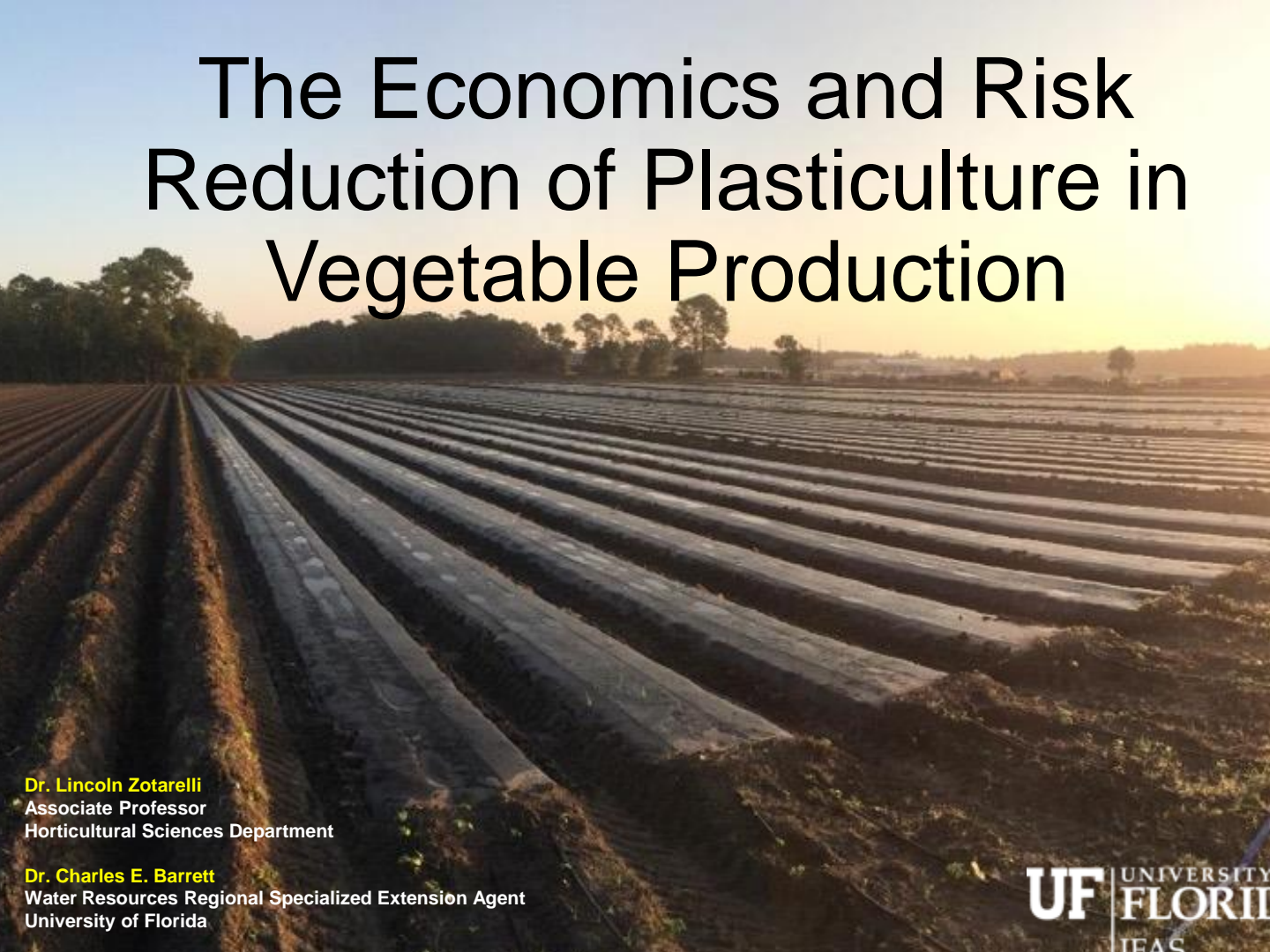


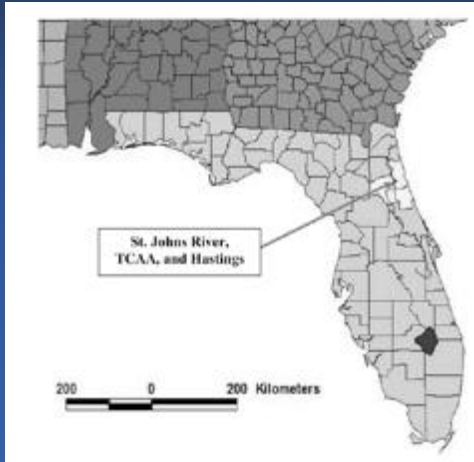
The Economics and Risk Reduction of Plasticulture in Vegetable Production



Dr. Lincoln Zotarelli
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Horticultural Sciences Department

Dr. Charles E. Barrett
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University of Florida

The Tri-County Agricultural Area and St. Johns River

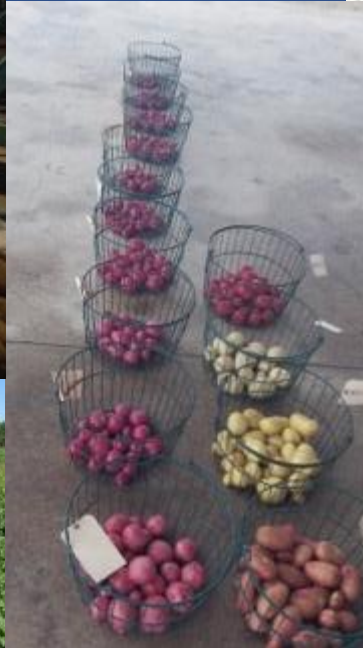


Potato and cabbage



20,300 acres of potatoes
5,500 acres of cabbage

Potato diversity direct from the field



Broccoli and Asian vegetables



2,000 acres of broccoli/corn
??? acres of asian veg.



General Soil Properties

management of water and nutrients challenging

Texture: 95% sand

SOM: Low <1.0 %

Clay layer between 2-10 ft

Shallow water table

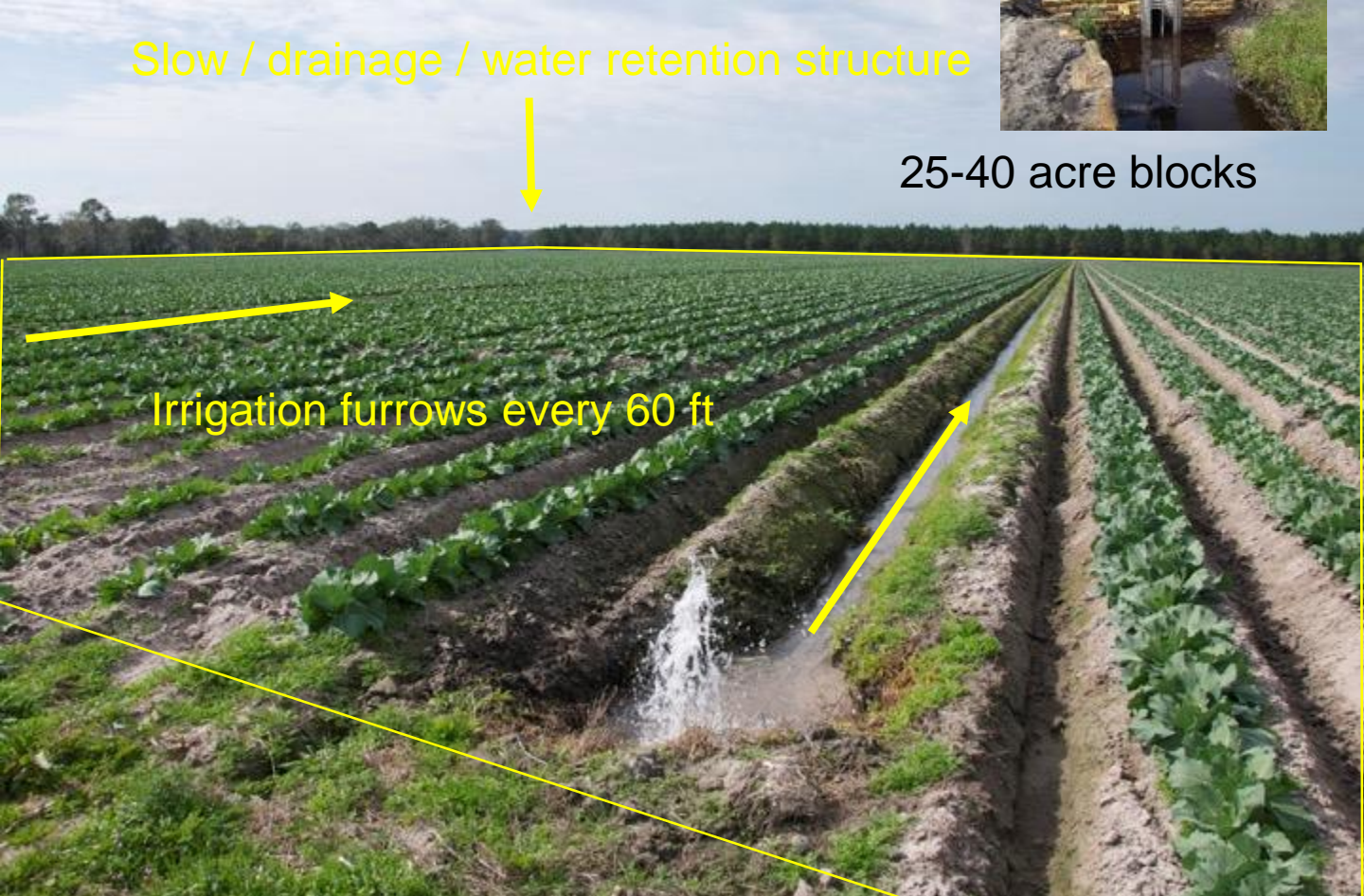


Seepage Irrigation

Slow / drainage / water retention structure



25-40 acre blocks



Irrigation furrows every 60 ft

Seepage Irrigation



Spatial distribution of soil moisture in the root zone and effects on potato maturation



TOXIC ALGAE OUTBREAKS IN FLORIDA

Many of Florida's postcard-perfect blue waters are coming up green and choked with nasty, toxic algae. The culprit behind this environmental and economic crisis? Pollution caused by inadequately treated sewage, manure and fertilizer.



© Bill Yates / CYPix 2005 all rights reserved

Toxic algae bloom in Goodby's Creek at the St. Johns River, Jacksonville, FL. Photo taken on September 14, 2005.

The challenges

- Strategies for irrigation focusing on:
 - Water conservation
 - Water quality
 - Nutrient management
 - Maintain of increase profit



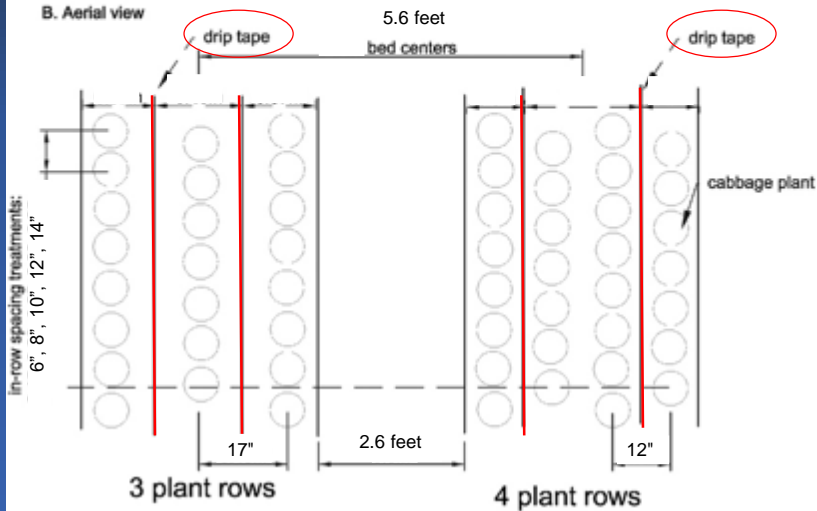
Bareground vs. Plasticulture



A. Transect view



B. Aerial view



In-row spacing (in)	Plant population (plant/ac)	
---------------------	-----------------------------	--

	3-row	4-row
--	-------	-------

6	39,204	52,272
8	29,403	39,204
10	23,522	31,363
12	19,602	26,136
14	16,802	22,402

Seepage: 19,602 plant/ac

Barrett et al 2015. HortScience



Cabbage plant population vs yield

Marketable yield (cwt/acre)

In-row spacing (in)	Winter 2010 ^y	Fall 2011 ^x				Winter 2011	
		3-rows		4-rows		3-rows	4-rows
6	476	365 A	331 A	292 A	176 B		
8	579	484 A	432 B	455 A	287 B		
10	616	471 A	473 A	455 A	441 A		
12	619	432 A	474 A	488 A	440 A		
14	595	476 A	497 A	459 A	489 A		
	Q**	NS	Q**	Q**	L**		

^xRegression analysis for the effect of in-row spacing; L, linear; Q, quadratic, * $P < 0.05$; ** $P < 0.01$; NS, not significant for L or Q.

^yValues followed by the same uppercase letter within each in-row spacing indicate mean marketable cabbage yield was not significantly different ($P \leq 0.05$) when comparing 3-rows and 4-rows for Fall 2011 and Winter 2011 with mean separation by Tukey-Kramer test.

Cabbage plant population vs head weight

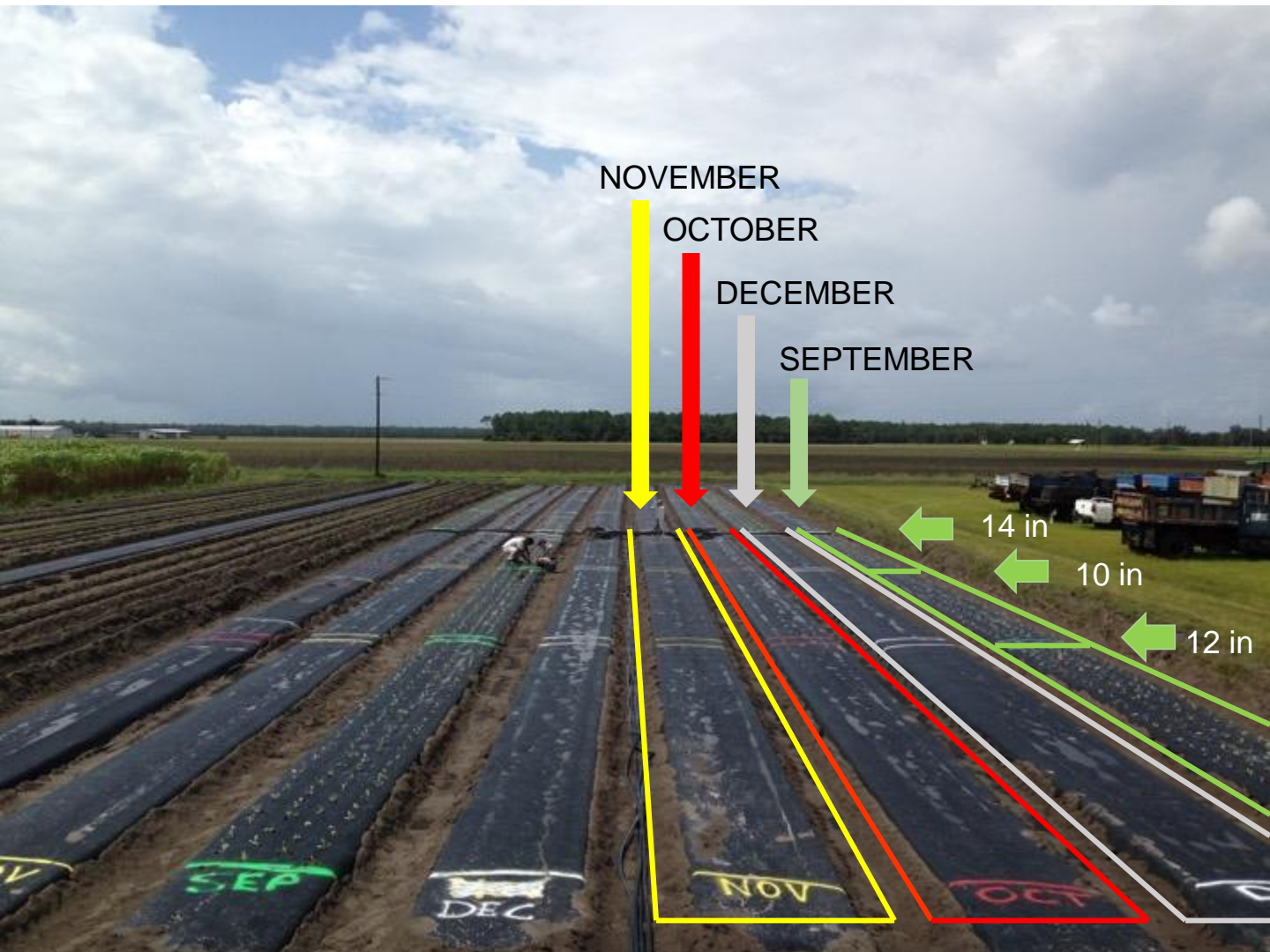
In-row spacing (in)	Head weight (lb/head)			
	Winter 2010		Fall 2011	Winter 2011
	3-rows	4-rows		
6	2.34 A	1.88 B	1.76	1.69
8	2.76 A	2.21 B	2.03	2.08
10	2.87 A	2.66 A	2.22	2.26
12	3.11 A	2.93 A	2.54	2.37
14	3.33 A	3.22 A	2.80	2.66
	L**	L**	L**	L**

*Regression analysis for the effect of in-row spacing; L, linear; Q, quadratic, * $P < 0.05$; ** $P < 0.01$; NS, not significant for L or Q.

*Values followed by the same uppercase letter within each in-row spacing indicate mean marketable cabbage yield was not significantly different ($P \leq 0.05$) when comparing 3-rows and 4-rows for Fall 2011 and Winter 2011 with mean separation by Tukey-Kramer test.

Cabbage planting dates vs. plasticulture





NOVEMBER

OCTOBER

DECEMBER

SEPTEMBER

14 in

10 in

12 in

SEP

DEC

NOV

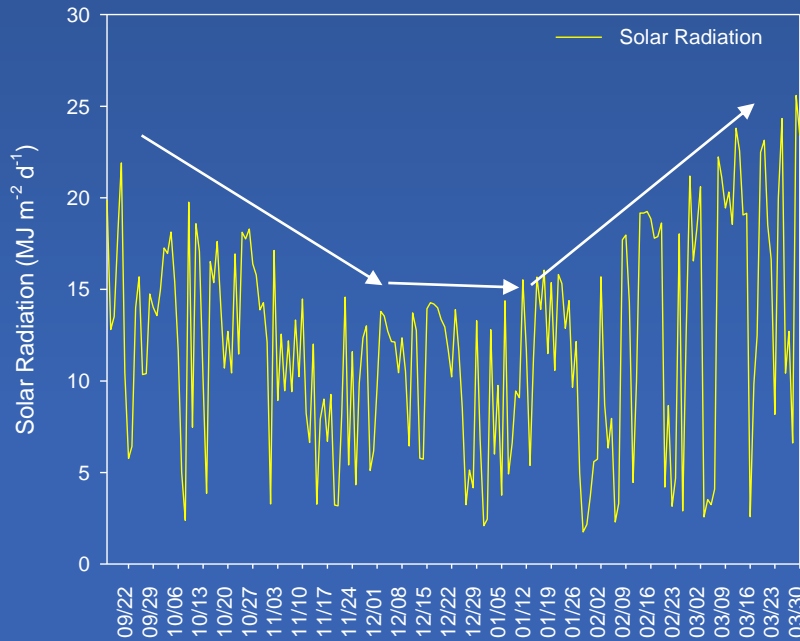
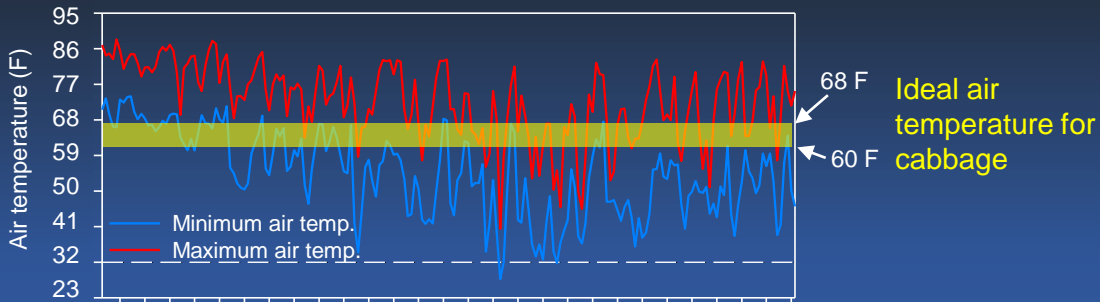
OCT

Planting dates vs plasticulture

Planting Date	Marketable yield (cwt/acre)	
	2013-14	2014-15
SEP	507 b	612 a
OCT	579 a	501 b
NOV	448 c	376 c
DEC	418 c	628 a
Plant spacing		
10 inches	454	483
12 inches	484	549
14 inches	528	556
	L*	ns

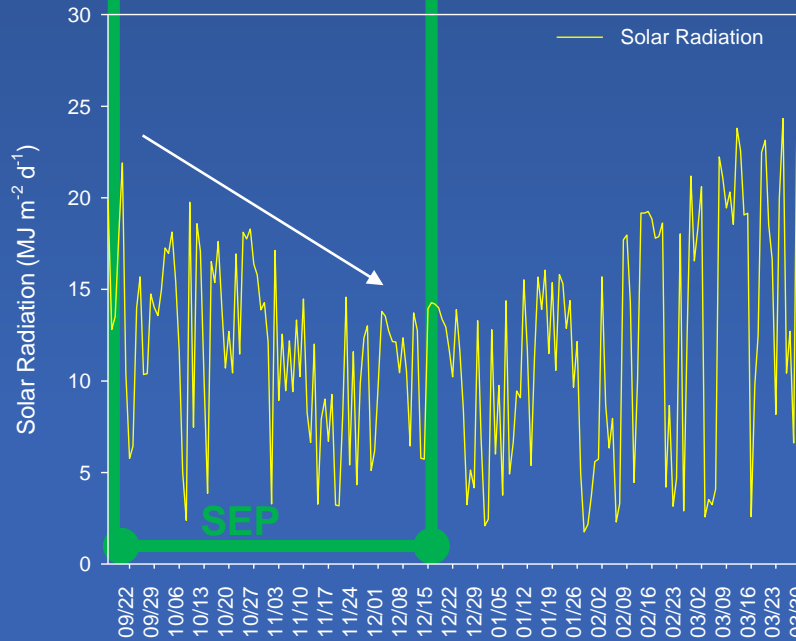
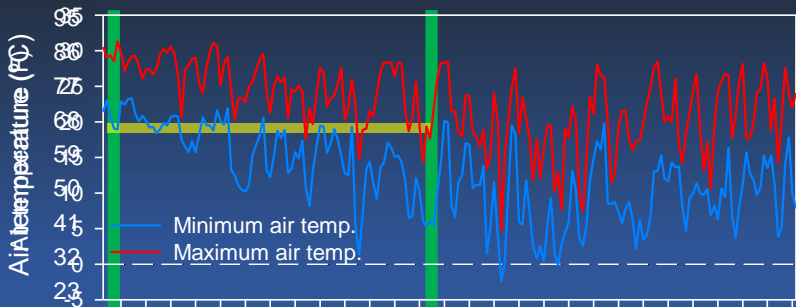
Weather conditions 2013-14 Growing Season

Overall Weather conditions



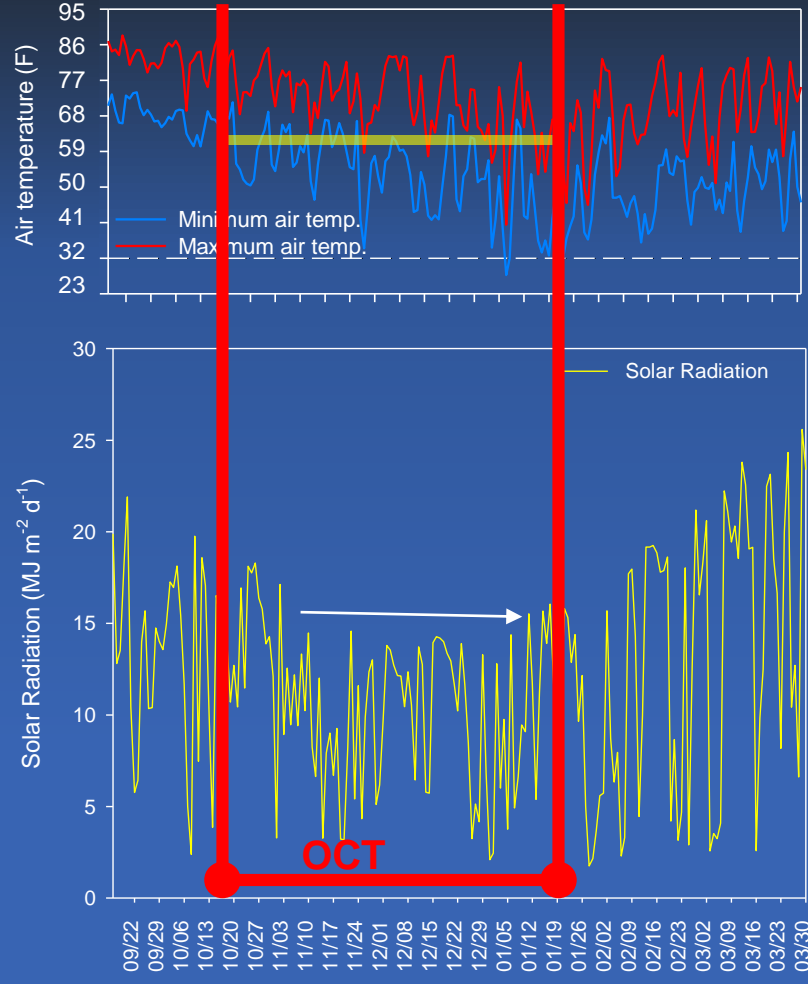
Weather conditions 2013-14 Growing Season

Average air temperature between planting and harvest 67 °F

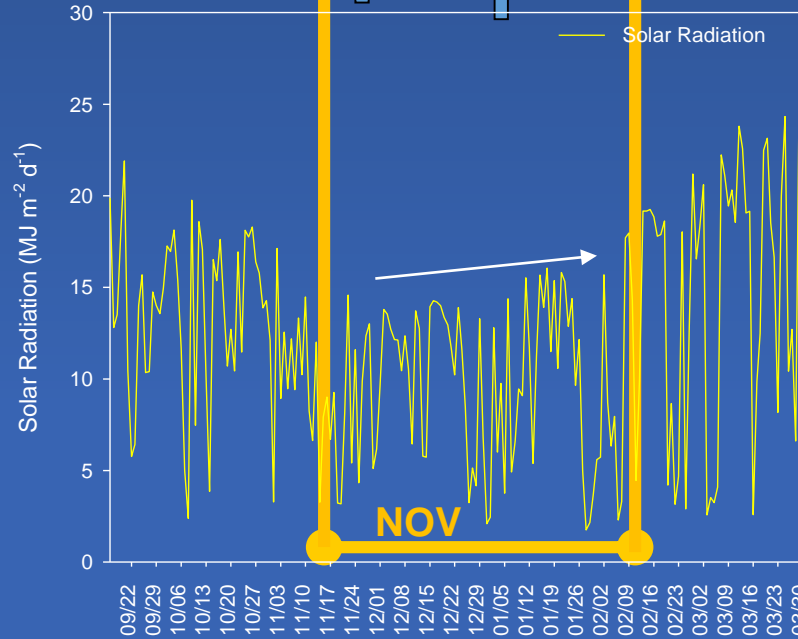
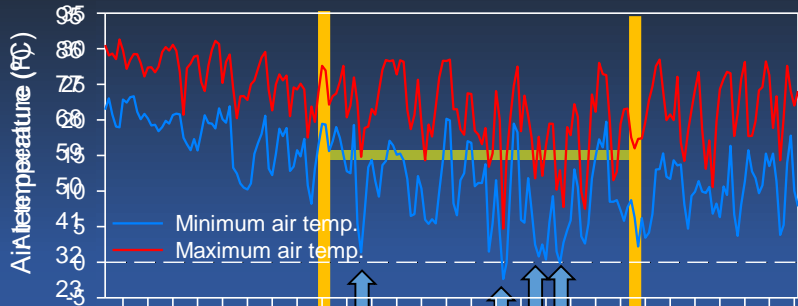


Weather conditions 2013-14 Growing Season

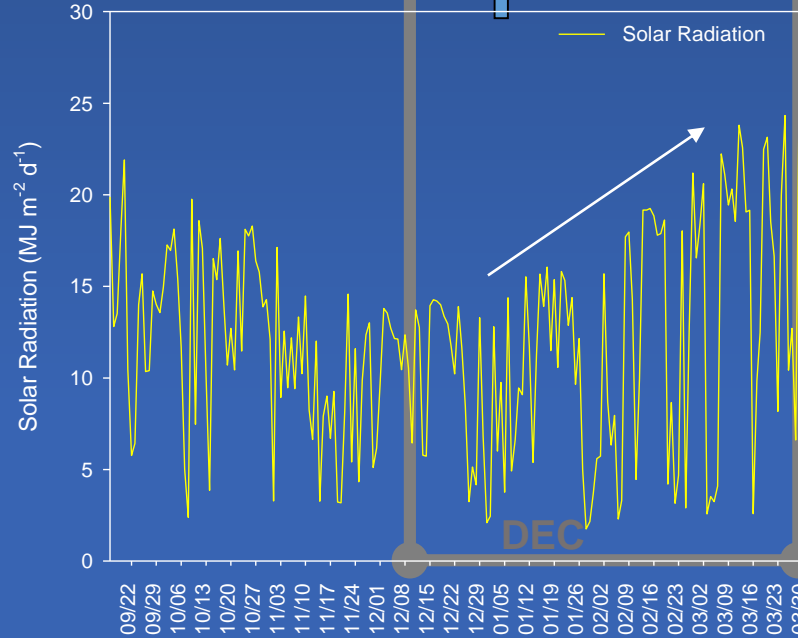
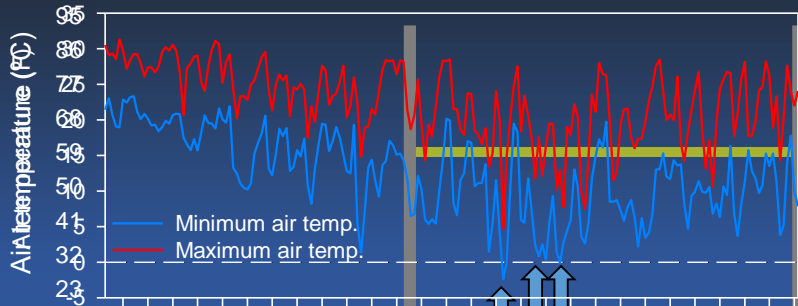
Average air temperature between planting and harvest 60 F



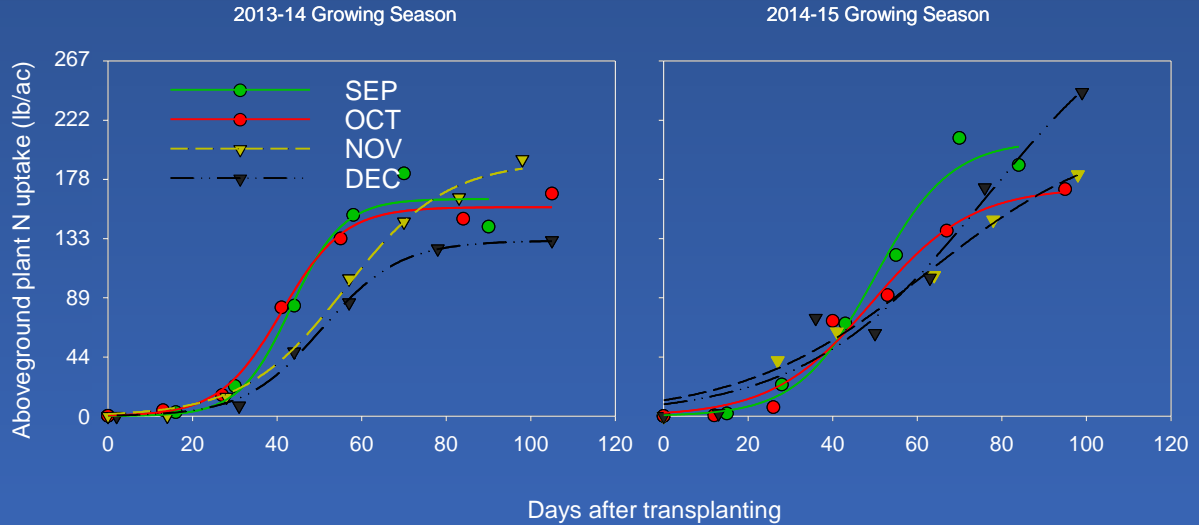
Weather conditions 2013-14 Growing Season



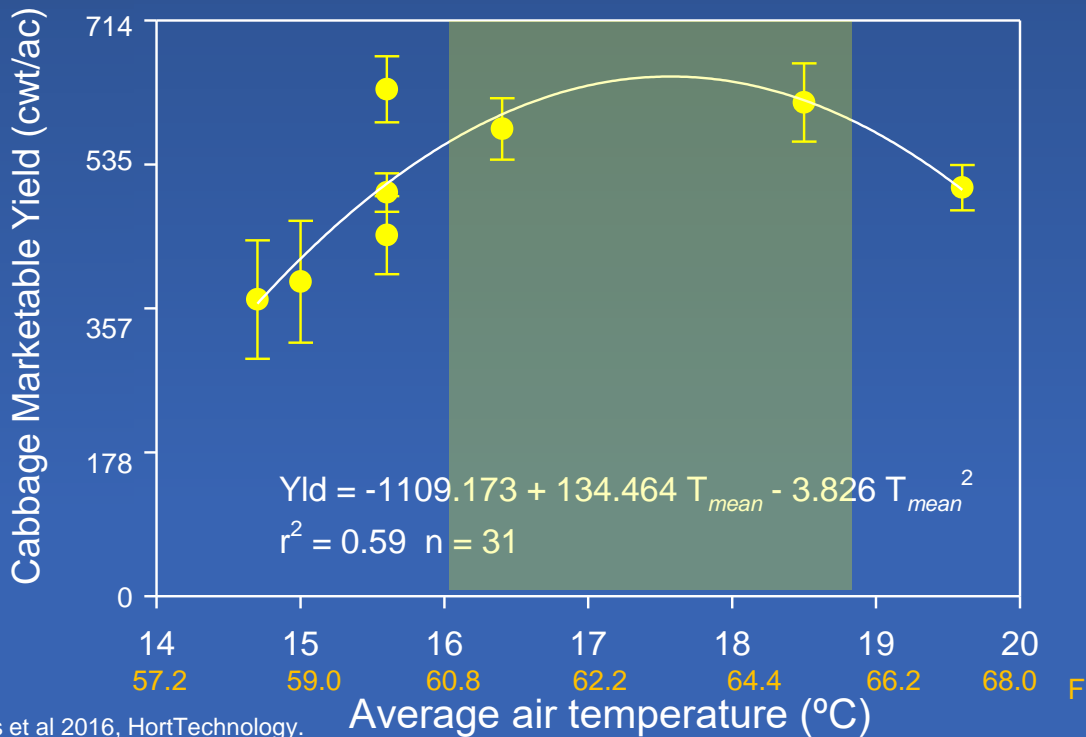
Weather conditions 2013-14 Growing Season



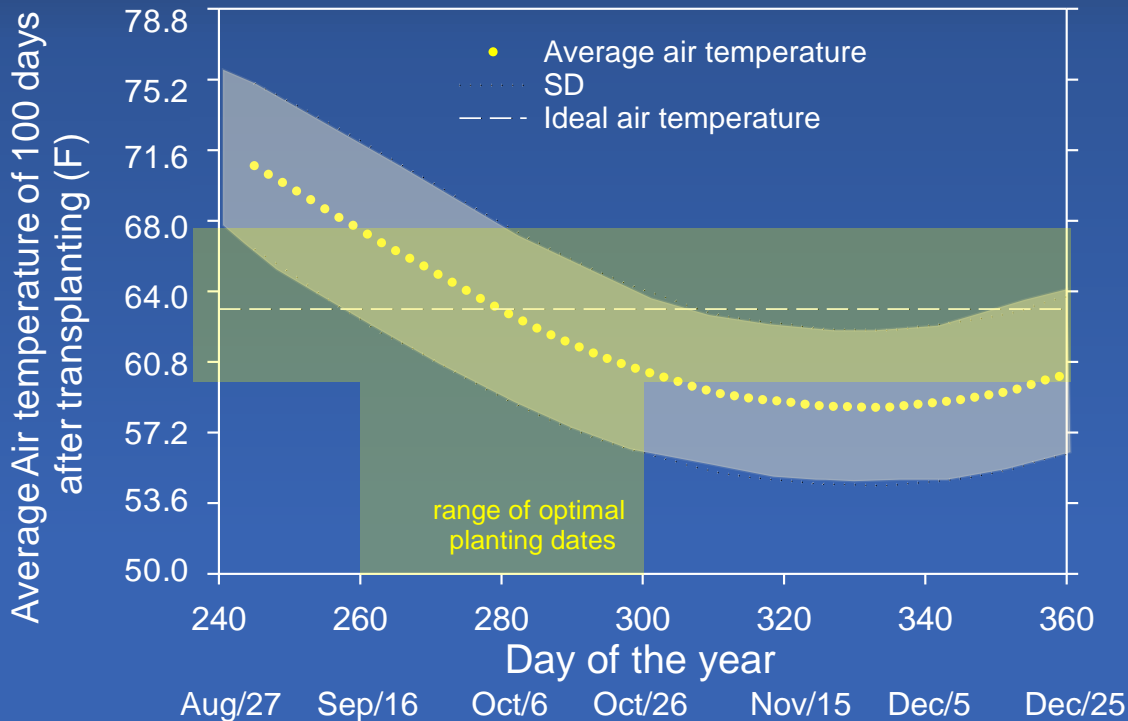
Cabbage N uptake



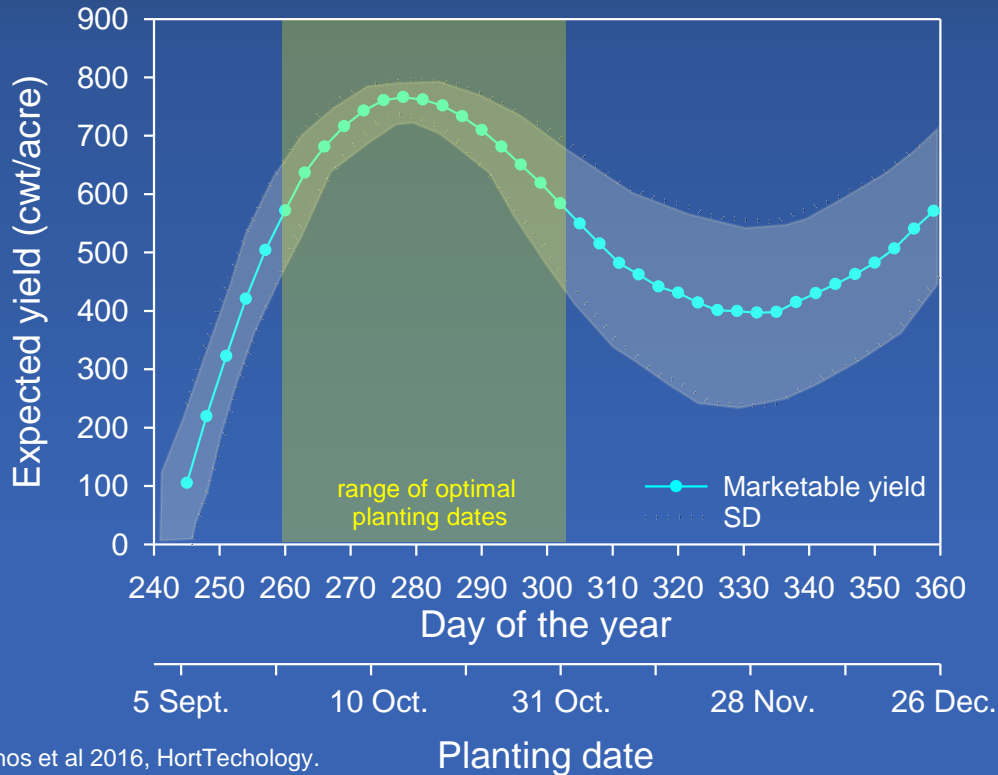
Cabbage yield vs. Average air temperature



Air temperature patterns (50 yrs) during cabbage growing season



Expected cabbage yield based on variation of air temperature

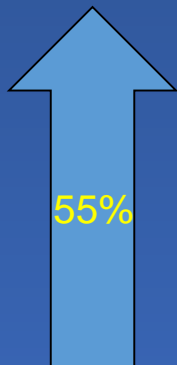


Economics

- Pre-harvest costs:

- Drip tape + plastic mulch + irrigation fittings
- Fertilizer
- Transplants
- Additional labor

Plasticulture
\$4,726/ac

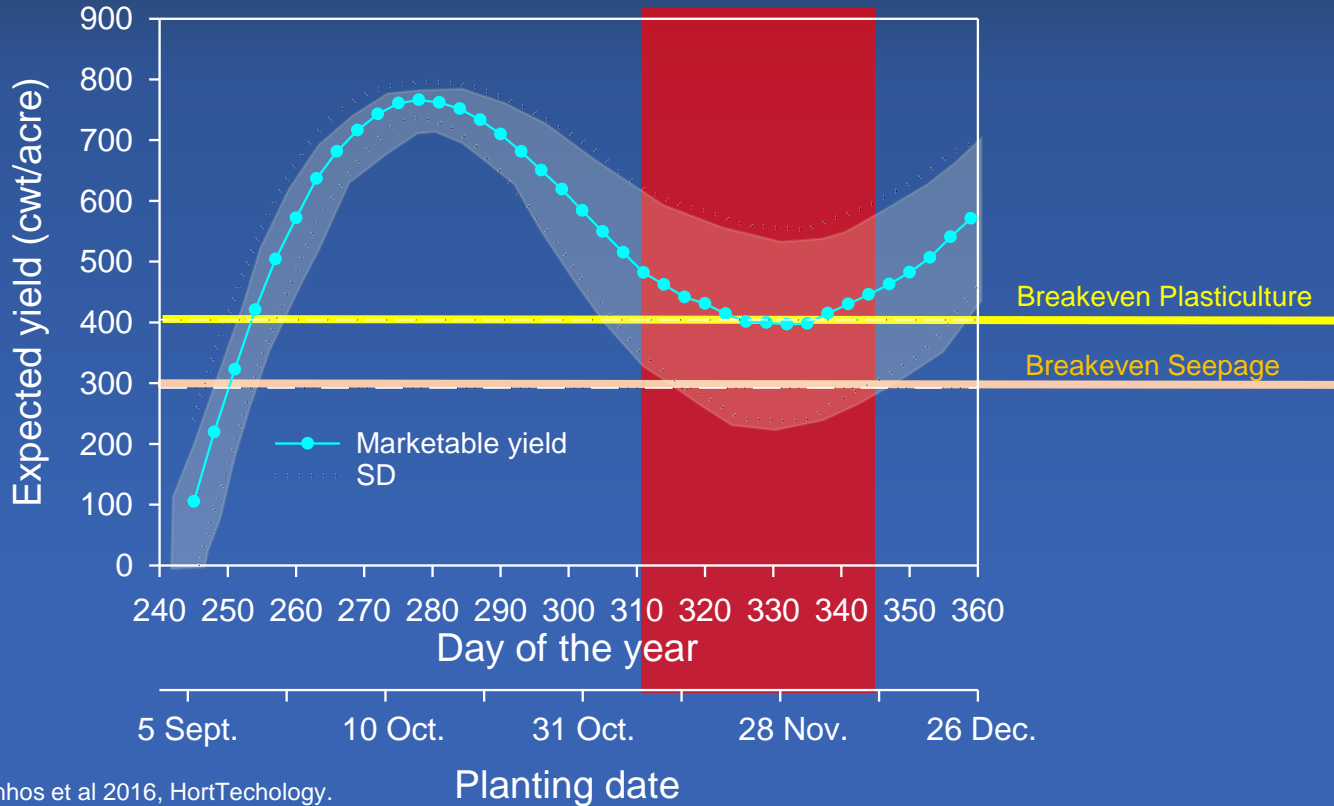


55%

Seepage
\$3,035/ac



Expected cabbage yield based on variation of air temperature



Economic risk of Florida cabbage plasticulture and bareground

Overall model

$$\text{Profit} = (\text{yield} * \text{price}) - \text{cost} + \varepsilon$$

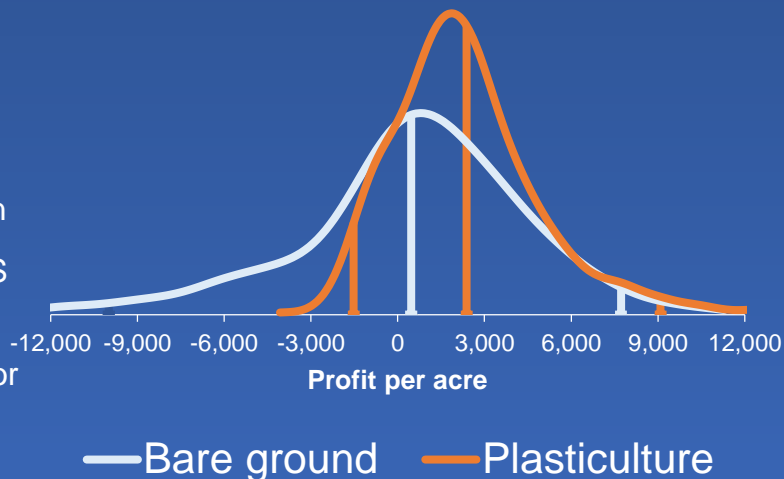
Where;

Yield = multiple regression model with stochastic weather parameters (temp, SR) estimated by a multivariate empirical distribution

Price = Florida cabbage price from NASS

Cost = estimated costs from Paranhos (2015) partial budget analyses for Florida plasticulture and bare ground production systems

Probability Density Functions (PDFs)



Economic risk of Florida cabbage plasticulture and bareground

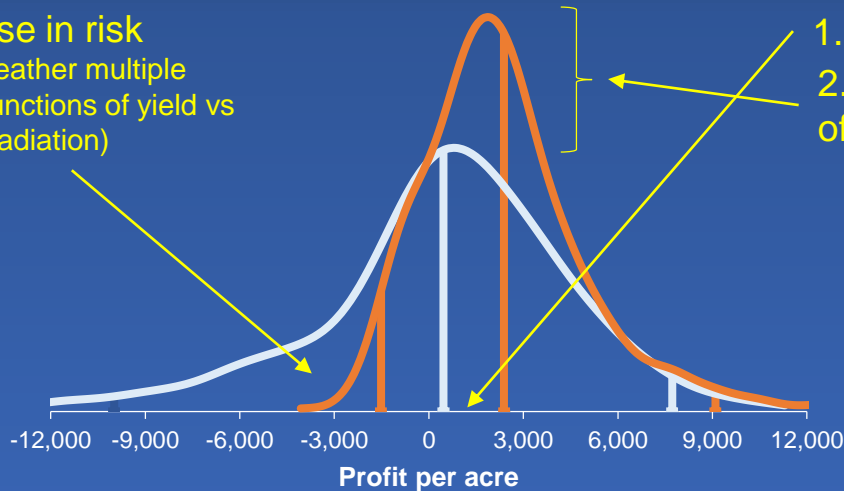
Probability Density Functions (PDFs)

3. Decrease in risk

(based on weather multiple regression functions of yield vs temp, solar radiation)

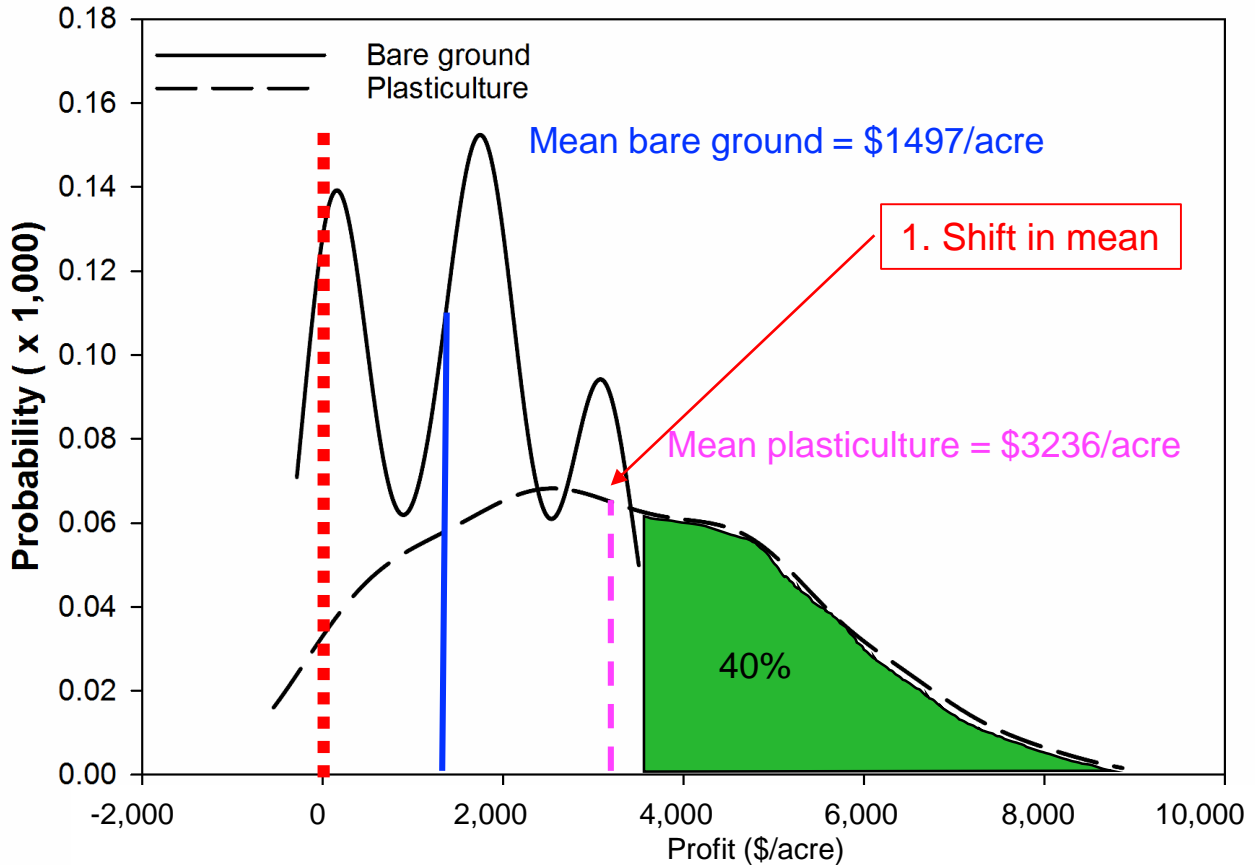
1. Shift in mean

2. Higher probability of making profit



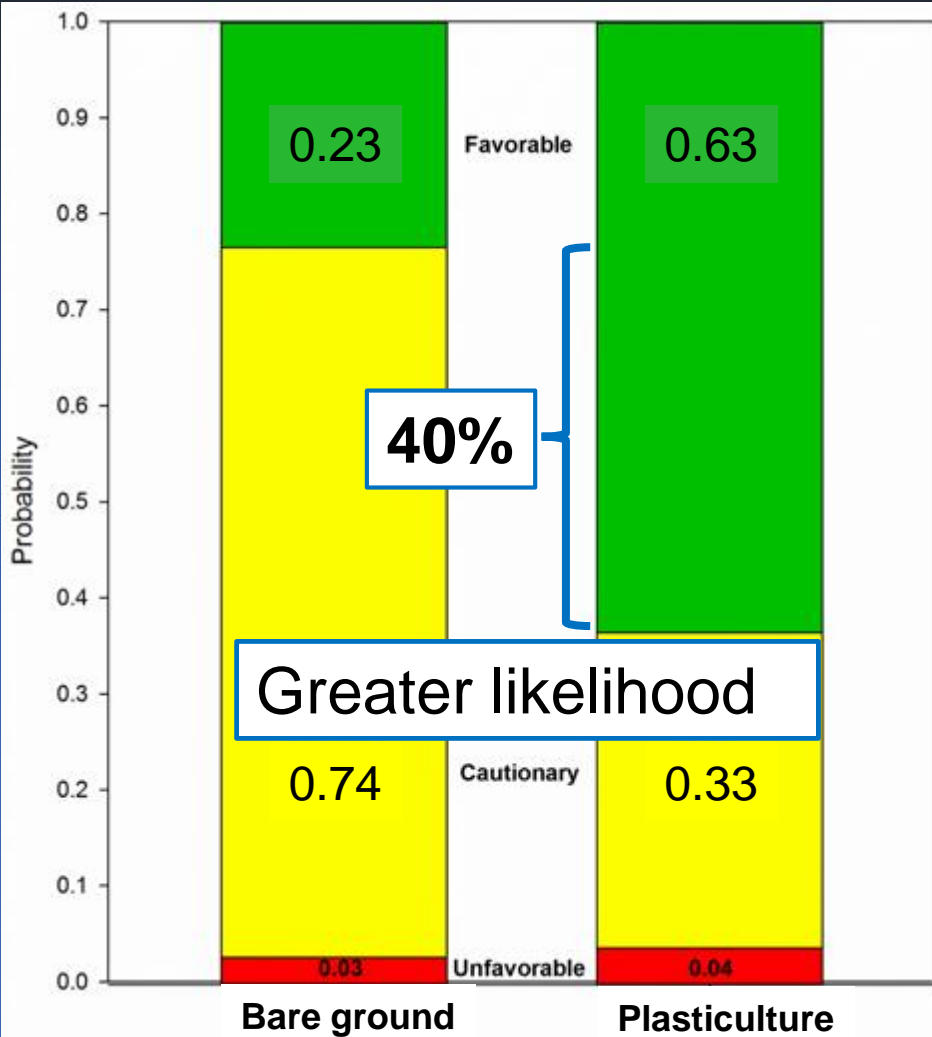
— Bare ground — Plasticulture

Profit simulation



Stoplight

What is the probability of making...



On farm demonstration

cabbage



On farm demonstration



onions



On farm demonstration



Nutsedge



squash



butternut



Bell peppers

Take home message

- Plasticulture is a viable option for cabbage for planting dates in Sep/Oct and Dec –
- Planting dates had different marketable yields mainly due to weather conditions
- Air temperature of 63-64 °F and high solar radiation were ideal conditions for cabbage head development
- For plasticulture, under unfavorable weather conditions, wider in-row plant spacing is recommended to increase production

Florida
Cabbage
8/22

Take home message

Population

Population increase from 14-60%

48% yield increase

Weather dependent

Commercial application

It is feasible, more experience = fine tuning

Economics

Cost

Plasticulture Less risky, greater likelihood increased profit

Extension education to increase adoption

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