



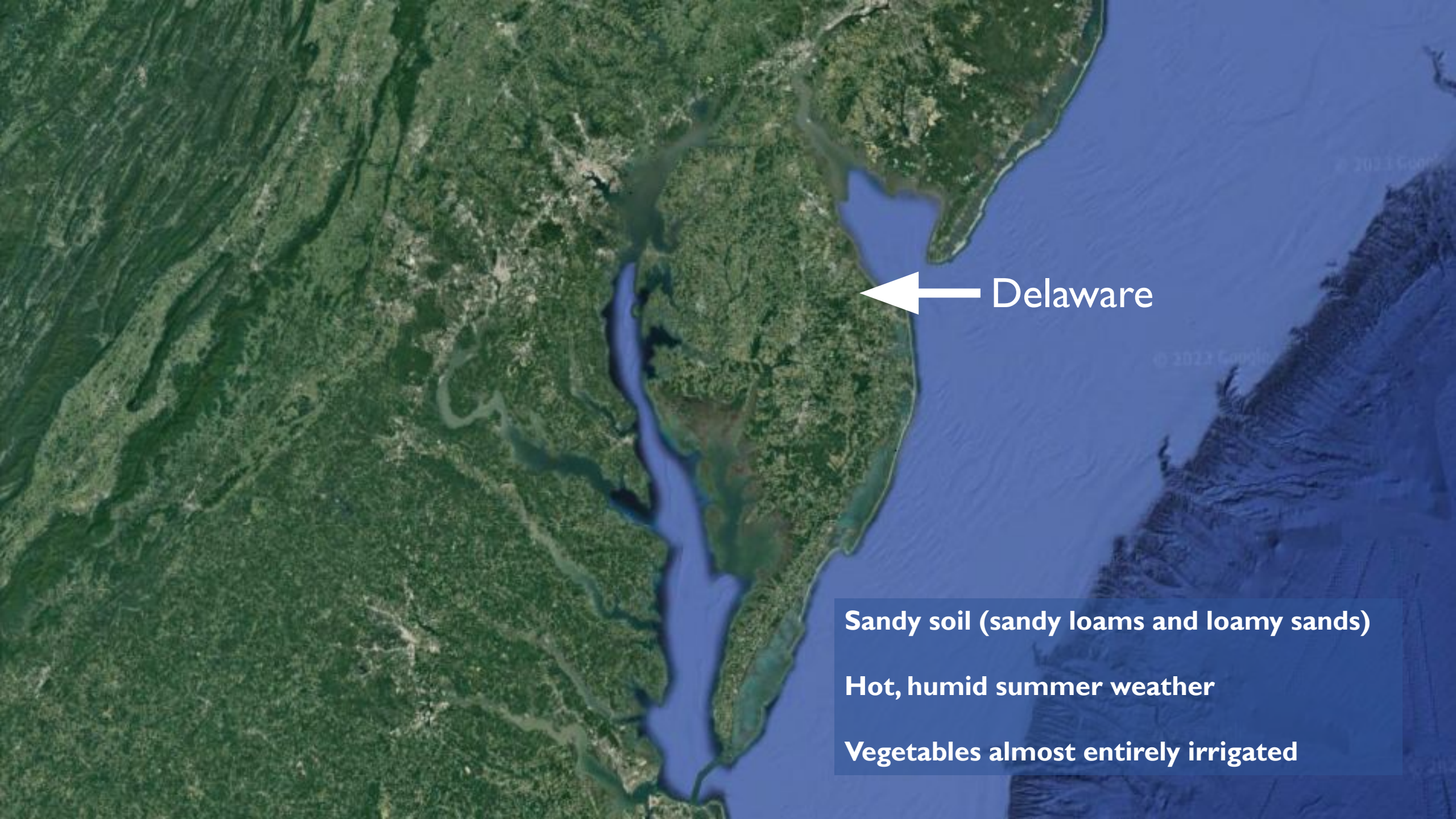
Lettuce for Hot Weather: Effects of Variety, Mulch, and Shade

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Dela-Where?





← Delaware

Sandy soil (sandy loams and loamy sands)

Hot, humid summer weather

Vegetables almost entirely irrigated

Avoiding Heat-Induced Quality Problems in Lettuce

- High temperatures promote flowering (bolting)
- High temperatures cause bitter flavor to develop



Bolting occurred in most varieties planted in a fall trial in 2012. This trial was planted on August 15.

Avoiding Heat-Induced Quality Problems in Lettuce

Heat Tolerant Varieties

Tested in trials in:
2012, 2018, 2019, 2023, 2024



Shade Cloth

Tested in trials in:
2018, 2019, 2023



White or Silver Mulch

Tested in trials in:
2019, 2023, 2024



Heat Tolerant Lettuce Varieties



June 12, 2023



July 5, 2023



July 3, 2024



July 11, 2024

2023 Trials

14 varieties

White mulch, 30% black shade

Transplanted June 5 and June 22

Harvested early July and early August

2024 Trials

28 varieties

White & silver mulch, no shade

Transplanted June 6 and July 10

Harvested early July and mid August

Heat Tolerant Lettuce Varieties

Flavor Ratings for Lettuce Varieties Transplanted on June 5 and Harvested in Early July

Variety Name	Type	Average Flavor Rating*	
Skyphos	Butterhead, Red	1.04	a**
Muir	Batavia, Green	1.08	ab
Nevada	Batavia, Green	1.13	abc
Jericho	Romaine	1.17	abc
Salanova Red Tango	One-Cut, Red	1.33	abc
Sunland	Romaine	1.38	abc
Salanova Red Butter	On-Cut, Red	1.42	bcd
Verigo	One-Cut, Green	1.46	cde
Rubygo	One-Cut, Red	1.75	def
Salanova Green Oakleaf	One-Cut, Green	1.79	efg
Adriana	Butterhead, Green	1.92	fg
Starfighter	Leaf, Green	2.04	fg
Salanova Green Butter	One-Cut, Green	2.13	g
Red Cross	Butterhead, Red	3.21	h



*Flavor was rated on a 1-4 scale with ratings 1 and 2 having marketable flavor and 3 and 4 being un-marketable.

**Averages followed by the same letter are not statistically different from one another.

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Only Muir and Nevada produced marketable lettuce when transplanted on June 22 and harvested in early August.

*Flavor was rated on a 1-4 scale with ratings 1 and 2 having marketable flavor and 3 and 4 being un-marketable.

**Averages followed by the same letter are not statistically different from one another.

Heat Tolerant Lettuce Varieties

Flavor and Bolting for Lettuce Varieties Transplanted on June 6 and Harvested in Early July

	Silver		White	
	% Bolted	Flavor	% Bolted	Flavor
Baja	17	1.0	6	1.0
Kalura	0	1.1	0	1.1
Nevada	6	1.1	0	1.1
Smile	50	1.0	44	1.2
Muir	0	1.1	0	1.2
Sparx	39	1.1	33	1.3
Skyphos	0	1.1	0	1.3
Panisse	39	1.3	33	1.2
Mikola	0	1.0	0	1.5
Slogun	22	1.5	22	1.1
Hanson Red	0	1.3	0	1.3
Victoria Batavian	11	1.5	6	1.2
Salnova Red Tango	0	1.6	0	1.2
Sunland	6	1.4	0	1.4
Magenta	6	2.0	11	1.0
Chalupa	0	1.5	0	1.6
Bambi	50	1.9	56	1.2
Galisse	11	1.7	22	1.5
Romulus	22	1.6	6	1.6
Ear of the Devil	50	1.6	50	1.8
Vulcan	50	1.2	50	2.3
Sangria	50	1.6	50	2.3
Winter Density	17	2.3	6	1.8
Saragossa	0	2.6	0	1.9
Jericho	50	2.1	44	2.5
Green Star	50	2.7	44	2.5
Tropicana	50	2.2	50	3.1
Bunyards Matchless	100	NA	100	NA



Baja, Kalura, Nevada, Muir, Skyphos, Mikola, Hanson Red, Salanova Red Tango and Sunland

Using Shade Cloth and Mulch in Lettuce

Mulch Treatments

Bare Ground

Black

White

Silver

Shade Treatments

30% Black Shade Cloth

No Shade

Variety Treatments

Muir

Green Saladbowl

Skyphos

Alkindus

Transplanted

June 5, 2023

July 20, 2023



Using Shade Cloth and Mulch in Lettuce

Harvest Dates

July 6 & 13

September 1 & 18

Harvest Measurements

Plant Weight

Bolting

Flavor

Microclimate

Monitored soil and air temp in Trial 2



Using Shade Cloth and Mulch in Lettuce

Treatment Effects on Plant Weight

Effect of Mulch		Effect of Shade		Effect of Variety	
Treatment	Plant Wt (g)	Treatment	Plant Wt (g)	Treatment	Plant Wt (g)
Silver	201 a	No Shade	189 a	Green Saladbowl	205 a
Black	173 b	Shade	151 b	Muir	199 a
White	162 c			Skyphos	179 b
Bare	144 d			Alkindus	96 c
<i>p-value <0.0001</i>		<i>p-value <0.0001</i>		<i>p-value <0.0001</i>	

All mulch colors separated statistically.

Silver produced the biggest plants and bare ground produced smallest plants.

No shade produced bigger plants than shade.

Green Saladbowl and Muir produced the biggest plants.

Alkindus produced the smallest plants.

Using Shade Cloth and Mulch in Lettuce

Treatment Effects on Flavor Rating

Effect of Mulch		Effect of Shade		Effect of Variety	
Treatment	Plant Wt (g)	Treatment	Plant Wt (g)	Treatment	Plant Wt (g)
Silver	1.2 a	No Shade	1.4 a	Skyphos	1.2 a
White	1.4 b	Shade	1.5 a	Muir	1.2 a
Black	1.5 c			Green Saladbowl	1.6 b
Bare	1.7 c			Alkindus	1.8 c
<i>p-value <0.0001</i>		<i>p-value 0.5775</i>		<i>p-value <0.0001</i>	

Silver produced the least bitter lettuce.

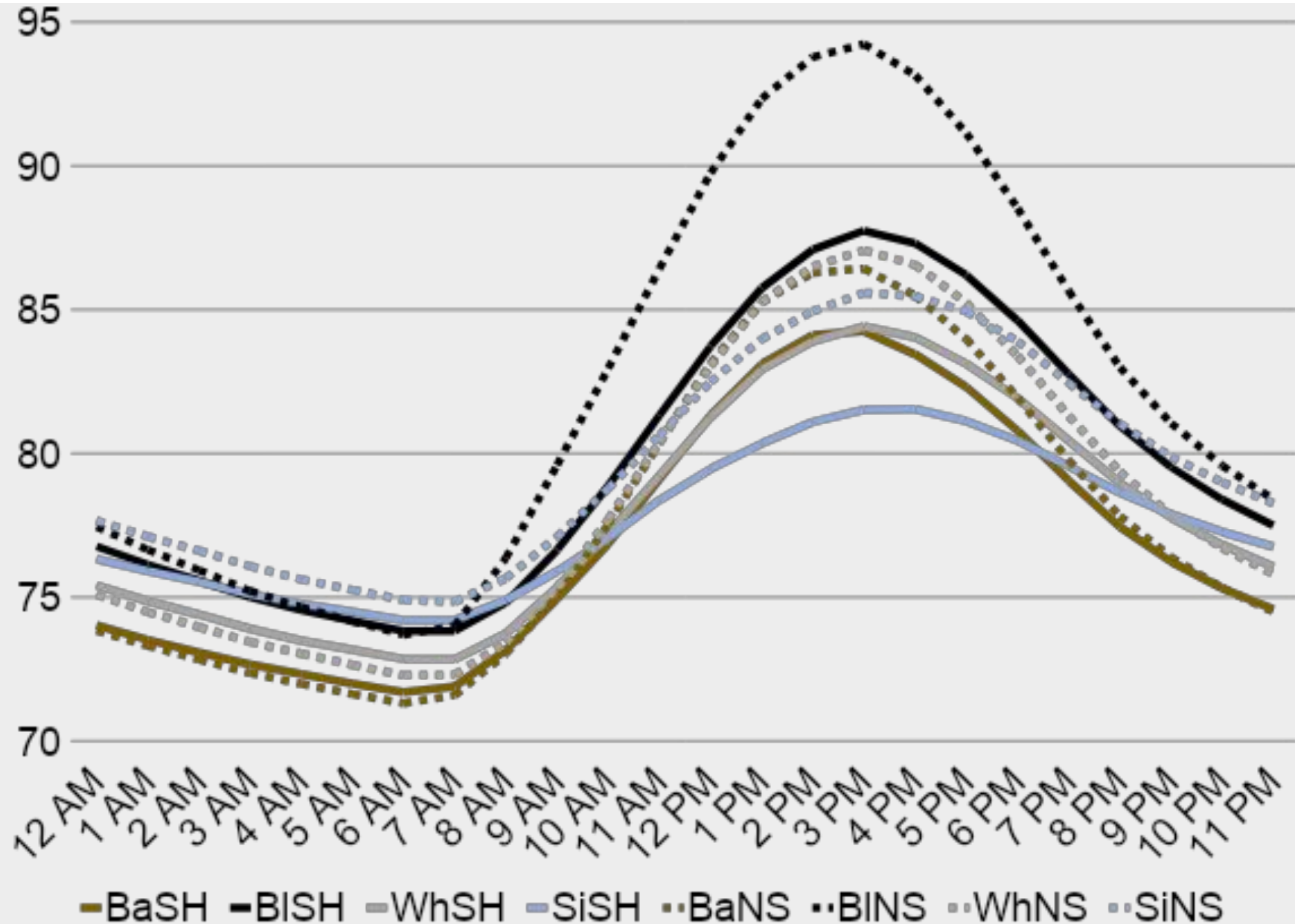
Black & bare ground produced the most bitter lettuce.

Shade treatment did not affect lettuce flavor.

Skyphos and Muir produced the least bitter lettuce.

Alkindus produced the most bitter lettuce.

Using Shade Cloth and Mulch in Lettuce – Soil Temp Effect



Avoiding Heat-Induced Quality Problems in Lettuce

Heat Tolerant Varieties

Tested in trials in:
2012, 2018, 2019, 2023, 2024

Some varieties have significantly lower levels of bolting and bitter flavor development.

The effect of variety is statistically significant and meaningful in the “real world”.



Shade Cloth

Tested in trials in:
2018, 2019, 2023

In 2018 and 2019 trials, shade cloth reduced bitter flavor but increased bolting.

In 2023 trials, shade did not impact bolting or bitterness.



White or Silver Mulch

Tested in trials in:
2019, 2023, 2024

White and silver mulch reduced bolting and bitterness in 2019 and 2023 trials. White had lower bolting than silver in July-planted 2024 trial.



Summer Lettuce Challenges

Starting Transplants



Not Bolted ≠ Tasty



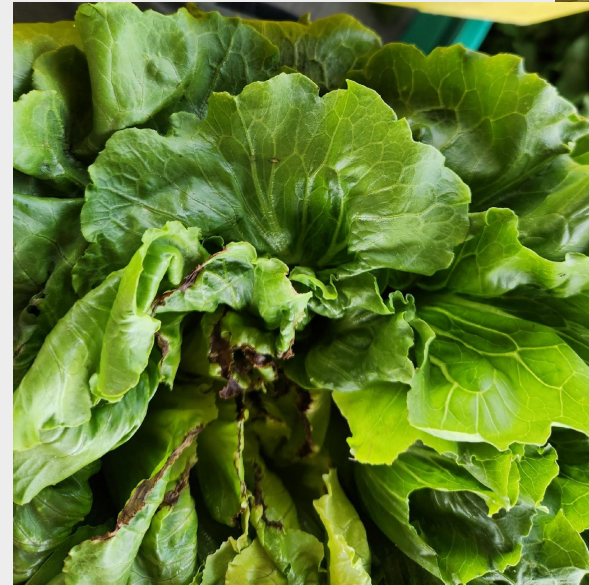
Physiological Disorders



Thrips



Mohammad Mirnezhad, Leiden University,
Bugwood.org



Thank You!

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**Developing Practices to Minimize High
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2022-2025**

Vegetable Program Seasonals

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Lyndsie Mikkelsen, Vegetable & Fruit Agent

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