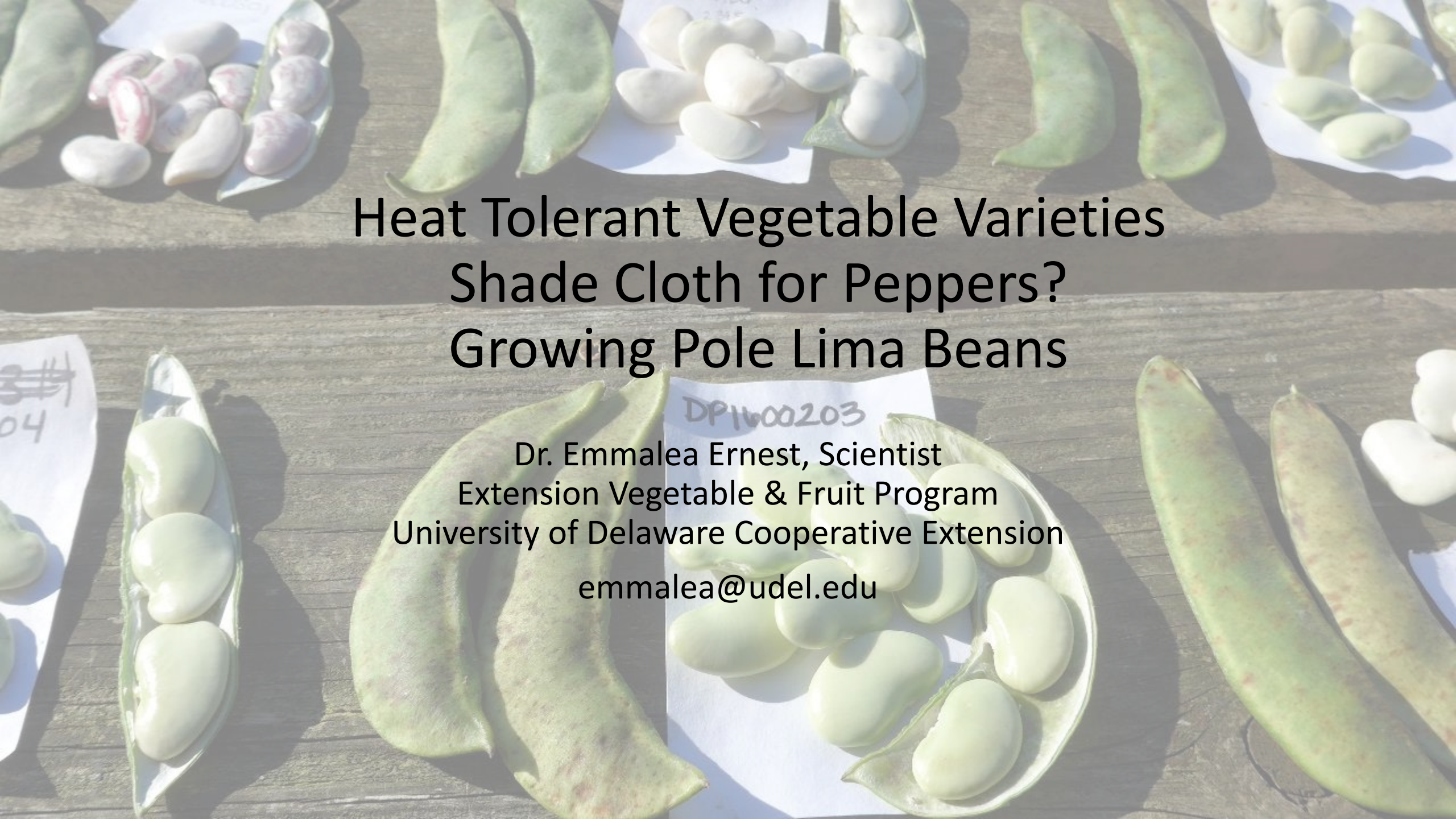

Heat Tolerant Vegetable Varieties
Shade Cloth for Peppers?
Growing Pole Lima Beans

Dr. Emmalea Ernest, Scientist
Extension Vegetable & Fruit Program
University of Delaware Cooperative Extension

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Heat Tolerance Differences Between Crops

Cool Season Crops

Images by E Ernest.

Heat Tolerance Differences Between Crops

Warm Season Crops

Heat Tolerance Differences Between Crops

Crops with Potential for Improved Heat Tolerance

Images by E Ernest.

Heat and Drought Stress Interact

Heat Stress & Drought Stress

→Often occur together

→Heat stress exacerbates drought stress and vice versa

→Physiological effects of heat and drought are distinct

Drought Stress

→Primary physiological effect is decrease in photosynthesis resulting from stomates closing

Heat Stress

→Primary physiological effects are membrane disruption and protein denaturation

Synergistic Effect of Drought on Heat Stress

Drought stressed plants close stomates to reduce water loss

Closed stomates → decreased evapotranspiration

Decreased evapotranspiration → higher leaf temperatures

Higher leaf temperatures → increased heat stress

Synergistic Effect of Heat on Drought Stress

High temperatures → high rate of evapotranspiration

Increased evapotranspiration → higher water use by plant

Higher water used by plant → increased chance for plant water deficit

Irrigation can solve the problem of drought stress;

<u>however</u> it can only mitigate the problem of heat stress.

Heat Stress Effects on Broccoli

Temperatures above 86°F during early head formation causes uneven floret development and “rough” heads.

Images by E Ernest.

Heat Stress Tolerant Broccoli

Eastern Crown
Sakata

Millennium
Sakata

& hopefully more from the Eastern Broccoli Project
https://blogs.cornell.edu/easternbroccoliproject/main/production/varieties/

Images by Gordon Johnson, University of Delaware.

Heat Stress Effects on Cauliflower

High temperatures (mid to upper 80s) during head formation and growth cause purpling, ricing, fuzziness or leafiness.

Images by E Ernest.

Successful Spring Varieties 2020

Bishop 64 days
Rijk Zwaan
87% Marketable

Bermeo 62 days
Bejo
80% Marketable

Denali 67 days
Rijk Zwaan
73% Marketable

Images by E Ernest.

Successful Fall Varieties 2019

Candid Charm 80 days
Sakata
95% Marketable

Tended to be a bit fuzzy

Bermeo 95 days
Bejo
86% Marketable

Also a bit fuzzy

Freedom 82 days
Bejo
82% Marketable

Flamenco 88 days
Bejo
78% Marketable

Bishop 93 days
Rijk Zwaan
78% Marketable

Alcala 94 days
Bejo
76% Marketable

Images by E Ernest.

Heat Stress Effects on Lettuce

> High soil temperatures (>80°F) inhibit germination.

> During growth, high temperatures (>80°F) cause bolting and bitterness.

Images by E Ernest.

Heat Tolerant Lettuce Varieties

Dov

Skyphos

Starfighter

Arroyo

Forlina

Salanova® Green Butter
Salanova® Red Butter

Images by E Ernest.

Combining Heat Stress Management Practices

Shade Cloth + HT Varieties

or

Shade Cloth + HT Varieties + White/Reflective Mulch

Images by E Ernest.

Heat Stress Effects on Sweet Corn

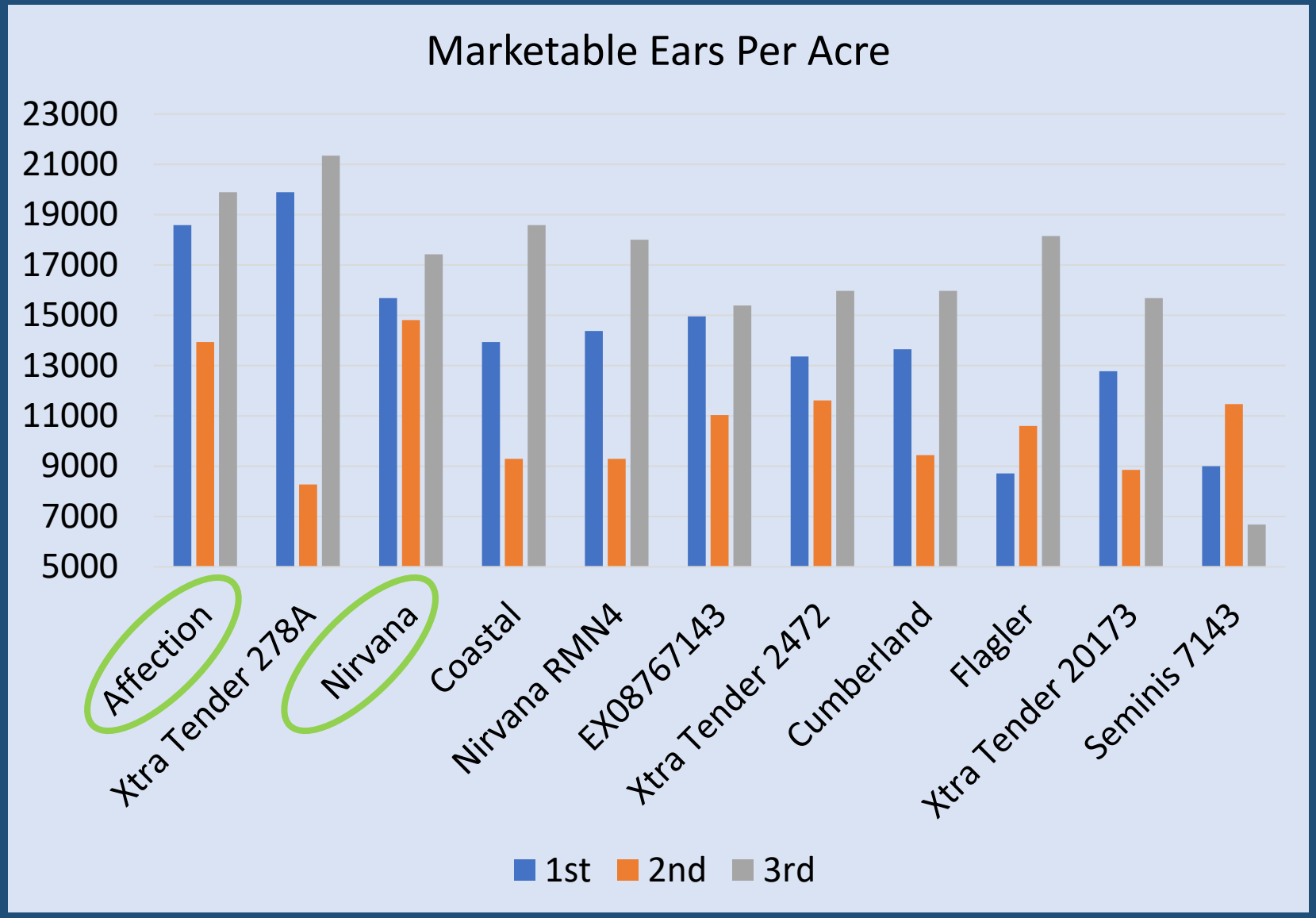
Leaf scald caused by high temperatures.

Reduced ear diameter and poor tip fill.

> Heat susceptible growth stages: pollination to harvest

Images by E Ernest.

Bicolor Supersweet Corn Trials in 2019



Heat Tolerant Sweet Corn Varieties

Bicolor Supersweet

Affection

Nirvana

White Supersweet

Xtra Tender 378A

XTH 3174

White se

Whiteout

Mattapoisette

Images by E Ernest.

Heat Stress Effects on Tomatoes

Flower Abortion; Low/No Fruit Set

> Night temps >70°F inhibit pollination

Images by Gerald Brust, University of Maryland.

Heat Stress Effects on Tomatoes

Internal White Tissue

Yellow Shoulders Ripening Disorder

> High temps during fruit development cause ripening disorders

> Ripening disorders also related to potassium status of fruit and impacted by root health

Images by G Brust, University of Maryland and Purdue University.

Heat Tolerant Tomato Varieties

STM2255

Red Bounty

High Yield
&
Low White Tissue Incidence

Grand Marshall

Red Snapper

Red Mountain

High Yield

Images from seed suppliers.

Heat Tolerant Tomato Varieties

		
Primo Red	Grand Marshall	Mountain Majesty
		
Dixie Red	Red Bounty	Red Mountain
		
Red Deuce	Bella Rosa	Mountain Merit
		
Scarlet Red	Camaro	Biltmore

Images from Gordon Johnson, University of Delaware.

Heat Stress Effects on Snap Beans

Hot **night** temperatures cause the biggest problems

Flowers susceptible to heat damage in the bud stage (in the 10 days prior to opening).

Hot nights cause anther indehiscence (anthers do not open and release pollen).

Hot nights also reduce pollen quality.

Result → fewer seeds per pod, misshapen pods, short pods, pod abortion, delayed harvest

Image by E Ernest.

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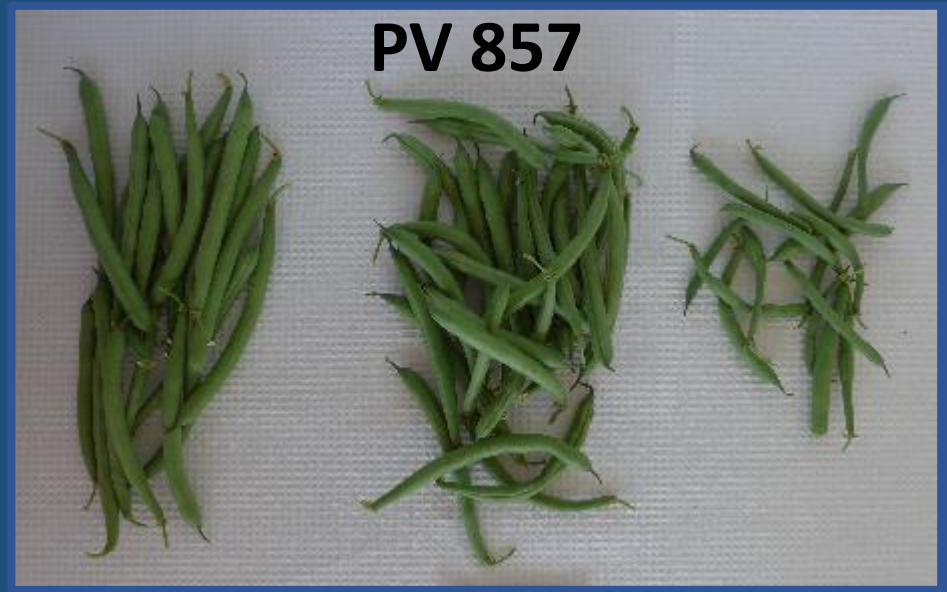
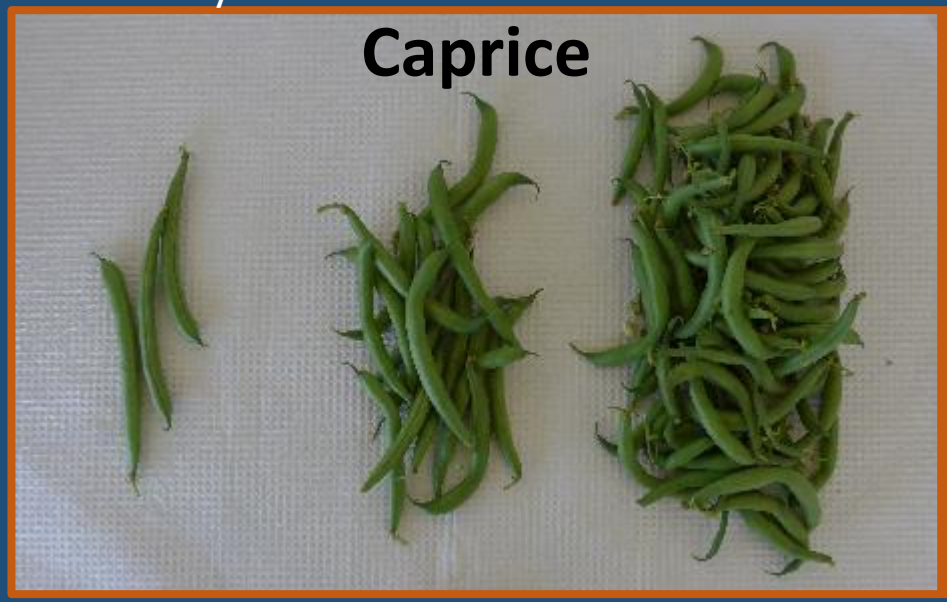




Images by E Ernest.

Heat Tolerant Snap Bean Varieties

PV 857 – Crites Seed
Sieve 3-4
Trialed in 2017, 2018, 2020, 2021

Bridger – HM Clause
Sieve 4-5
Trialed in 2020, 2021

Jaguar – Crites Seed
Sieve 3-4
Trialed in 2021

Usambara – Seminis
Flat podded
Trialed in 2019, 2021
(highest yield in stressed & unstressed trial in 2019)

Images by E Ernest, Jaguar from seed supplier.

Shade Cloth for Bell Peppers

For green bell peppers planted in early June,

30% black shade cloth increased marketable yield:
3x the marketable yield of no shade!

30% black shade cloth increased the % marketable weight from 39% to 67% marketable.

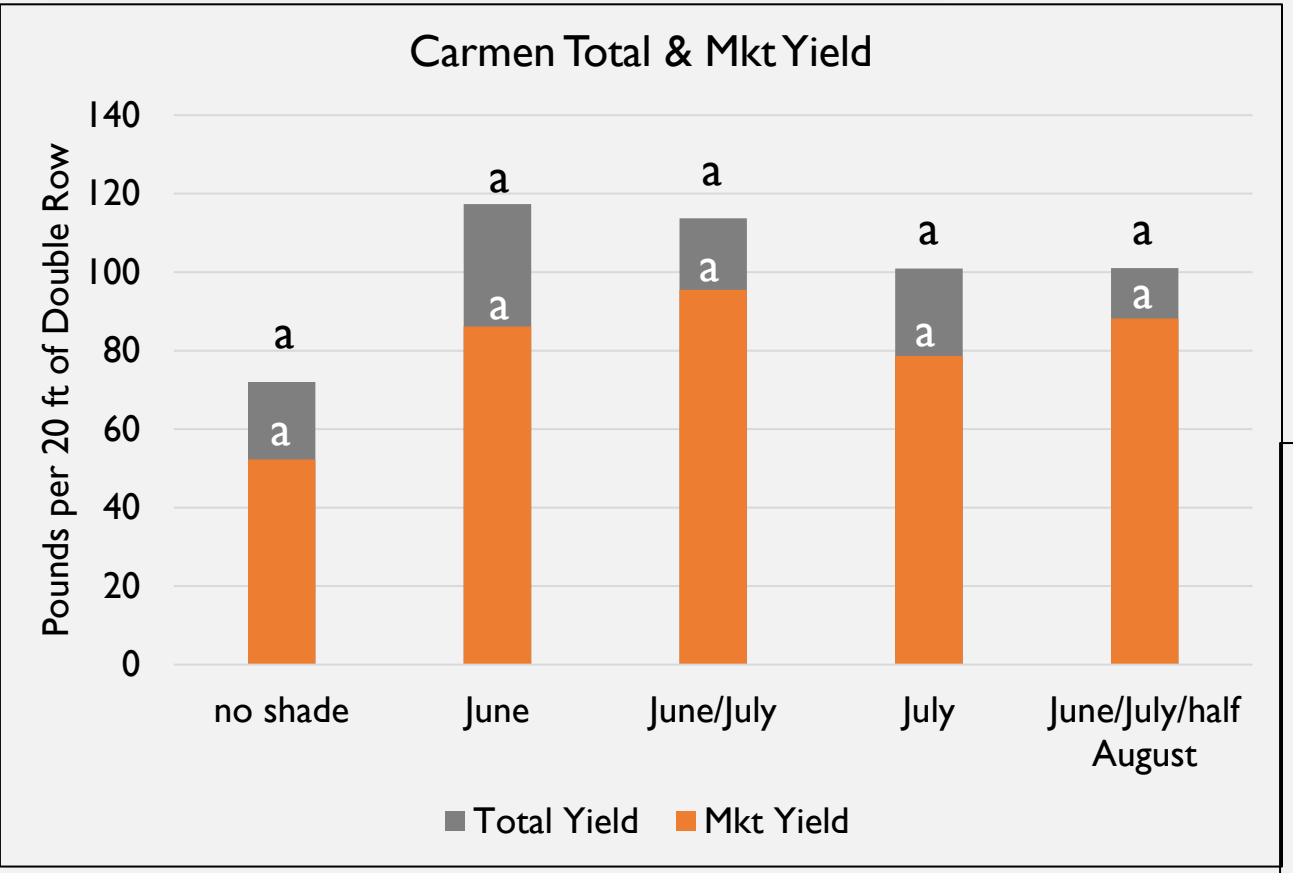
Shade Cloth for Bell Peppers

2021 Experiment

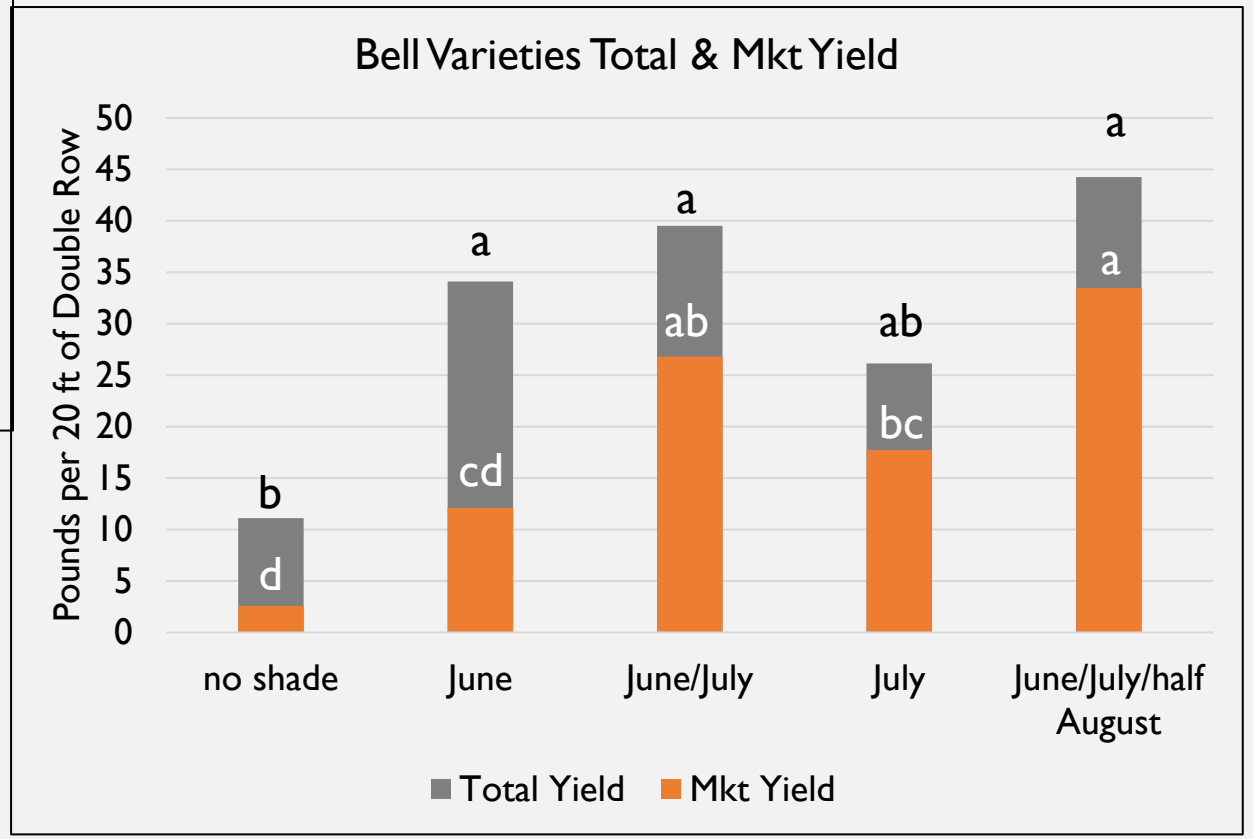
Shade Timing and Variety Effects

no shade	Early Sunsation
June	Mandarin Perfection
June/July	Aristotle
July	
June/July/half August	Carmen

Shade Cloth for Bell Peppers



Shade cloth benefit for all bell varieties but not 'Carmen' the sweet Italian type.



Shade cloth benefits most apparent if applied for June, July and half of August;
June & July most important


DP1600203

Pole Limas Planting

Planting
Start plants in greenhouse
Transplant after danger of frost
4-6’ spacing in-row at least 5’ between rows

Fertility
Use Mid-Atlantic Recommendations as a guideline.
Total N applied depends on season length, rainfall and N fixation opportunity.

Irrigation
Highly recommended, essential on light soils.
Drip irrigation commonly used.
Tubing can be attached to bottom wire.

Days to Harvest
90-100 days to succulent stage harvest
Hand harvest
Pods can be shelled mechanically or by hand

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Pole Limas

Production Practices

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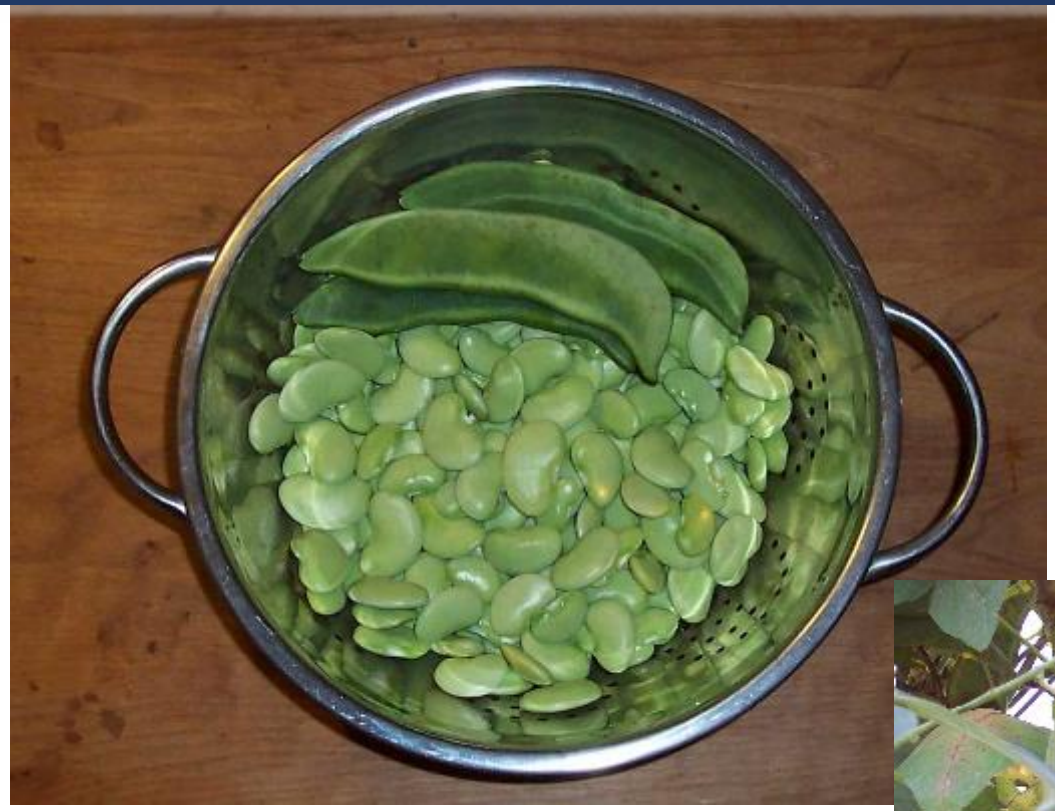


Pole Limas

Production Practices

Trellis
~6 ft tall and sturdy enough to support vines

Usually semi-permanent

Consider spray equipment when planning row spacing (5-10 ft)

Install twine or plastic mesh for plants to climb.

Diseases: Downy Mildew, *Phytophthora phaseoli*

Downy Mildew
Affects pods, racemes & tendrils
Specific to lima bean
Affects all lima types
Dispersed by wind
Overwinters
Phosphonate fungicides very effective

Stinkbugs
Feed on pods
Cause seed damage or pod drop
Limited insecticide options (bifenthrin)

Pests: Stinkbugs

Stinkbugs
Feed on pods
Cause seed damage or pod drop
Limited insecticide options (bifenthrin)

Other Pests
Spider mites, aphids and bean beetles are occasional pests on pole limas.

Lygus bugs can be a problem (major problem in CA).

Potato leafhoppers are not an issue.

Pole Limas Heat Stress

Hot **night** temperatures cause poor pollination.

Causes anther indehiscence (anthers do not open and release pollen

Causes loss of pollen quality

Result → fewer seeds per pod, misshapen pods, short pods, pod abortion, delayed harvest

High temperatures also cause poor seed fill in large seeded limas.

Effects are small seeds, incomplete seedcoats.

Pole Limas Varieties

Pole Limas

Green: Dr. Martin, Big Mama

White: King of the Garden

Speckled: Christmas

Dr. Martin

available from Rohrer's Seed, Vermont Bean Seed

Big Mama

available from Burpee

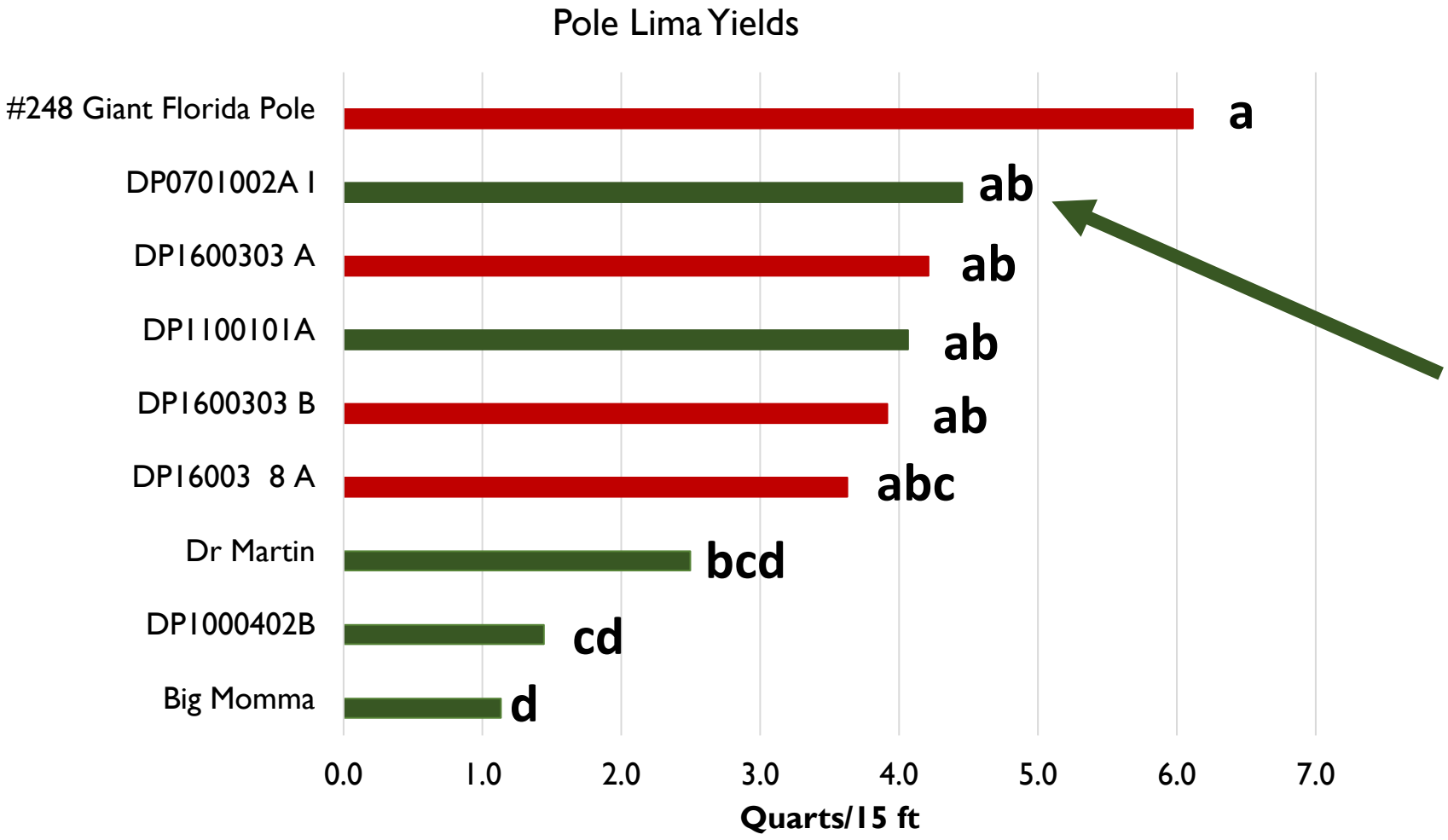
King of the Garden

various vendors

Christmas Lima

various vendors

Pole Limas Breeding Lines



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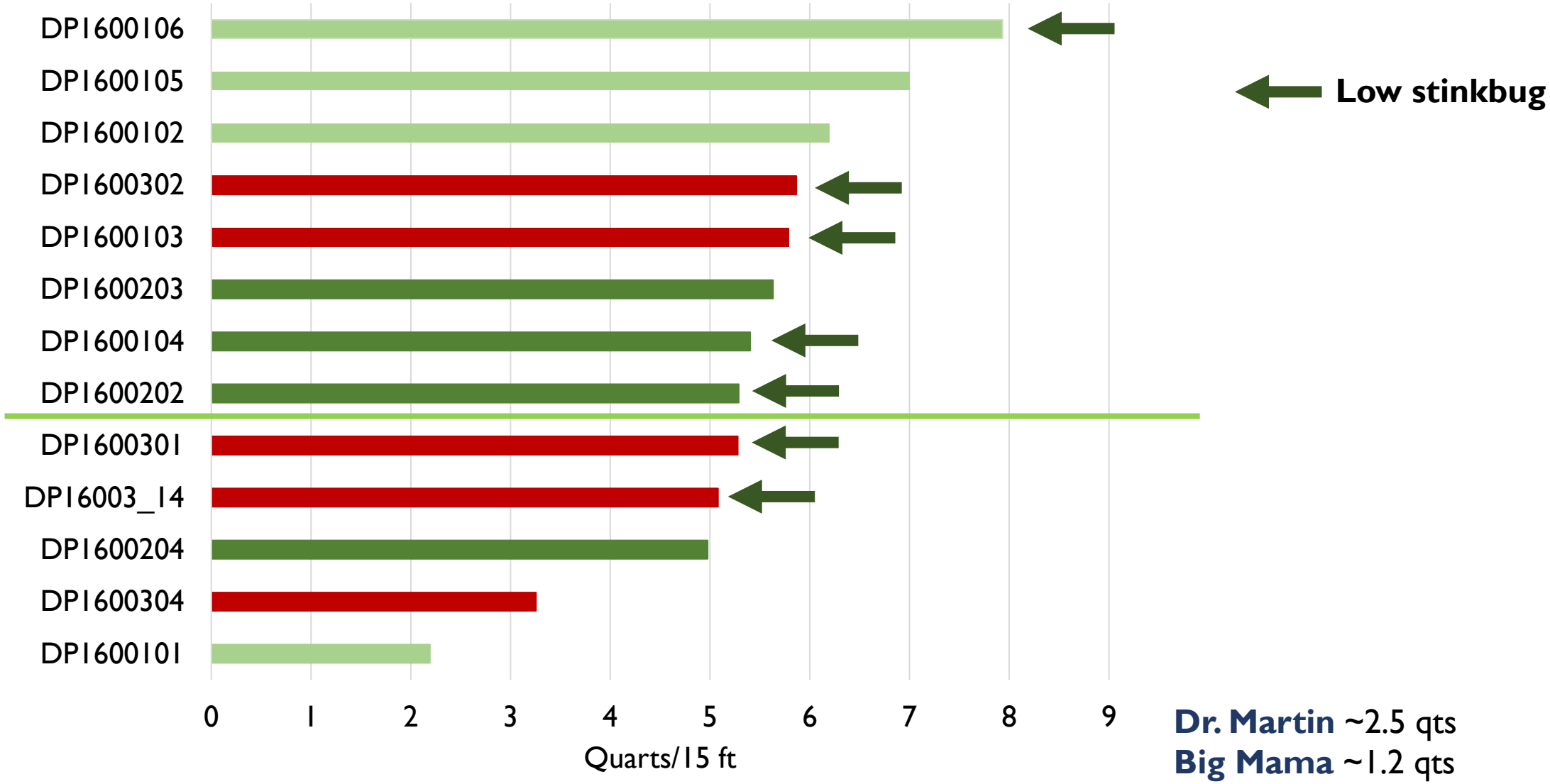
Beautiful and good yield but failed the taste test.

Pole Limas Breeding Lines



Dr. Martin ~2.5 qts

Big Mama ~1.2 qts

Pole Limas Breeding Lines