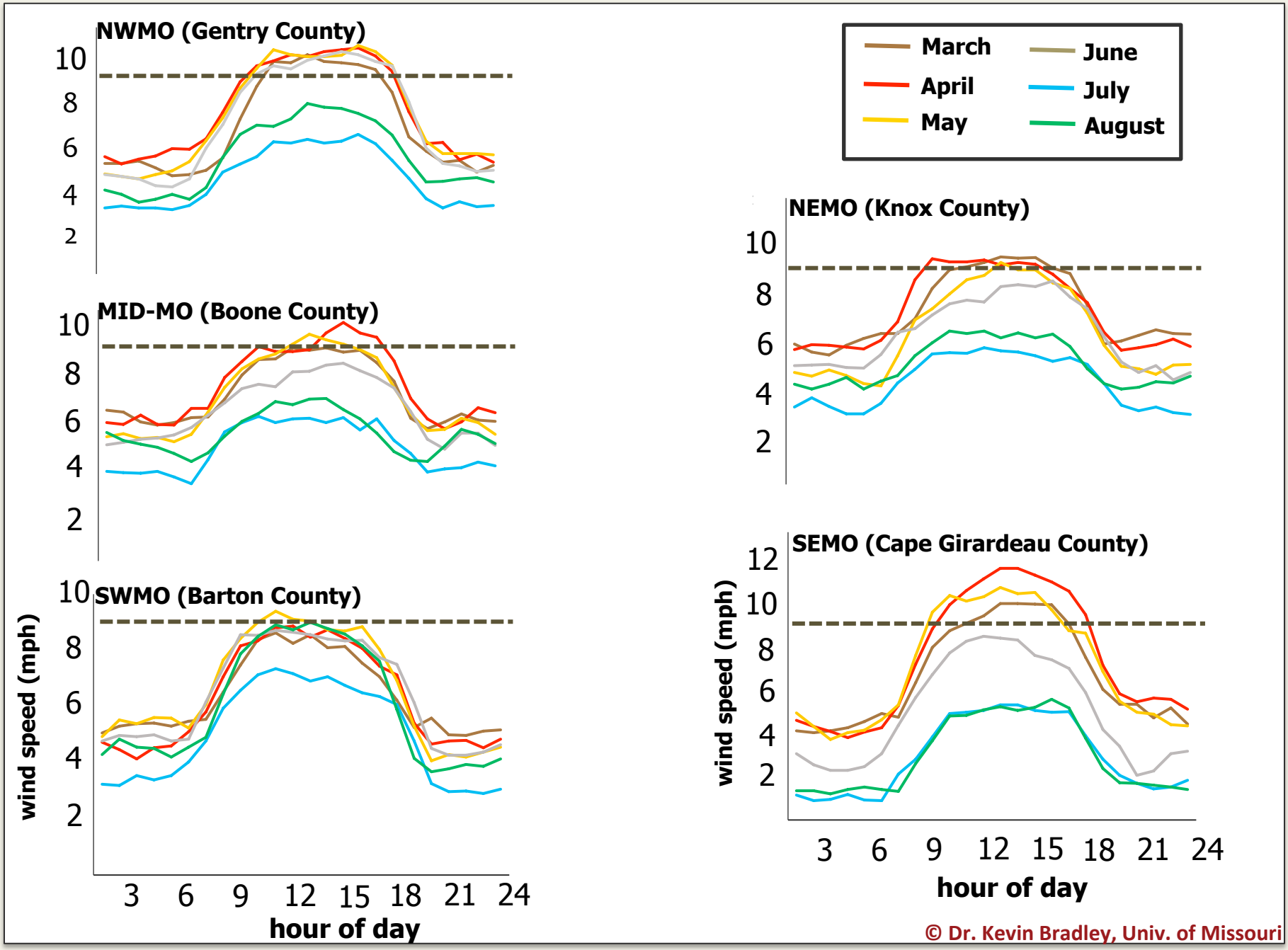
1st rinse water;
2nd rinse ammonia;
3rd rinse water

48 Bu/A

Off-Target Movement: Physical Drift

Wind can move herbicide particles off-target; avoid application in the afternoon, especially in late spring when speeds average >9 mph

Average hourly wind speeds (mph) (Missouri, 2000-2014)



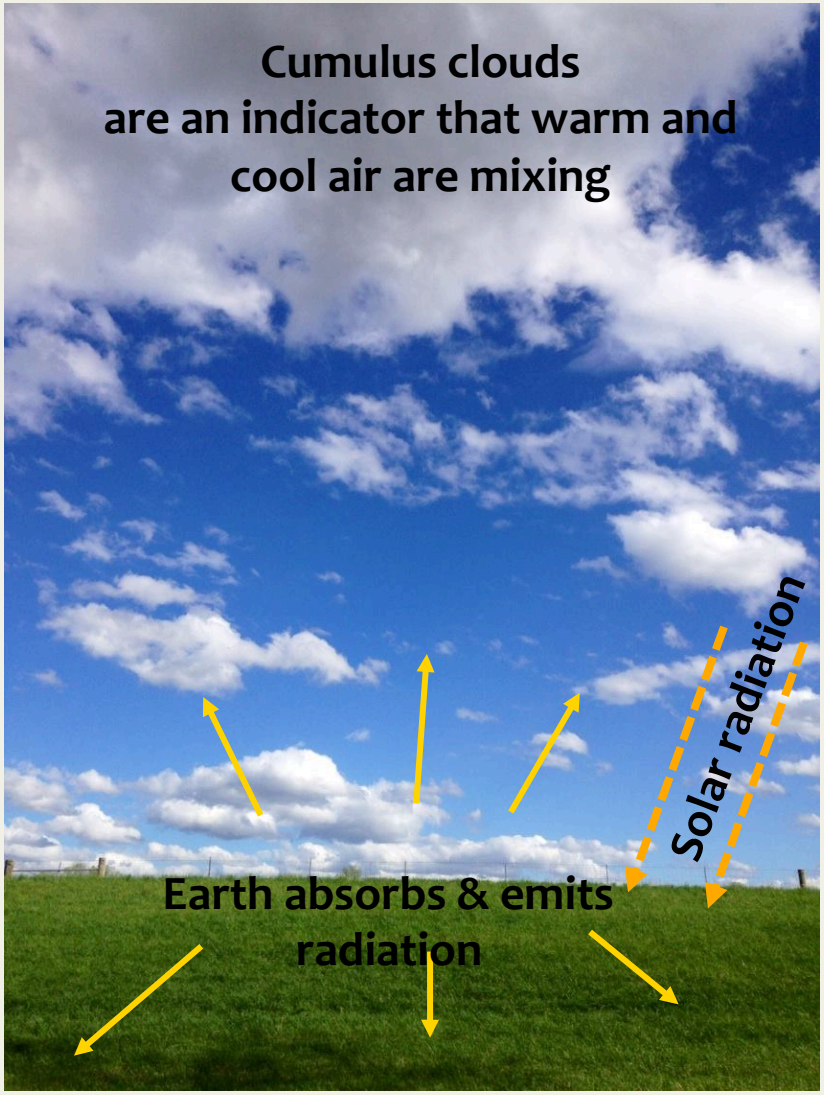
Off-Target Movement: Herbicide Volatility

- Herbicide volatility can play a role in drift.
- Risk of volatility increases when application occurs during a temperature inversion, when cool air gets trapped below warm air at dusk/dawn.
- Small herbicide particles may get trapped in the stable air mass and larger particles may not be absorbed by the plant due to the high humidity. This may allow large particles the opportunity to vaporize from the target surface and move in the air.

Understanding Temperature Inversions

FIRST, under normal conditions:

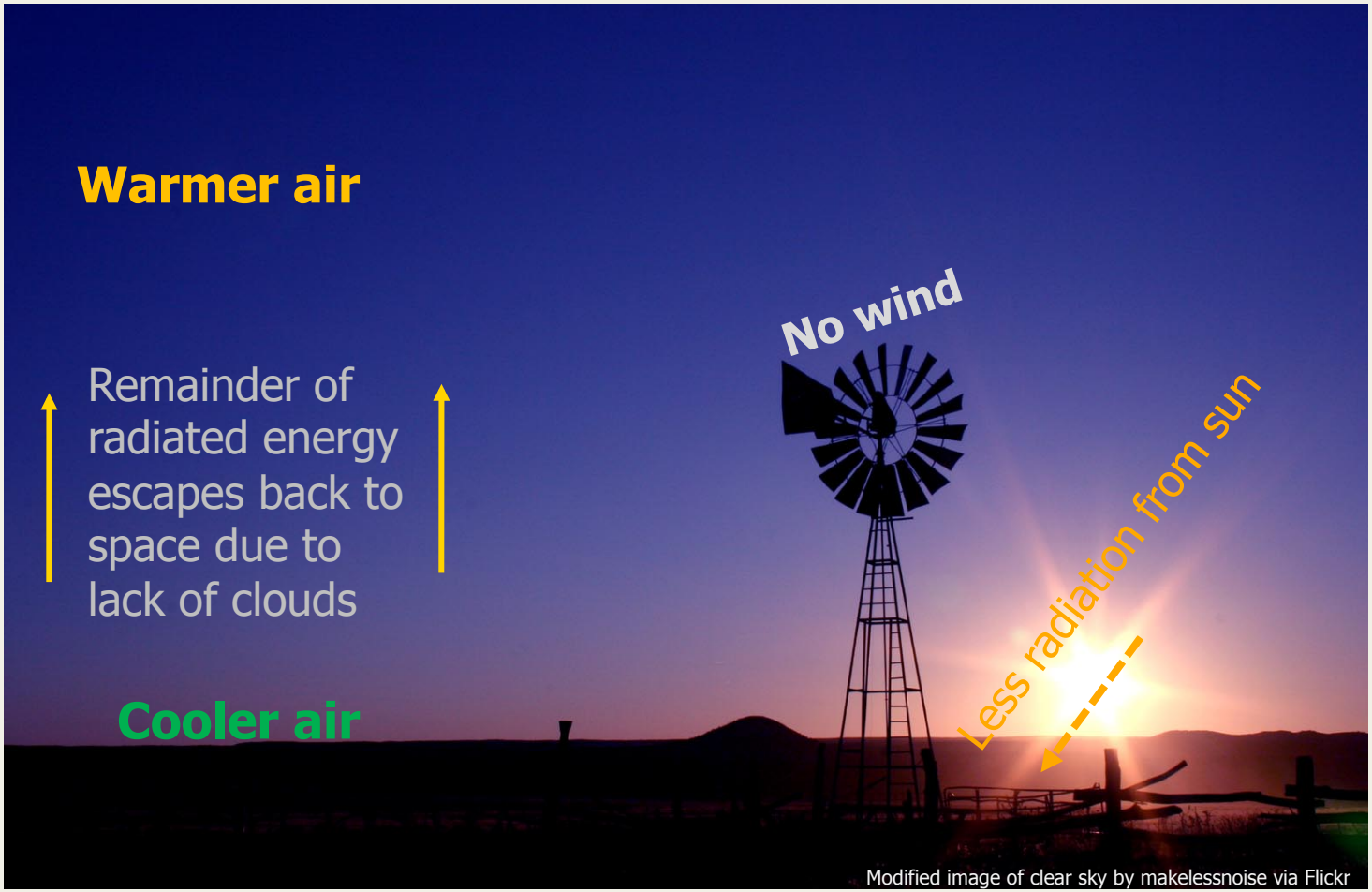
- As the earth's surface warms, air near the surface begins to warm, becoming less dense than cool air, and rises
- The rising warm air mixes with the cooler air, producing wind as the cooler air sinks towards the surface
- The air near the surface is warmed and rises—a constant shuffle



Understanding Temperature Inversions

The Start of an Inversion:

- Earth's surface stops emitting energy as it cools
- Air near the surface is no longer being warmed and does not rise
- The cool air settles below the warm air in a stable formation



Understanding Temperature Inversions

Indicators of Temperature Inversions:

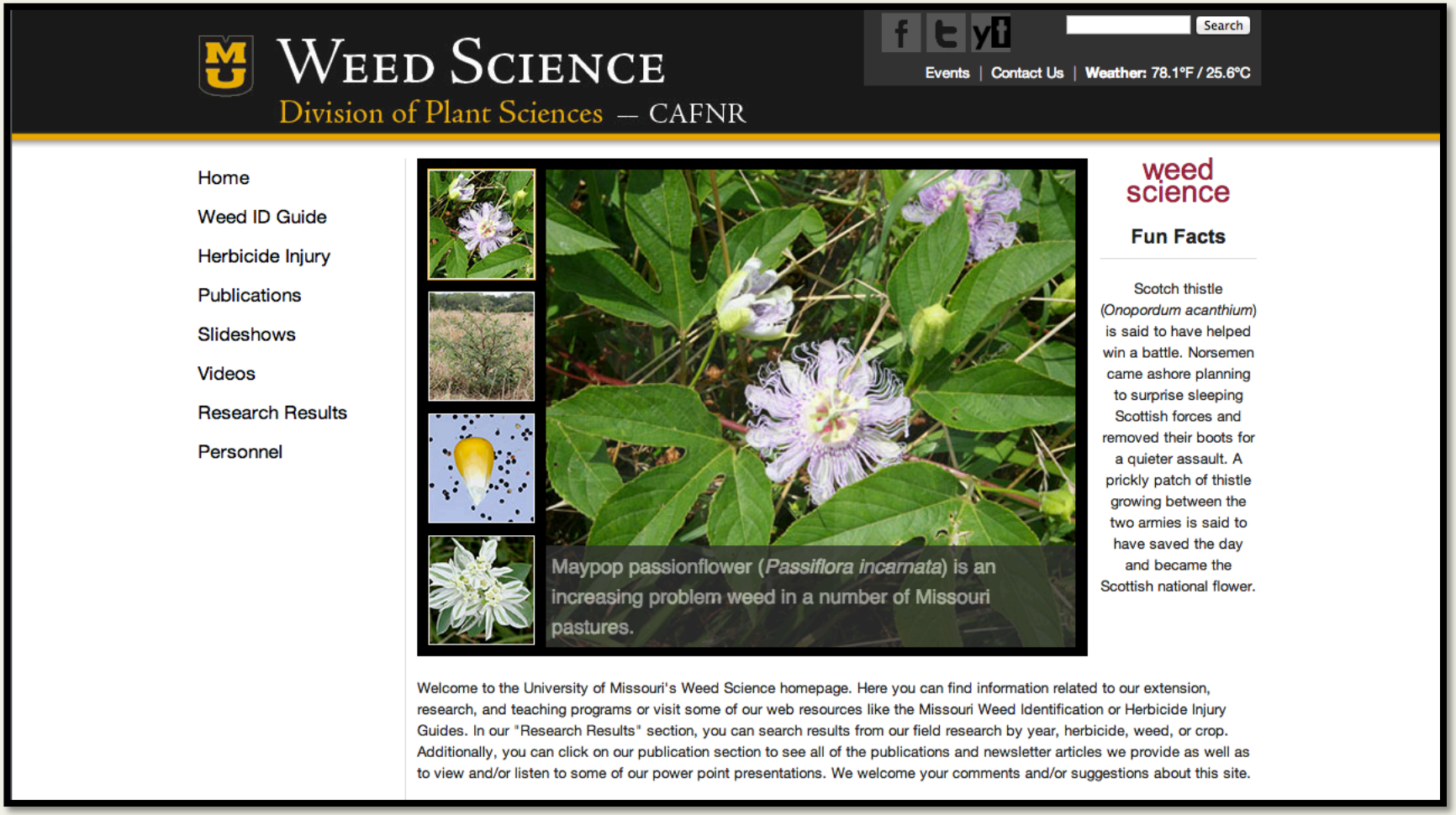
- Wind speeds < 2-3 mph
- Lack of cloud cover at dusk and/or early dawn
- Dew or frost present, low-lying fog

Conclusions: Off-Target Herbicide Movement

- Proper equipment cleanout is essential; double and triple rinses are necessary following dicamba application

- Wind speeds during mid-spring can average above 9 mph and increase the risk of drift. Take time to verify the direction of the wind and identify the crops downstream of it

- Temperature inversions increase the risk of herbicide volatilization; learn to recognize the signs of these weather patterns



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