Carinata Agronomy: Best Management Practices to Maximize Yield Potential

Ramdeo Seepaul, David Wright, Jim Marois, Chris Bliss, Sheeja George

History of *Brassica carinata* Research at UF, NFREC

- **Evaluation of carinata germplasm in 2011-2013, Quincy, FL**

- **FDACS grant 2013-2016**
  1. Genotype ecoedaphic adaptability screening – Jay, Quincy, Citra
  2. Production best management practices
  3. Providing ecosystem services
  4. Crop diversification
  5. Carinata oil to ‘drop-in’ fuels conversion
  6. Seed meal supplementation in ruminant nutrition

History of *Brassica carinata* Research at UF, NFREC

- **Partnership – UF, Agrisoma, Mustard 21, ARA**

- **Agrisoma, Mustard 21 grant 2013-2018**
  1. Multi-location yield performance testing - at Jay, Quincy, Live Oak and Citra, FL
     - AGR044 sib lines (22 entries)
     - Advanced frost tolerant, early maturing lines (20 entries)
  2. Dicamba tolerant mustard screening
  3. NAM project seed increase – 3150 rows
  4. Seed increase of mutagenized *B. carinata* DH lines
  5. Early maturity carinata nursery– 1668 rows

ARA

Mustard 21

Agronomic Research Scope at UF, 2015-2016

Best management practices for *B. carinata* production

Planting date (October, November, December)
Row spacing and seeding rates
- Four row spacing (7, 14, 21, 35")
- Four seed rates (2.7, 5.4, 8, 10.7 lb/acre)

Tillage method and N rates
- Three tillage methods (no till, disk, and chisel)
- Four N rates (0, 40, 80, and 120 lb N/acre)

Timing and N rates
- Application of 80 lb at planting, bolting, and flowering with differing application combinations

N uptake and plant nutrient partitioning
- Four N rates (0, 40, 80, and 120 lb N/acre)

Harvest management
- Timing of chemical desiccation or swathing

Plant Growth Regulator
- Two PGR (Paczol and Cycocel applied at bolting, flowering, 2 varieties)

Sulphur and Nitrogen Rate
- Four S (0, 15 , 30 and 45 lb/acre) and 4 N rates (0, 40, 80, 120 lb/acre)

Irrigation timing
- Irrigated vs non-irrigated, canola vs carinata, bolting vs flowering vs pod set

Cropping systems
- Integration of carinata in sod-based rotation as a winter cover crop

Fungicide screening
- Screening 7 fungicides for Sclerotinia control

Multi-location Yield Performance Testing – Jay, Quincy, Live Oak and Citra, FL

AGR044 sib lines (22 entries)
Advanced frost tolerant, early maturing lines (20 entries

Herbicide chemistries – Jay

Screening herbicide tolerance
Herbicide carry over effects on carinata establishment

Greenhouse studies – Quincy

Determine N and S effects on early-season growth, physiology, and reproduction of carinata and canola
Determine the effect of irrigation on yield critical stages of carinata and canola

Seed increase nurseries – Quincy

NAM Project Seed Increase
Seed Increase of Mutagenized *B. carinata* DH lines

Selection nursery – Quincy

Early maturity carinata nursery

UF Carinata Team

NFREC, Quincy	NFREC, Marianna	WFREC, Jay	SVAEC, Live Oak	PSREU, Citra
D. Wright	**N. DiLorenzo**	**R. Leon**	**P. Troy**	**N. Dufault**
J. Marois		**M. Mulvaney**		**B. Colvin**
C. Bliss				
S. George				
P. Anderson				
R. Seepaul				
T. Stansly				
Agronomy	Ruminant nutrition	Herbicide chemistries	Agronomy	Pathology
Cropping systems	Animal development	Crop protection	Variety trial	Agronomy
Soil biogeochemistry		Agronomy		Variety trial
Soil microbiology		Variety trial		
Physiology				
Crop improvement				

Brassica carinata

Characteristics of a competitive dedicated energy crop

- Planted in fall and harvested in spring
- Winter production on fallowed lands
- No displacement of food crops
- Increased revenue for farmers
- Amenable to existing infrastructure

- Closely related to rapeseed
- Cold, heat and drought tolerant
- Large seeded mustard (300-350M seeds kg^{-1})
- Low rates of seed shattering, non dormant

- 40% oil content with a highly desirable fuel chemistry for ‘drop in’ aviation fuels
- Meal is high protein (45%),low fiber (11%)

Carinata Phenology
Germination and establishment

- Epigeal germination – strong main root and fibrous lateral roots
- Seedling emergence 5 – 7 days
- Optimum temperature range for germination and emergence is 20-25°F

Carinata Phenology
Vegetative

- Stem elongation
- Increasing leaf area index
- 18 leaf stage
- Monitor for aphids, DDM, Sclerotinia during warm winters

Carinata Phenology
Bolting

- Transition Stage
- Approaching maximum leaf area index
- Increasing day length and temperatures initiate bolting
- Accumulation of foliage is required to provide adequate sugars during flowering and pod fill
- Primary branches develop from axillary buds

Carinata Phenology
Flowering

- Start of leaf abscission
- 2 flowers per raceme per day
- Flowering continues for 2 - 3 wks

Carinata Phenology
Seed development

- Rapid decline in leaf area
- Pod fill and seed ripening

Carinata Phenology
Maturity

- Harvest maturity

Growth stages: from seed to seed

Emergence/seedling establishment

Stage 0 [0.0–0.8]
Germination and emergence

25 DAP

Vegetative

Stage 1 [1.0–1.2]
Leaf production

70 DAP

Bolting

Stage 2 [2.0–2.2]
Stem elongation

95 DAP

Flowering

Stage 3 [3.0–3.9]
Flower bud development

120 DAP

Seed development/ maturation

Stage 5 [5.1–5.9]
Pod development

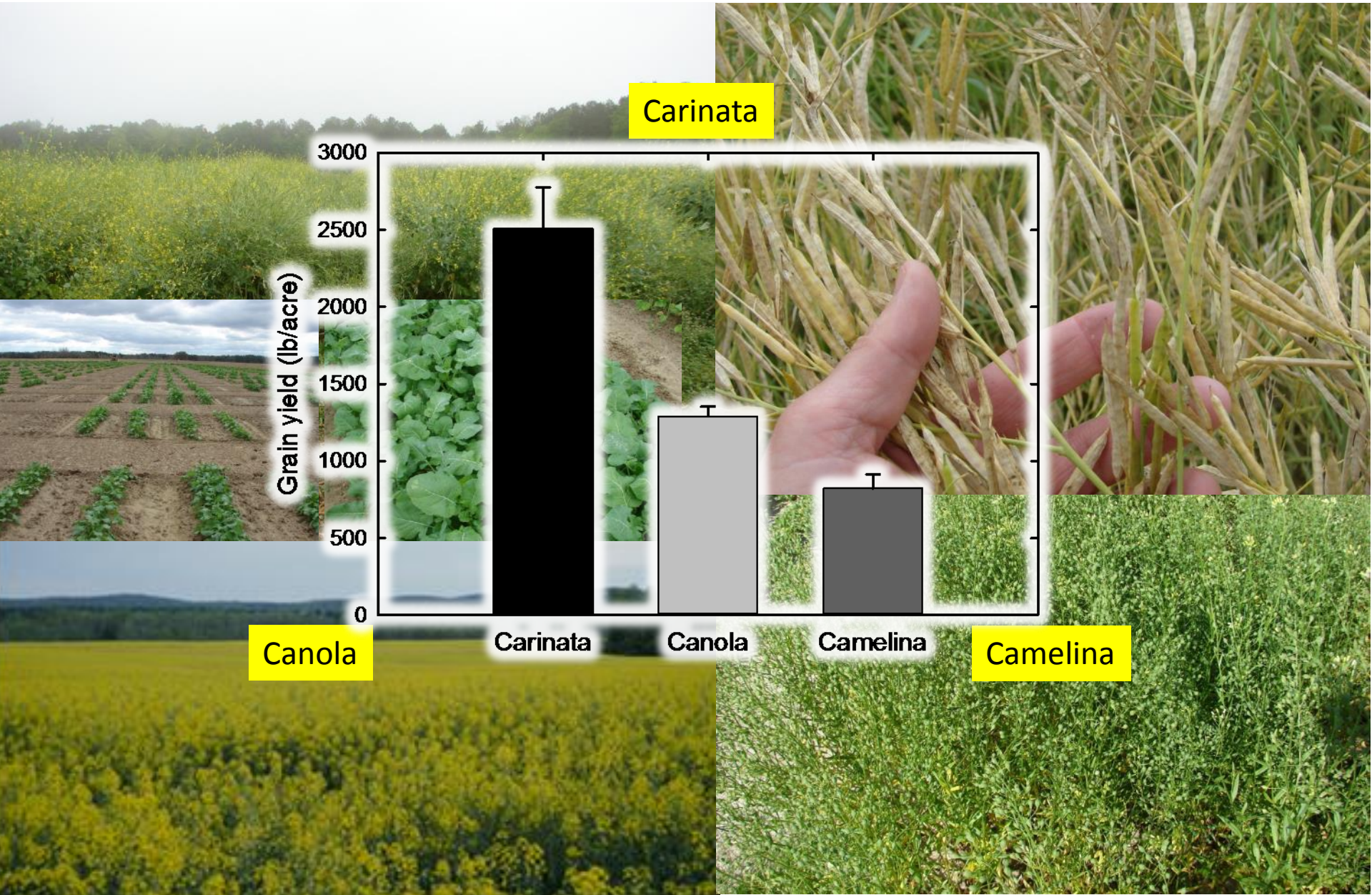
145/175 DAP

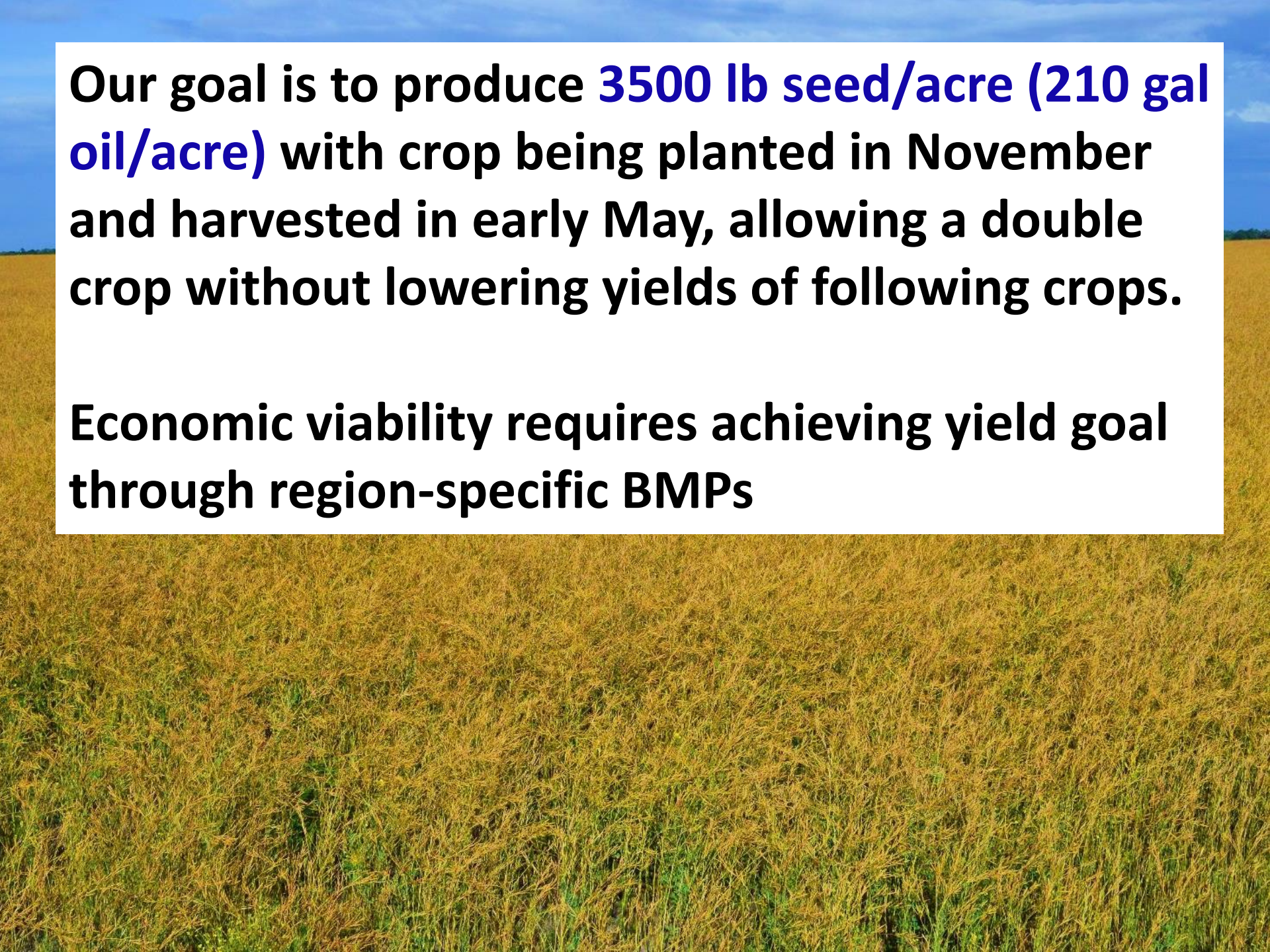
Seed desiccation

190 DAP


Carinata Agronomics

Oilseed Crop Production (Nov.- late May)
Produced with conventional equipment for wheat, etc.

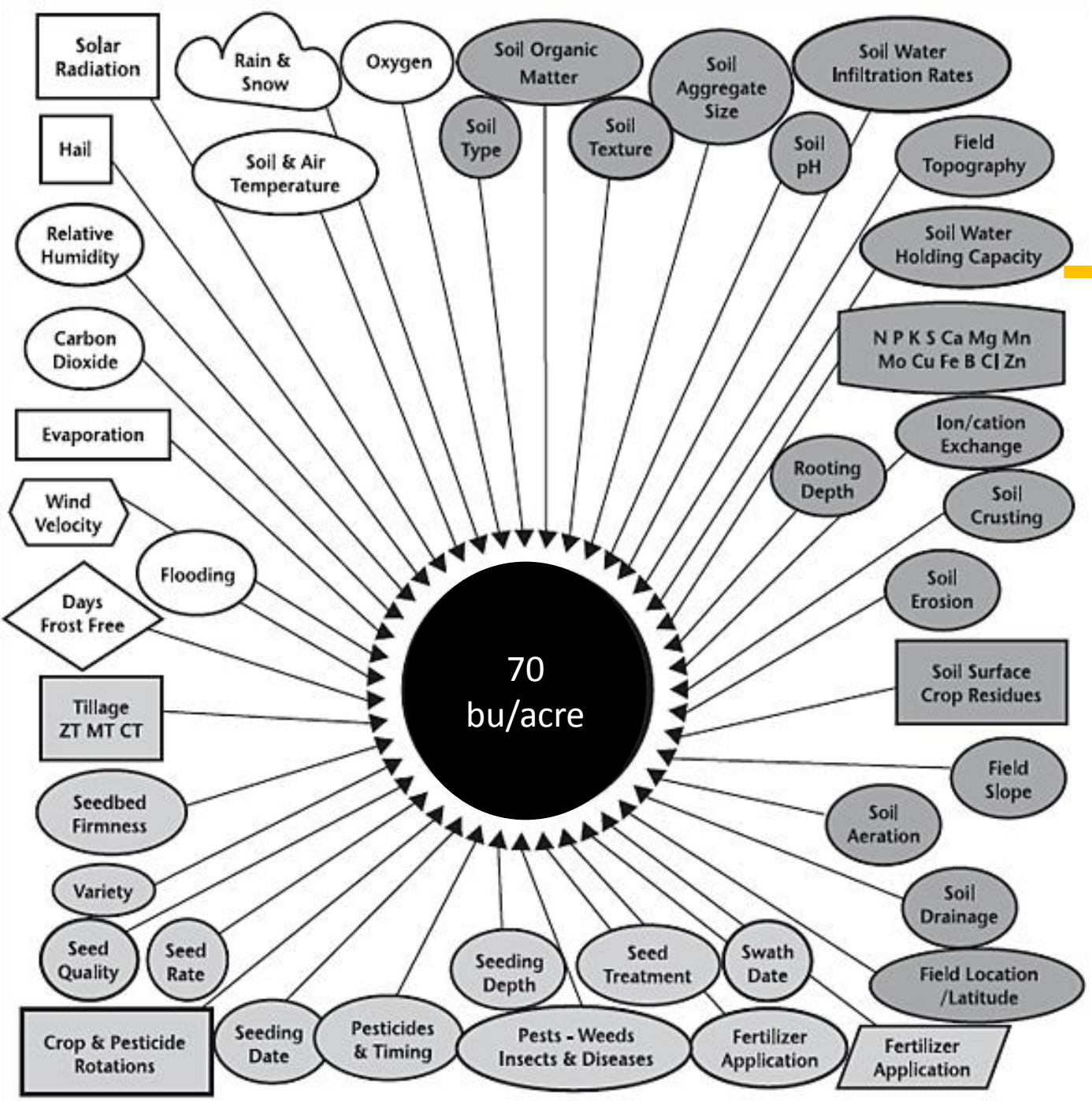




Our goal is to produce 3500 lb seed/acre (210 gal oil/acre) with crop being planted in November and harvested in early May, allowing a double crop without lowering yields of following crops.

Economic viability requires achieving yield goal through region-specific BMPs

Factors affecting yield



http://www.canolacouncil.org/crop-production/canola-grower's-manual-contents/chapter-1-the-basis-of-canola-yields/the-basis-of-canola-yields

Best Management Practices
Research Objectives

Funding Agency: Florida Dept. of Agriculture and Consumer Services

- High yielding varieties
- Crop establishment (planting date, tillage, density)
- Nutrient management
- Pest management
- Harvest management
- Crop rotation (3 years – disease, herbicide residue)

UF IFAS UNIVERSITY of FLORIDA

AGRIsoma
Sustainable Energy Founded in Agriculture

Timing desiccants to accelerate carinata harvest maturity

R. Seepaul, D. Wright, S. George

Harvest management practices for carinata are similar to canola. Unlike canola, carinata has high pod shattering resistance; nonetheless, harvest timing and method are critical for optimum seed yield and quality. Sequential flowering in carinata results in a mix of mature, partially mature, immature and unfilled pods that makes it difficult to judge the right time to harvest for top yields. Harvesting can be delayed due to continuous erratic wet periods in late spring. Alternate wetting and drying cycles can increase shattering losses in dry, windy conditions. Therefore, cost effective methods to optimize ripening uniformity and accelerate maturity for mechanized harvesting may be desirable for many growers. Ongoing research at NFREC, Quincy, FL shows the potential of chemical desiccants to accelerate seed dry-down and harvest thereby facilitating the timely planting of subsequent summer crops. During the 2014-2015 growing season, chemical desiccation one week in advance of natural desiccation produced yields similar to naturally desiccated carinata without having an effect on the protein and oil content (Table 1). Green stems, weeds and uneven ripening can hinder optimum harvest (Fig. 1)

Chemical desiccation enables uniform crop ripening by drying down all green vegetative growth. This allows for earlier harvest thereby reducing shattering losses. To optimize yield and seed quality, the crop must be physiologically mature before desiccants are applied. Physiological maturity is the stage of development when the seed is fully developed and capable of germination. Usually, carinata seed is physiologically mature when the seed color changes from green to olive green (Fig. 2). Leaf, stem or pod color change may not be predictors of physiological maturity. Normal seed desiccation progresses rapidly, indicated by a drop in moisture content from 50% to 10 % in 4 weeks. A chemical desiccant can be applied when >70% of the seeds are physiologically mature. At this time, the upper branches and pods will be brown, however, the main stem may remain slightly green (Fig. 3).

When the moisture content is 8% to 10%, carinata may be combined using the machine settings and screens for rapeseed outlined in the operator's manual and fine-tuned for conditions in the field.

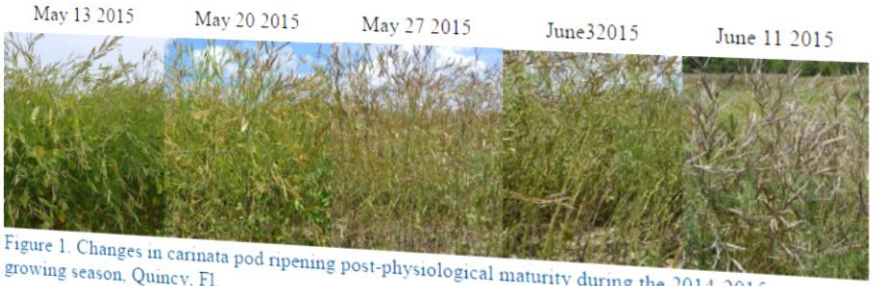


Figure 1. Changes in carinata pod ripening post-physiological maturity during the 2014-2015 growing season, Quincy, Fl.

SS-AGR-384

UF IFAS Extension UNIVERSITY of FLORIDA

Carinata, the Jet Fuel Cover Crop: 2016 Production Manual for the Southeastern United States[1]

R. Seepaul, C. M. Bliss, D. L. Wright, J. J. Marois, R. Leon, N. Dufault, S. George, and S. M. Olson[2]

Figure 1. From field to flight.
Credits: David Wright, UF/IFAS (field, seed); Thinkstock (plane, oil)

Brassica carinata (carinata) is an oilseed crop with great potential for profitable cultivation in the southeastern US. Its high oil content and favorable fatty acid profile make it suitable for the biofuel industry as a biojet fuel. The UF/IFAS North Florida Research and Education Center (NFREC) in Quincy, Florida has been working to identify advanced carinata genotypes that are high-yielding (seed and oil), disease-resistant, early-maturing, and adapted to the southeastern US. The work at NFREC is being done in conjunction with Agrisoma Biosciences Inc., a company that has the world's largest carinata breeding program and is developing varieties for the southeastern US and the northern prairie states as well as Canada and several other countries. This publication's "Agronomic Management" section provides recommendations based on research conducted at the University of Florida (UF).

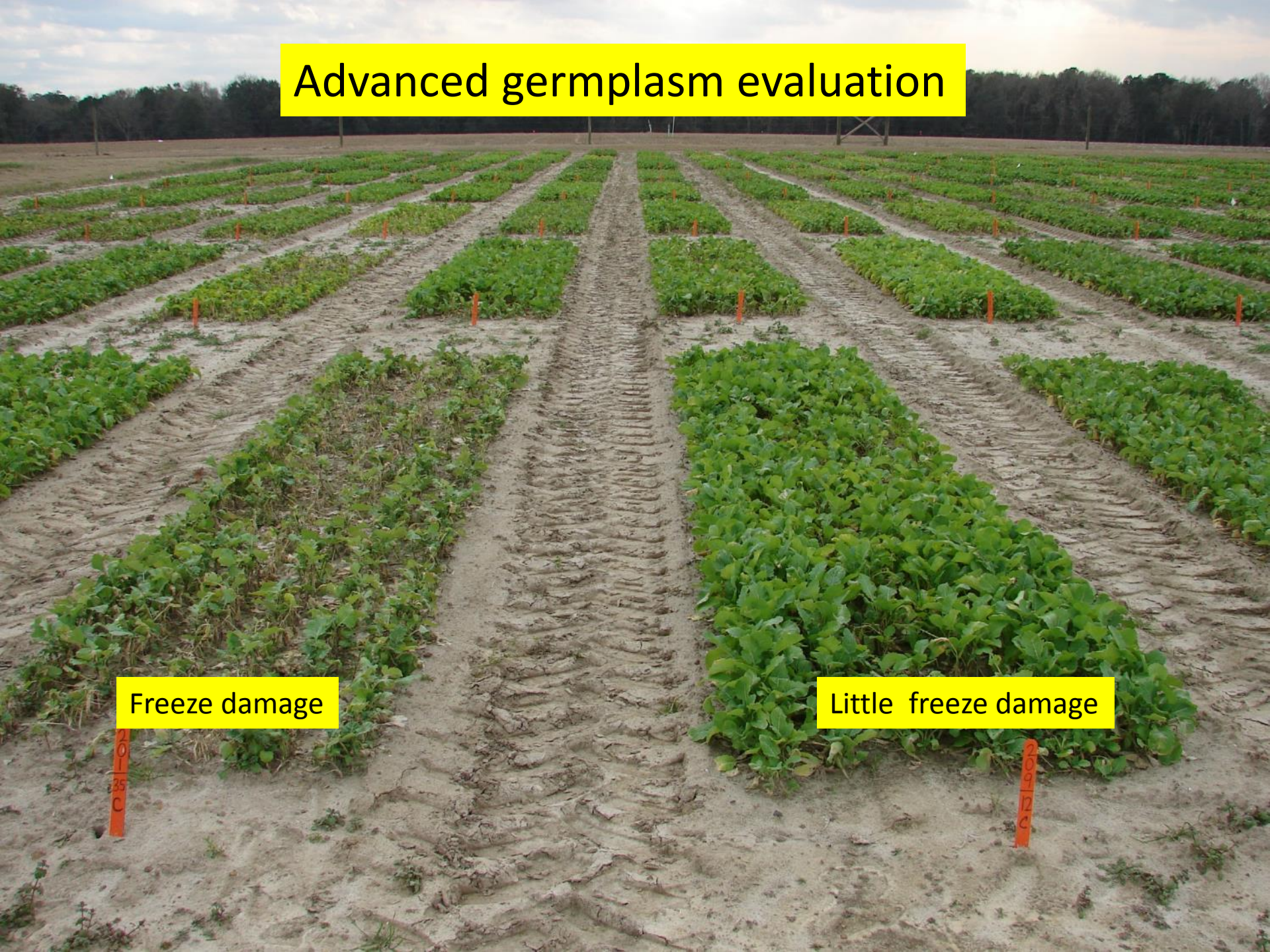
Carinata has been grown commercially for several years on the Canadian prairie and more recently in the US northern

1. This document is SS-AGR-384, one of a series of the Agronomy Department, UF/IFAS Extension. This research is supported by the Florida Department of Agriculture and Consumer Services Office of Energy grant SRD007 and focuses on the development of best management practices, demonstration of commercial potential, and feasibility of the presscake as a feedstuff. Our research partner, Applied Research Associates, FL, USA, was also supported through this grant to develop efficient conversion methods for *B. carinata* oil into "drop-in" bio-jet and bio-diesel fuels. The selection of regionally adaptable carinata genotypes with superior agronomic performance and high oil concentration is done in collaboration with Agrisoma Biosciences Inc. and Mustard 21 Canada Inc. Original publication date December 2014. Revised October 2015. Visit the EDIS website at http://edis.ifas.ufl.edu.

2. Ramdeo Seepaul, postdoctoral associate, Agronomy Department, UF/IFAS North Florida Research and Education Center, Quincy, FL; Christine M. Bliss, regional agronomist, Agrisoma Biosciences Inc., Saskatoon, Canada; David L. Wright, professor, Agronomy Department, UF/IFAS North Florida REC, Quincy, FL; Jim J. Marois, professor emeritus, Plant Pathology Department, UF/IFAS North Florida REC, Quincy, FL; Ramon G. Leon, assistant professor, Weed Science Department, UF/IFAS West Florida Research and Education Center, Jay, FL; Nicholas Dufault, assistant professor, Plant Pathology Department, UF/IFAS Plant Sciences Research and Education Unit, Citra, FL; Sheeja George, biological scientist, Agronomy Department, UF/IFAS North Florida REC, Quincy, FL; and Steve M. Olson, professor emeritus, Horticultural Science Department, UF/IFAS North Florida REC, Quincy, FL; UF/IFAS Extension, Gainesville, FL 32611.

Variety Selection

- Agrisoma has two commercial varieties
- AAC A110 has high yield potential, earlier maturing and has 0.5 % higher oil content than its predecessor AAC A100
- AAC A120 was identified as a high yielding cold tolerant variety in Florida and currently in commercial production in the southeast
- Ongoing research in region-specific crop genetics


Advanced germplasm evaluation
Freeze damage
Little freeze damage

Performance of *Brassica carinata* Genotypes (NFREC, Quincy, FL)

Seed Source	Genotype	50% Flowering	Freeze Damage	Lodging Score†‡	Lodging‡	Stand Density	Seed Moisture	Test Weight	1000 SW§	Seed Yield
		DAP	%		%	plants/ft²	%	lb/bu	g	lb/acre
Agrisoma	AGR400-A1	117	8	4.1	9.4	7.4	8.3	53.8	3.0	4996
Agrisoma	AGR044-3B1	119	25	4.9	25.6	6.7	9.3	52.3	3.1	4736
Agrisoma	AGR439-A	116	40	3.3	8.8	4.7	8.2	53.4	3.1	4402
Agrisoma	AGR207-A2	117	25	5	54.4	6.9	8.3	53.1	2.6	3831
Agrisoma	AGR207-11	115	18	4.8	27.5	6.4	7.9	53.6	2.6	3792
Agrisoma	AGR349-M2	9[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	53.1	2.9	3657
AAFC	AAFC-5465	11[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	54.1	3.7	3538
Agrisoma	AGR427-A	12[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	52.8	2.9	3465
Agrisoma	AGR159-1E	11[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	53.7	2.8	3462
Agrisoma	AGR136-CD	124	10	5	25.6	5.6	8.9	52.2	2.5	3331
Agrisoma	110999EM	118	70	5	33.1	5.3	8.1	52.8	3.1	3313
Agrisoma	AGR489-4	117	18	2.5	5.0	6.3	8.5	53.9	2.4	3288
Agrisoma	110994EM	118	53	5	71.9	4.9	7.9	53.7	3.1	3226
Agrisoma	AGR045-221	120	53	4.9	36.3	5.0	8.5	53.1	3.0	3155
Agrisoma	110998EM	119	48	5	40.6	4.4	8.0	52.4	2.8	3105
Agrisoma	AGR868-3	119	25	4.8	48.1	4.8	8.4	52.4	3.0	2988
Agrisoma	AGR840-A2	117	40	5	81.3	4.6	8.7	53.3	2.8	2973
Agrisoma	AGR859-1	111	18	3.9	10.6	6.0	8.4	53.8	2.5	2969
Agrisoma	AAC A110	119	48	5	67.5	6.0	8.3	52.3	2.9	2953
Agrisoma	AGR185-K2	118	40	5	71.9	4.0	8.5	53.3	2.7	2948
Agrisoma	7.AA60-3.4	119	15	4.9	58.8	6.7	9.2	52.1	3.0	2868
Agrisoma	3118	117	30	4.5	43.8	4.3	8.3	53.1	3.4	2847
Agrisoma	AGR002-C22	116	25	5	64.4	5.4	9.0	54.0	3.5	2830
Agrisoma	110910EM	118	43	5	69.4	4.2	8.2	52.9	2.9	2732
Agrisoma	110996EM	117	45	5	70.0	4.1	8.2	52.3	2.8	2710
AAFC	AAFC-5228	115	38	4.8	63.1	4.8	8.0	52.7	2.8	2629
AAFC	AAFC-5463	118	70	4.8	41.3	5.4	8.2	51.8	3.3	2602
AAFC	AAFC-5467	115	53	5	64.4	5.4	8.5	53.3	2.9	2584
Agrisoma	080814EM-J	111	40	5	71.9	4.5	8.1	52.9	2.6	2551
Agrisoma	AGR215-13	116	55	5	38.1	4.7	8.1	53.8	3.0	2534
Agrisoma	5228	116	25	5	71.3	7.6	8.0	52.1	2.9	2420
AAFC	AAFC-5464	115	53	5	35.0	3.9	8.3	54.0	2.9	2419
Agrisoma	111000EM	115	70	4.8	33.8	3.4	8.2	53.0	3.0	2400
Agrisoma	AGR409-2	117	55	5	53.8	2.9	8.8	50.2	2.5	2395
AAFC	AAFC-5478	114	70	4.3	20.0	4.7	8.6	53	2.9	2389
Agrisoma	AGR215Q-G2	117	50	5	52.5	4.6	8.3	54.3	2.9	2336
AAFC	AAFC-5458	118	55	5	64.4	3.8	8.1	51.5	2.9	2250
AAFC	AAFC-5475	118	50	5	78.1	3.4	8.4	51.9	3.0	2152
AAFC	AAFC-5457	118	53	5	73.8	3.4	8.5	52.4	3.0	1905
AAFC	AAFC-5422	115	68	5	28.1	5.2	8.5	53	3.2	1599
Mean		117	42	4.7	46.5	5.1	8.4	52.9	2.9	2982
Error df		120	120	120	120	120	120	120	80	120
LSD (0.05)		2.6	15.2	0.68	23.8	2	0.63	1.5	0.52	764
CV		1.6	25.9	10.5	36.6	28.7	5.4	2.1	10.9	18.3
R-sq		0.87	0.77	0.74	0.69	0.45	0.44	0.43	0.52	0.69

90 -100 bu/acre

Variety Selection

- Earlier maturing frost tolerant varieties
- Advanced lines being tested in several locations
- Specific to the Southeast US
- Opportunities to increase yield by 40%

Field Selection

- Medium to light well-drained soils with pH 5.5 – 6.8
- Deep sands require intense fertility program
- Avoid fields with excessive wild radish. Wild radish mixed with carinata seed will reduce oil quality and attract price dockage
- Avoid fields planted with carinata or other Brassicas in the past 12-24 months. Rotate with cereals.
- Carinata is susceptible to herbicides (Cadre, Strongarm) used in cotton-peanut rotations. Consider field herbicide history before planting and do not seed in fields where there is a herbicide carryover risk

Crop Rotation

Cadre effect on carinata growth (Santa Rosa County, FL, 2016)

Source: Ramon Leon

Crop Rotation
Herbicide Restrictions

Trade name	Active ingredient	Crop rotation restriction (months)
	Group 2 (ALS-inhibitors)	
Cadre	Imazapic	40
Classic	Chlorimuron	18
Permit or Sandea	Halosulfuron methyl	15
Pursuit	Imazethapyr	40
Staple	Pyrithiobac sodium	10*
Strongarm	Diclosulam	30*
	Group 14 (PPO-inhibitors)	
Reflex	Fomesafen	18
Valor	Flumioxazin	4 to 18**

Field Preparation

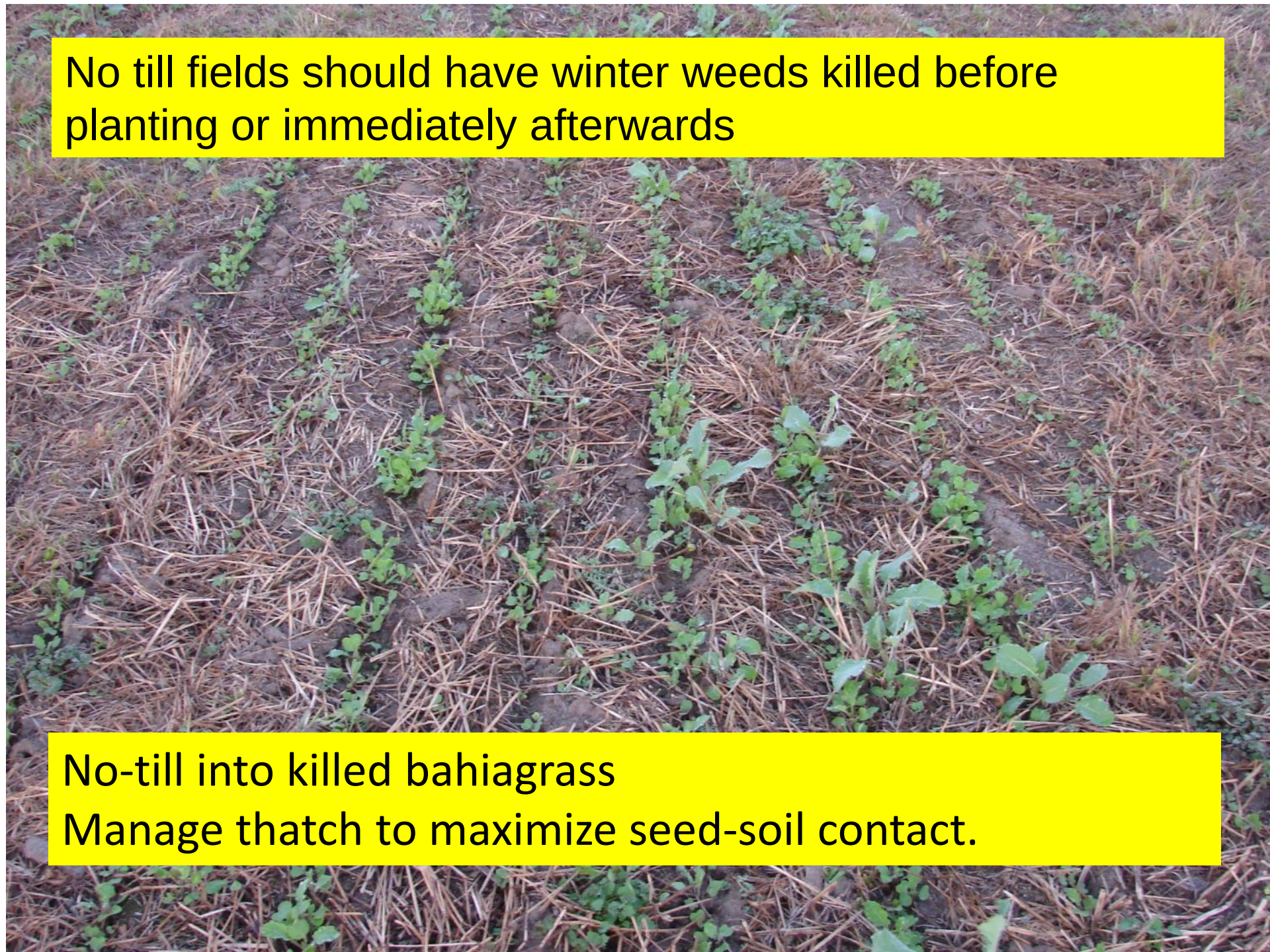
- Preplant weed control (use herbicide if necessary)

Herbicide	Active ingredient	Weeds	Timing
Aim	Carfentrazone-ethyl EC	Broadleaves	Pre-planting
Select Max, Shadow	Clethodim	Grasses	According to weed stage
Roundup	Glyphosate	Most annual and broadleaves	Pre-plant
Treflan 4D	Trifluralin	Annual grasses and broadleaves	Pre-emergence

Field Preparation

Tillage

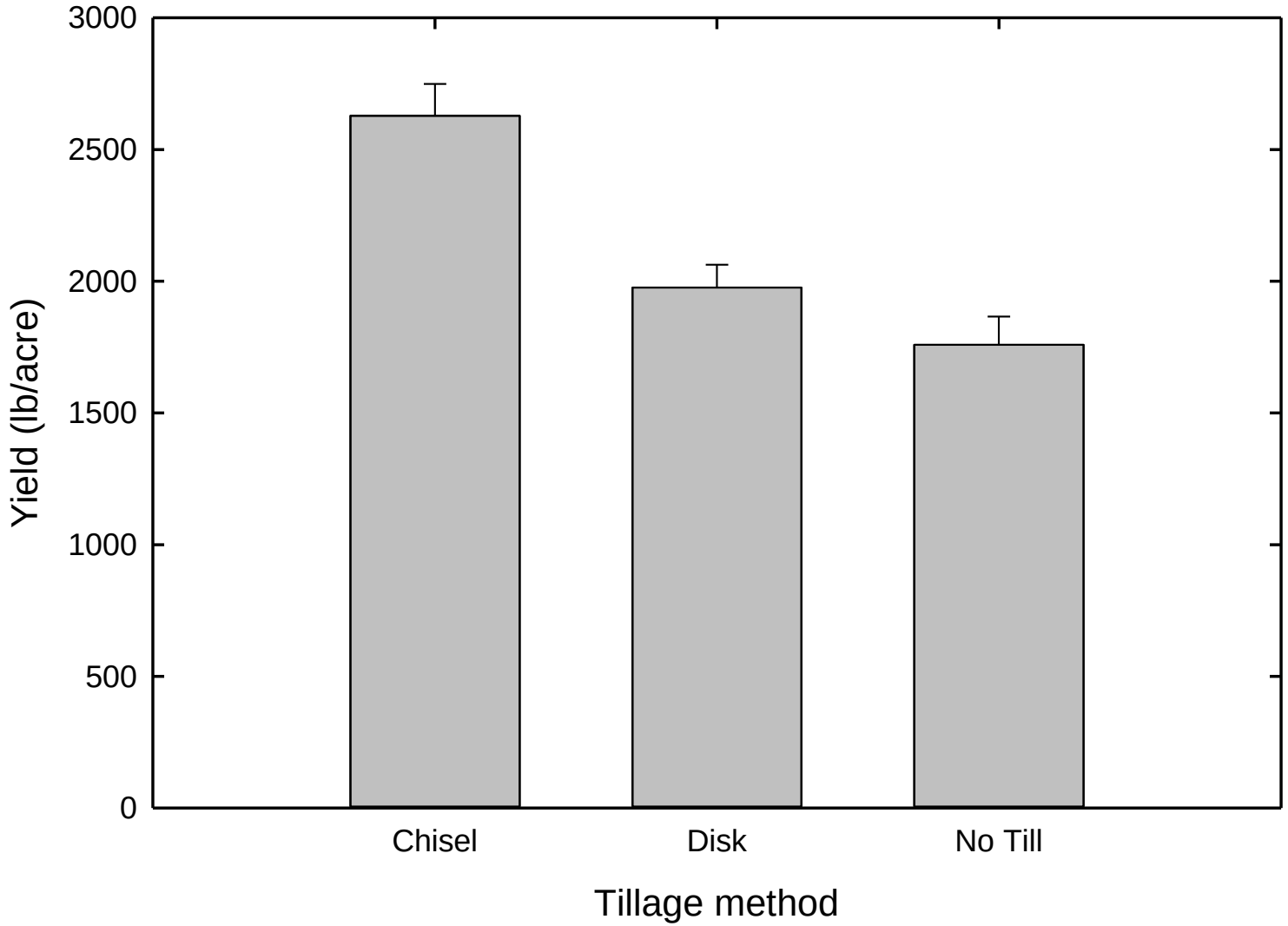
- Conventional, minimum, or no-till
- Firm with roller if using deep tillage or chisel plow
- Minimum stubble height with no-till
- Level seed bed


No till fields should have winter weeds killed before planting or immediately afterwards
No-till into killed bahiagrass
Manage thatch to maximize seed-soil contact.

Effect of tillage method on carinata yield

Quincy, FL, 2015

- Oil content and fatty acid distribution not affected by tillage method



Planting date

- **November 1-30**
- **November 1-15 is optimum**
  - Maximize yield potential
  - Reduce pest and disease incidence
  - Timely harvest allowing for on-time planting of next crop

Planting date

Quincy, FL, December 2014

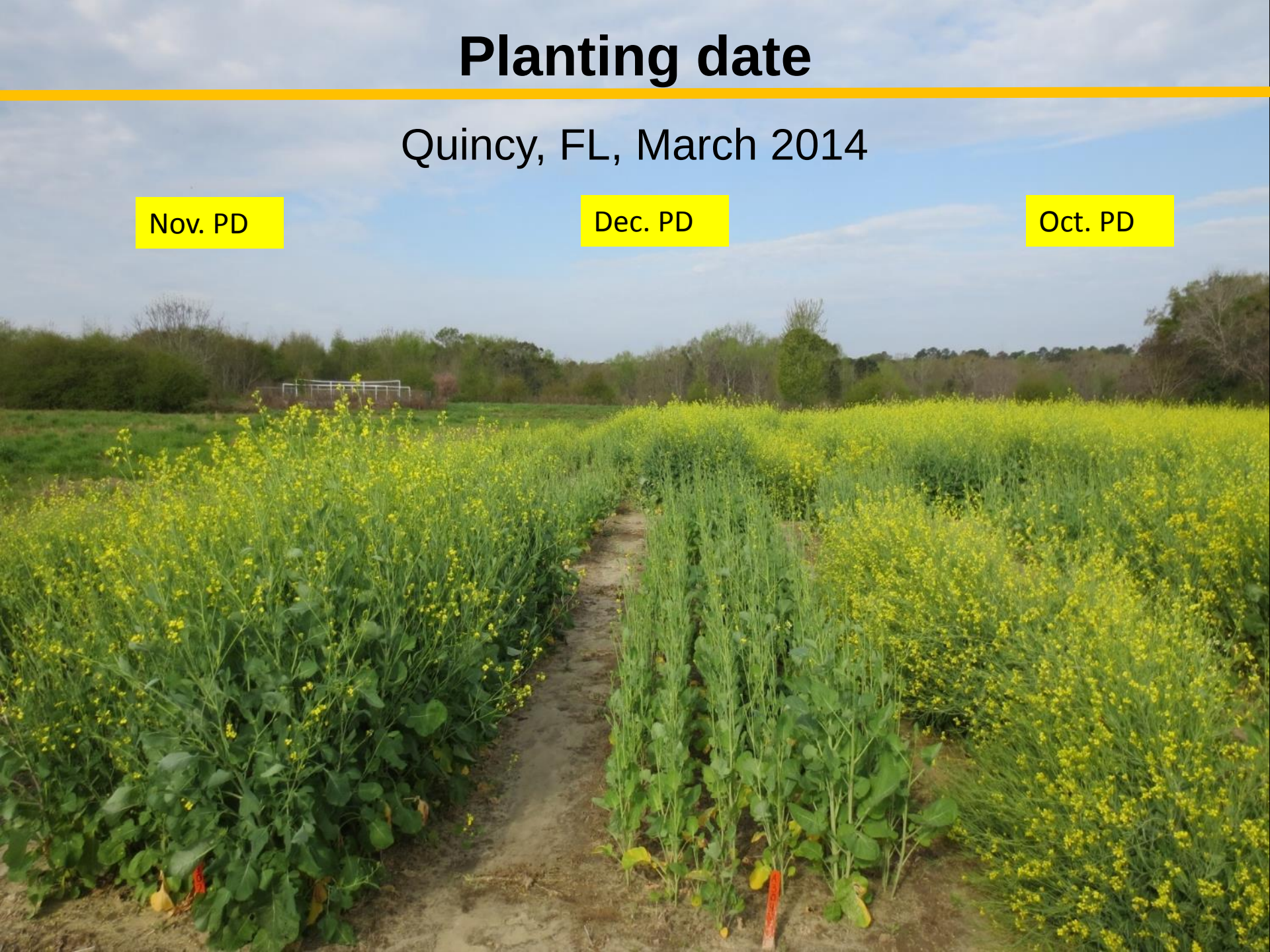
Oct. PD

Nov. PD

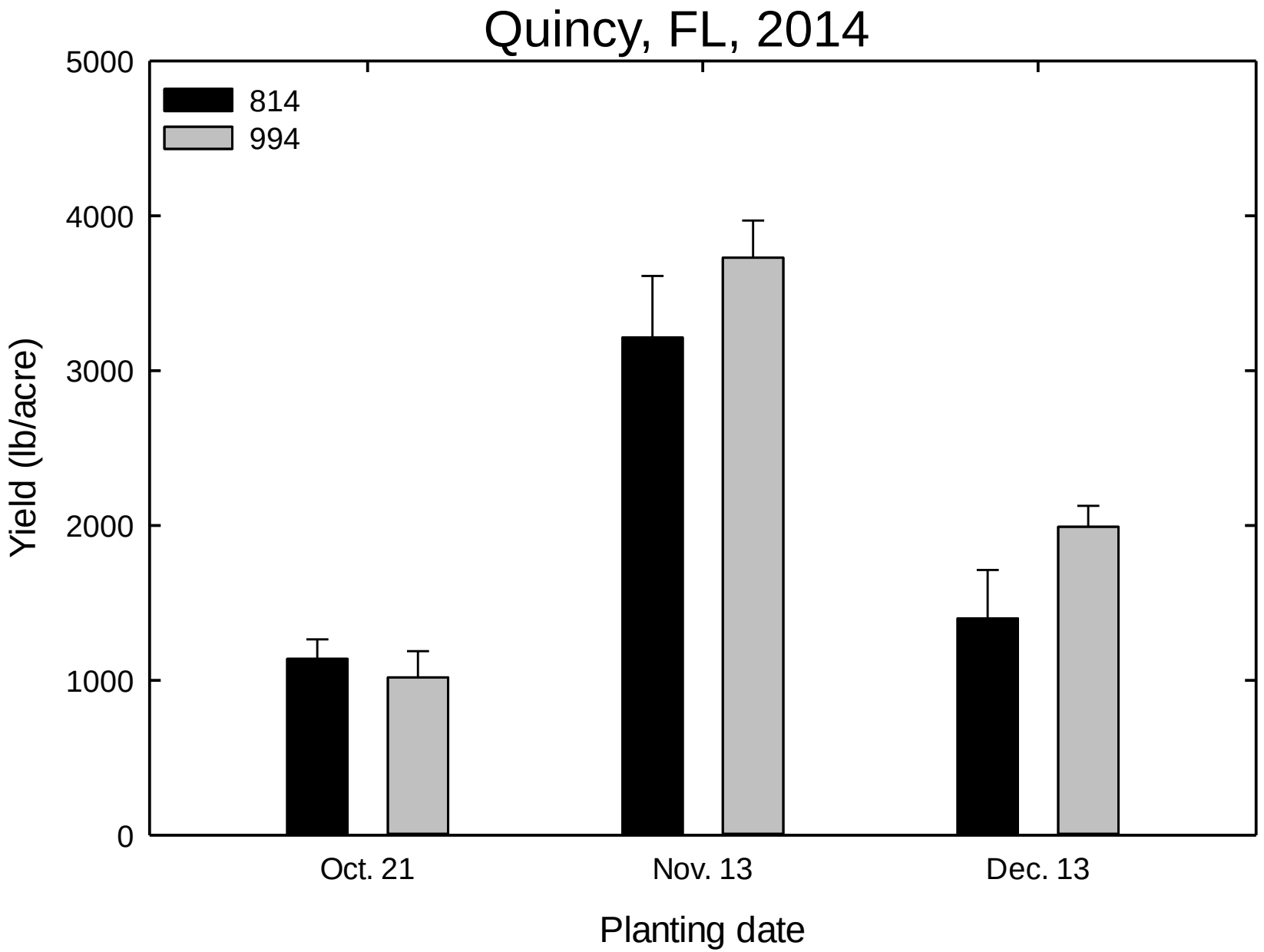
Dec. PD

Planting date

Quincy, FL, March 2014



Planting date effect on carinata yield



Planting date effect on carinata oil yield

Quincy, FL, 2014

- No effect of planting date on oil content and fatty acid distribution

Planting date	Yield	Oil content	Oil Yield
	lb/acre	%	gal/acre
Oct. 21	1167 b	38 b	66 b
Nov. 13	3559 a	40 a	212 a
Dec. 13	1550 b	39 ab	90 b
LSD	858	1.71	462

† Within columns, means followed by the same letter are not different ($P > 0.05$)

Crop establishment

Depth
½ - ¾ inch - deeper with sandy soil

Seeding rate
5-6 lbs/ac, depending on seeder

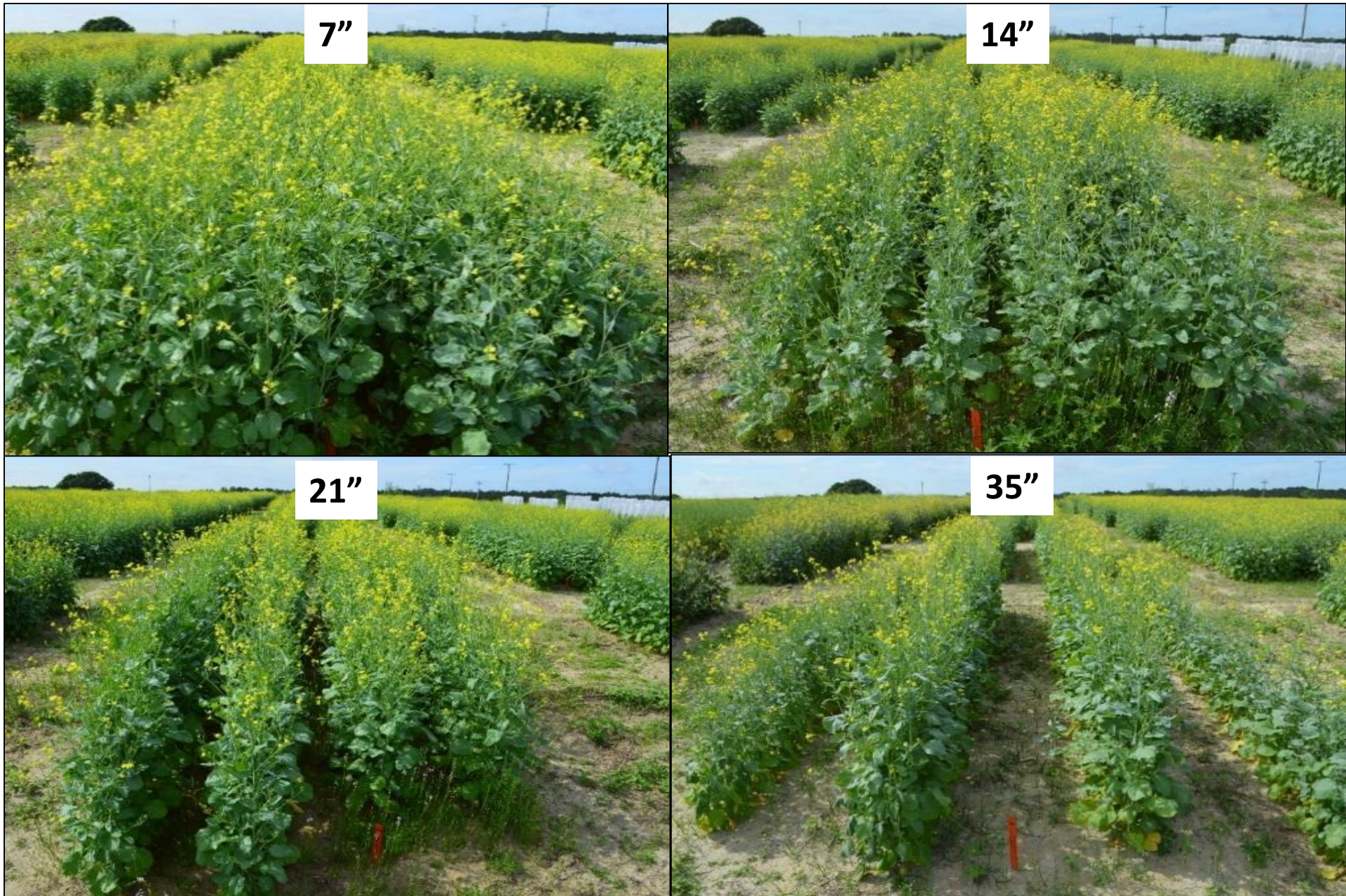
Row spacing
7-14 inch

- Shallow seeding into a firm, moist seedbed
- Shallow seeding depth require adequate moisture in top 1”
- Post-rainfall soil crusting form a physical barrier to emergence (residue management)

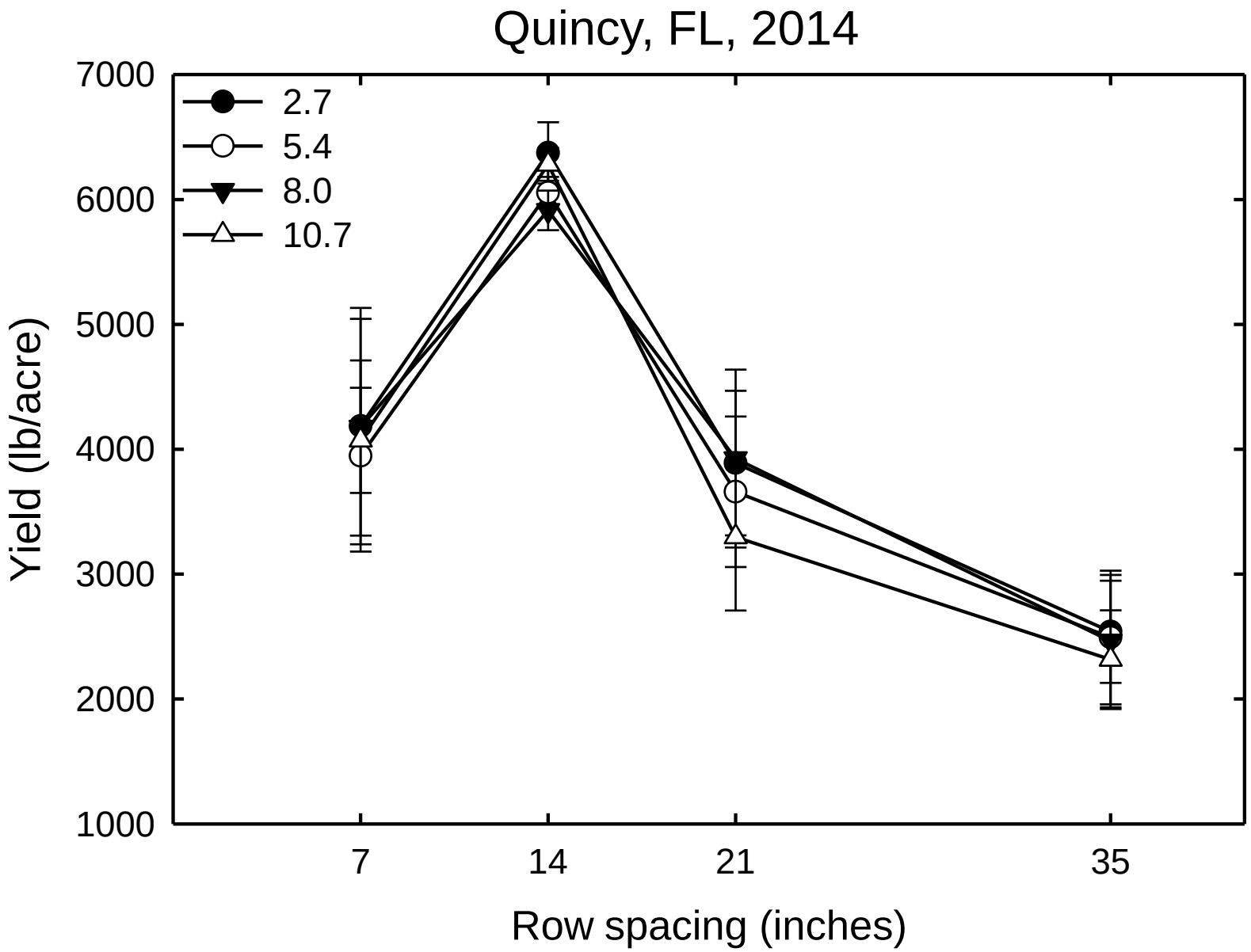
Source: Chris Bliss


Plant 14” apart, block every other hole
JOHN DEERE
1520
Source: Chris Bliss

Row spacing effect on canopy architecture



Row spacing and seeding rate effects on carinata yield



Row spacing and seeding rate effects on carinata oil quality

Quincy, FL, 2014

Row spacing inches	Seed yield lb/acre	Oil content %	Oil yield gal/acre
7	4186 b	42.1 a	263 b
14	6102 a	41.7 a	380 a
28	3890 b	41.7 a	242 b
35	2539 c	42.6 a	162 c
LSD	950.6	1.17	56.1

Nutrient Management

- Nutrient requirements similar to canola
- pH range 5.5 to 6.8 (moderate to slightly acidic)
- Follow soil test recommendations for fertilizer and liming amendments
- Total fertilizer needed in lb/A is **80 N, 40 P, 80 K, 25S**
- N management differ by soil type

Nutrient Management

Sandy loam soils

- At planting, apply 20-30 lb/A N and 10-15 lb/A S plus all P and K fertilizer
- At bolting, apply remaining N and S fertilizer

Deep sandy soils

- At planting, apply 20-30 lb/A N, 10-15 lb/A S, 50% K and all P fertilizer
- At bolting, apply 20-30 lb/A N, 10 lb/A S, and remaining K
- At early flowering, apply remaining N fertilizer

Nutrient Management

Sandy loam soils

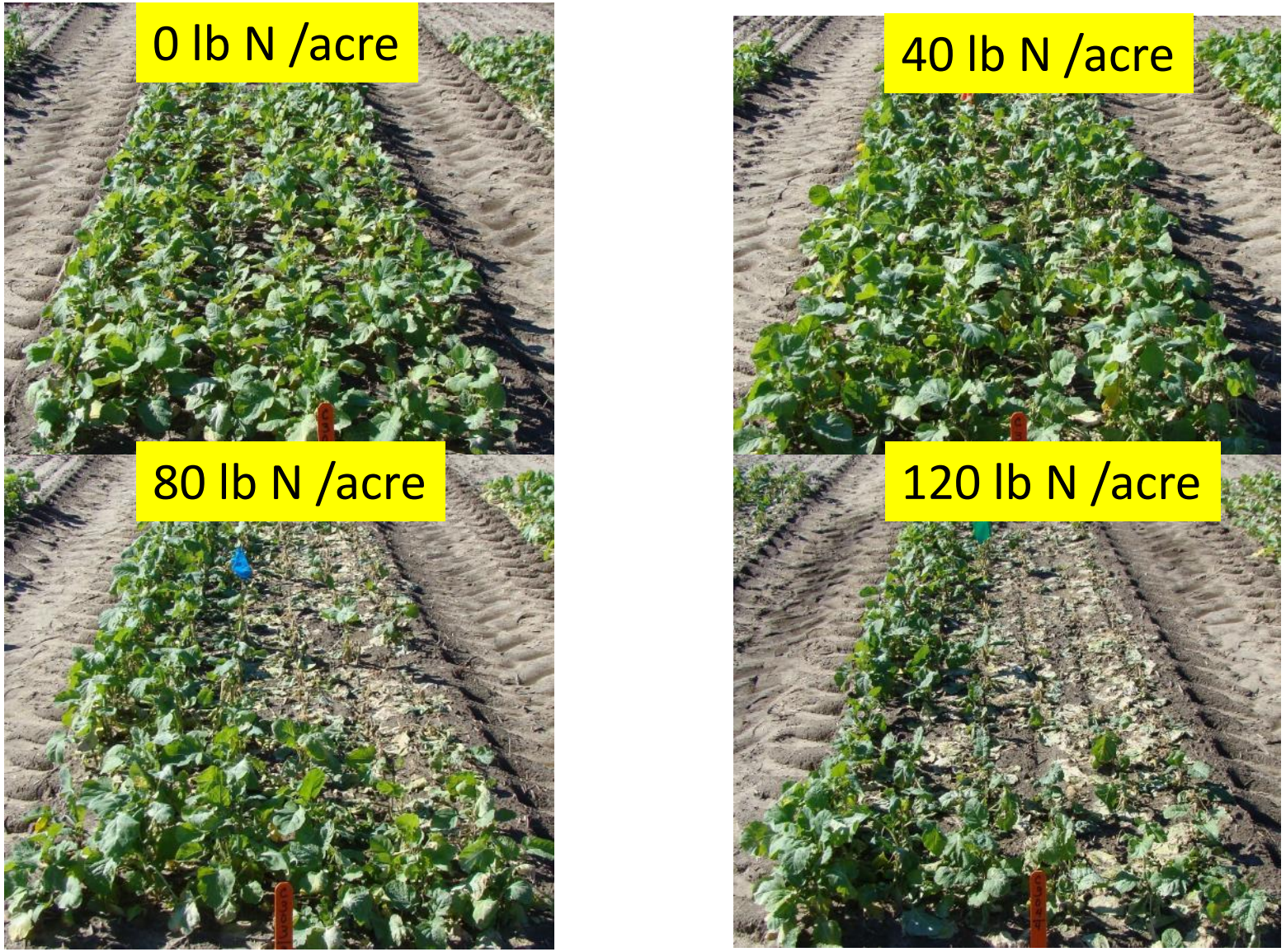
- At planting, apply 20-30 lb/A N and 10-15 lb/A S plus all P and K fertilizer
- At bolting, apply remaining N and S fertilizer

Deep sandy soils

- At planting, apply 20-30 lb/A N, 10-15 lb/A S, 50% K and all P fertilizer
- At bolting, apply 20-30 lb/A N, 10 lb/A S, and remaining K
- At early flowering, apply remaining N fertilizer

N management and freeze damage

Jan. 15, 2014, Quincy FL



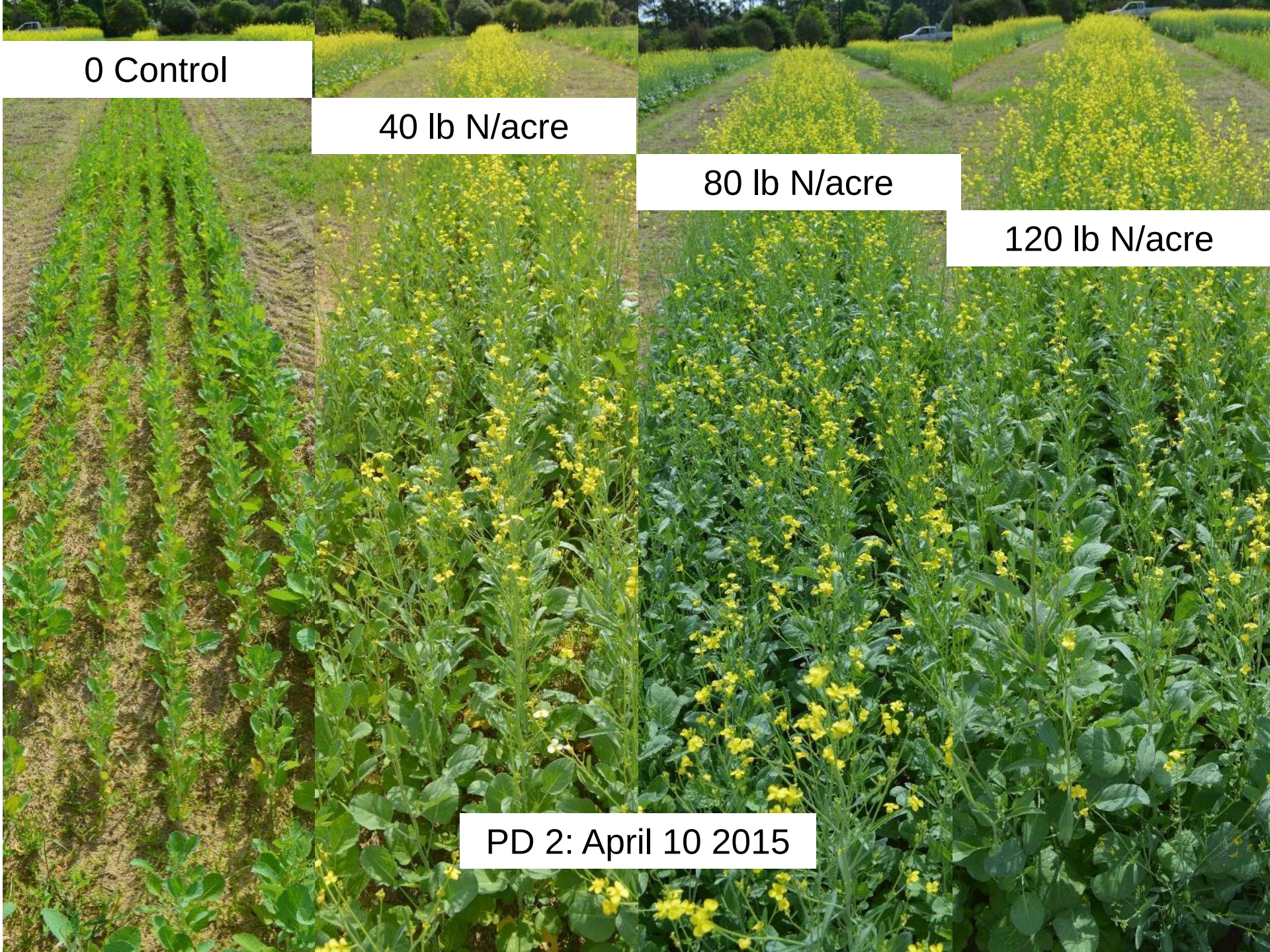
N rate effect on carinata oil quality

Quincy, FL, 2014

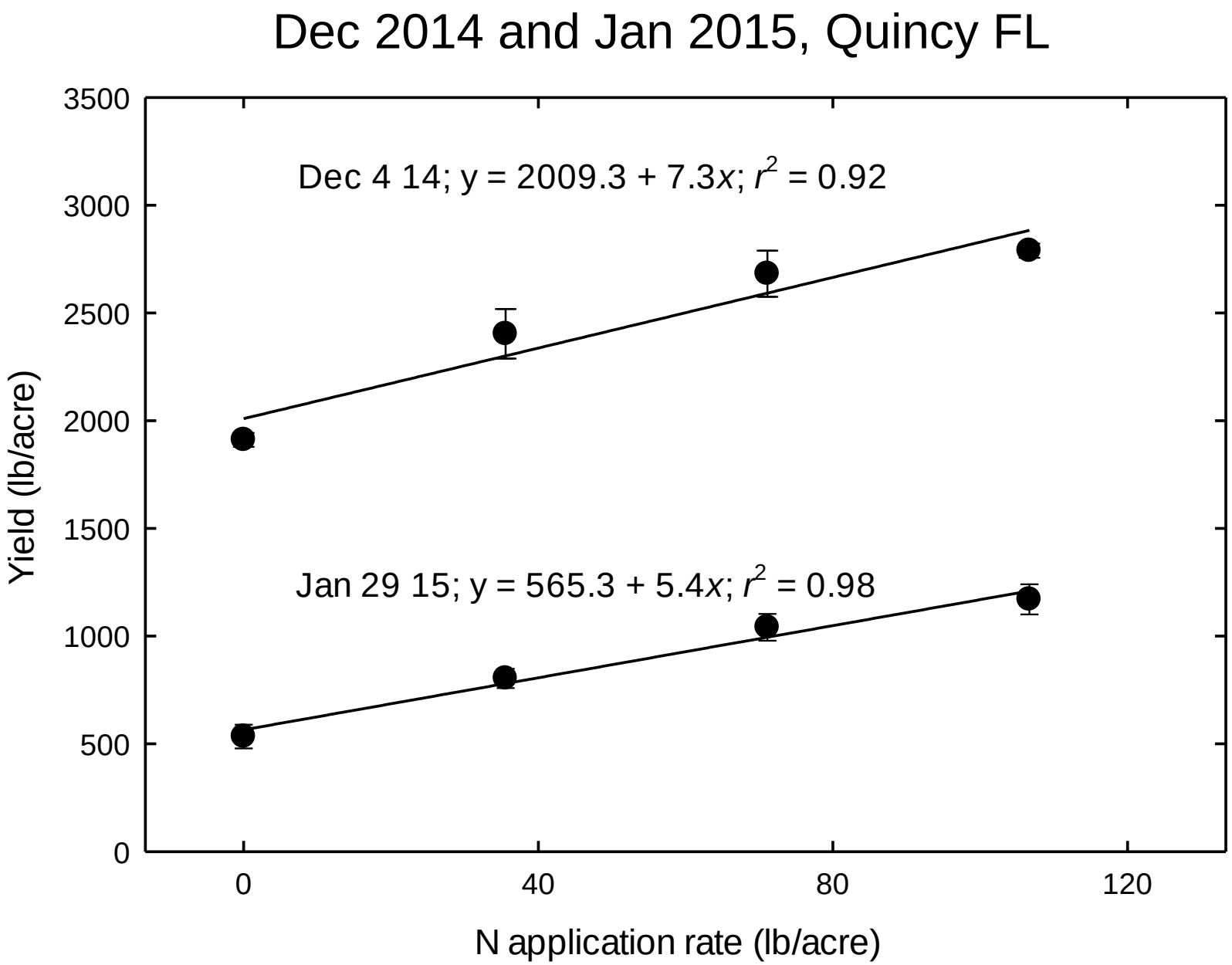
- Oil content and fatty acid distribution not affected by N rate

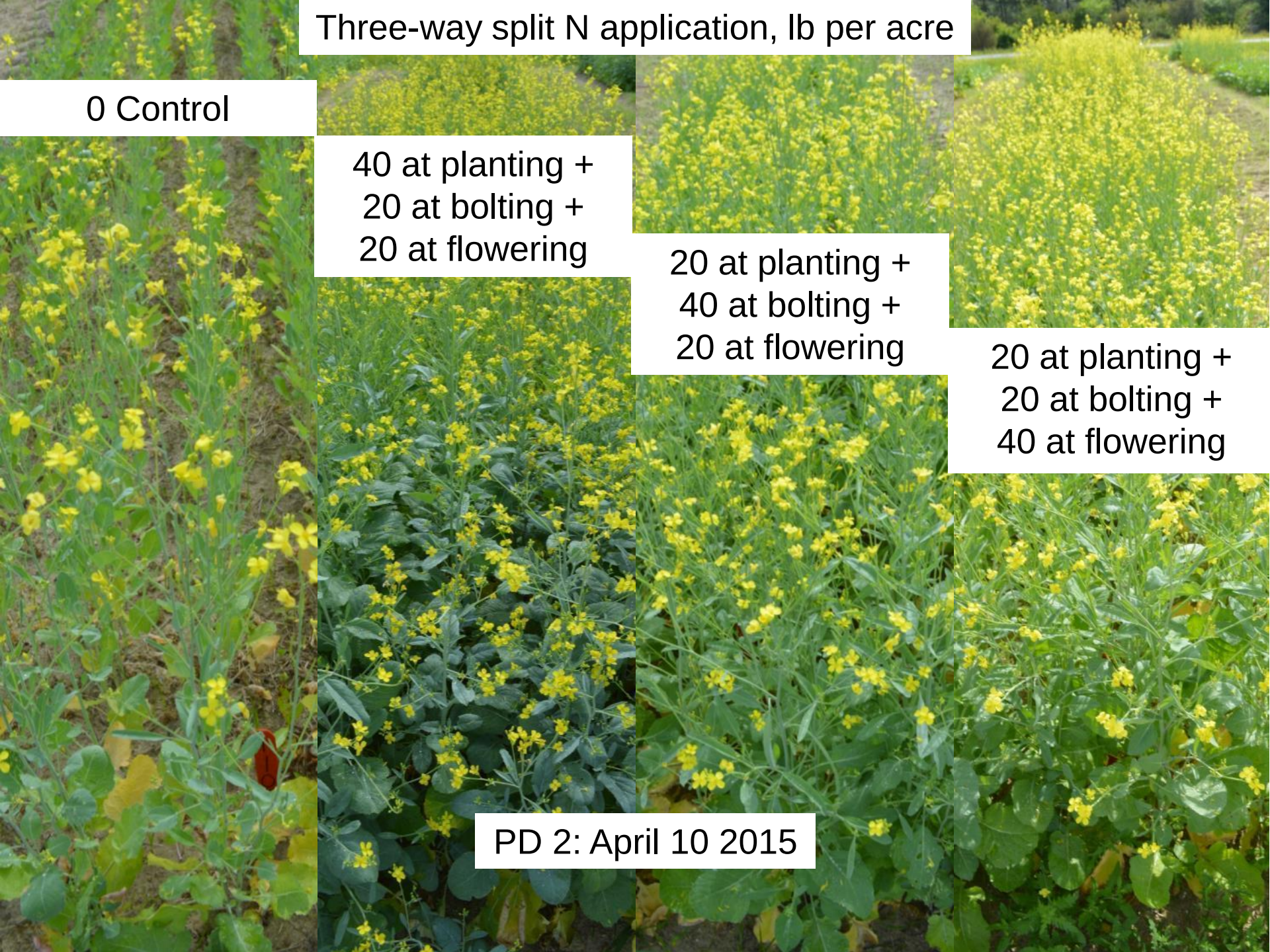
N rate	Seed Yield	Oil content	Oil Yield
lb/acre	lb/A	%	gal/A
0	4678 a	44.9	313.7 a
40	4756 a	44.5	316.3 a
80	4532 a	43.8	297.1 a
120	4242 b	42.7	268.8 b
OPC†	L**	L*	L***

† *, **, *** Orthogonal polynomial contrasts significant at the 0.05, 0.01, and 0.001 levels, respectively.


0 Control
40 lb N/acre
80 lb N/acre
120 lb N/acre
PD 2: April 10 2015

N management and seed yield




Three-way split N application, lb per acre
0 Control
40 at planting +
20 at bolting +
20 at flowering
20 at planting +
40 at bolting +
20 at flowering
20 at planting +
20 at bolting +
40 at flowering
PD 2: April 10 2015

N timing effect on carinata yield

- Oil content and fatty acid distribution not affected by N timing

N application rate timing	Dec. 4, 14	Jan. 29, 15
	lb/acre	
0N control	2137 g	712 e
100% ESN at planting	3047 de	1670 a
100% at planting	3088 de	1473 a
100% at bolting	3174 dc	877 de
100% at flowering	2501 f	817 de
50% at planting + 50% at bolting	3377 bc	1433 ab
50% at planting + 50% at flowering	3084 de	1220 bc
50% at bolting + 50% at flowering	2852 e	1085 dc
50% at planting + 25% at bolting + 25% at flowering	3684 a	1319 bc
25% at planting + 50% at bolting + 25% at flowering	3498 ab	1356 bc
25% at planting + 25% at bolting + 50% at flowering	3079 de	1309 bc
LSD (0.05)	277	292

Disease Management

- Resistant to black leg (*Leptosphaeria maculans*)
- Scouting required throughout the season
- Practice crop rotation to disrupt disease cycles

- Sclerotinia white mold (*Sclerotinia sclerotiorum*)
  - Symptoms appear 2-3 wks after infection
  - Light brown discolored patches on stems, branches and pods
  - Infected plants mature earlier
  - Standout as bleached among healthy plants
  - Stems break and shred at the base

Disease Management

Sclerotinia white mold symptoms

Disease Management

Alternaria symptoms

- Alternaria infects all growth stages
- Spots on leaves have a concentric or target-like appearance and are brown, black or greyish white with a dark border. Leaf spots may join causing leaf death.
- Lesions on green leaves are often surrounded by a yellow halo. Leaf lesions can join and cause leaf death and premature defoliation.
- Stem lesions start as small brown or black dots that elongate and expand.
- Seeds under pod lesions may rot, and pods often prematurely ripen and shatter.

Disease Management

Alternaria symptoms

Disease Management

Fungicide Options

Fungicide	Active Ingredient	Disease/Pest	Timing
Aproach	Picoxystrobin	Sclerotinia	20-50% flowering or prior to onset of disease
Endura	Boscalid	Sclerotinia	20-50% flowering or prior to onset of disease
Quash	Metconazole	Sclerotinia	20-50% flowering or prior to onset of disease
Priazor	Fluxapyroxad + Pyraclostrobin	Alternaria Sclerotinia	Varies according to target disease
Tilt	Propiconazole	Alternaria	Prior to bolting

Insect Management

Aphids

- Feed on the growing shoot tips, causing wilting, decrease plant vigor, flower abortion and reduced pod set
- Honeydew exudate lead to black mold growth
- Turnip mosaic virus vector

Insect Management

Diamond back moth

- Causes delayed maturity, uneven crop development and reduced yields.
- Damage appears as irregular shot hole feeding damage to leaves; larger larvae will also feed on buds, petals and young pods.

Insect Management

Insecticide Options

Insecticide	Active Ingredient	Disease/Pest	Timing
Coragen	Chlorantraniliprole	Diamondback moth	As required by scouting
Intrepid	Methoxyfenozide	Many insects	As required by scouting
Mustand Maxx, Mustang Maxx EC	Zeta-Cypermethrin	Aphids, cutworms, Diamondback moth, stink bugs	As required by scouting
Prevathan	Chlorantraniliprole	Diamondback moth, cutworms, armyworms	As required by scouting

Harvest Management

- Seed moisture will decrease quickly when close to maturity
- Pods and branches will continue to dry and appear brown
- Main stem will remain slightly green
- Harvest at 8-10% seed moisture
- Harvest aid for desiccation of late pods and stem
- Proper set-up of combines is a necessity – check manual for screen size and settings

Harvest Management

Carinata maturation and natural desiccation (var. 994)

50%

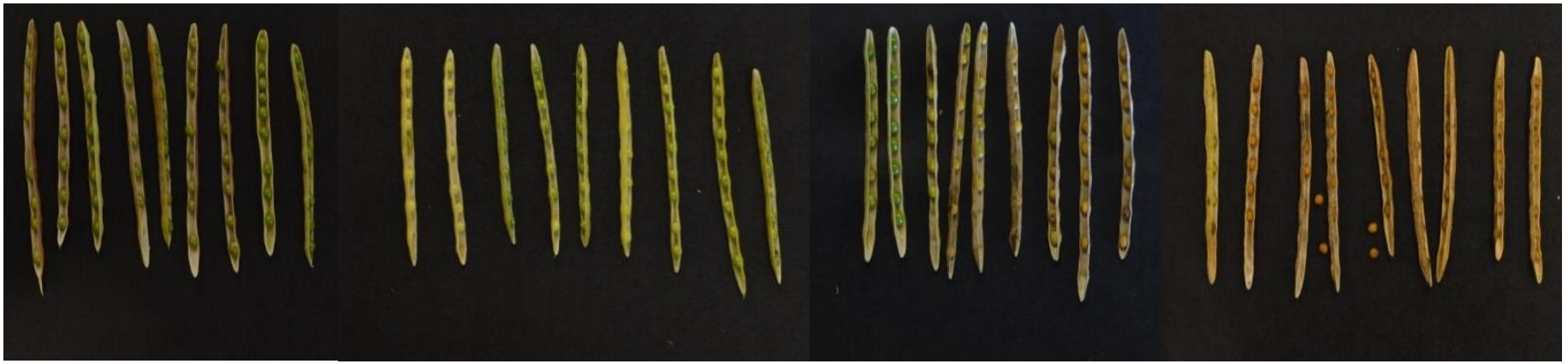
35%

25%

14%

10.5%

May 13 2015 | May 20 2015 | May 27 2015 | June 3 2015



Harvest Management

Staging carinata for chemical desiccation

Pods are tan to brown
Seeds are yellow/brown

Pods are yellow to light brown
Seeds are light yellow
Stems are light green

Pods are light green to yellow
Seeds are green to light yellow

Harvest Management

Staging carinata for chemical desiccation

Desiccated May 13 2015, 50% moisture content

Harvested May 20 2015, 15% moisture content

Harvest Management

Staging carinata for chemical desiccation

Desiccated May 27 2015, 25% moisture content

Harvested June 3 2015, 11% moisture content

Harvest Management

Chemical desiccation effects on carinata yield, Quincy, FL, 2015

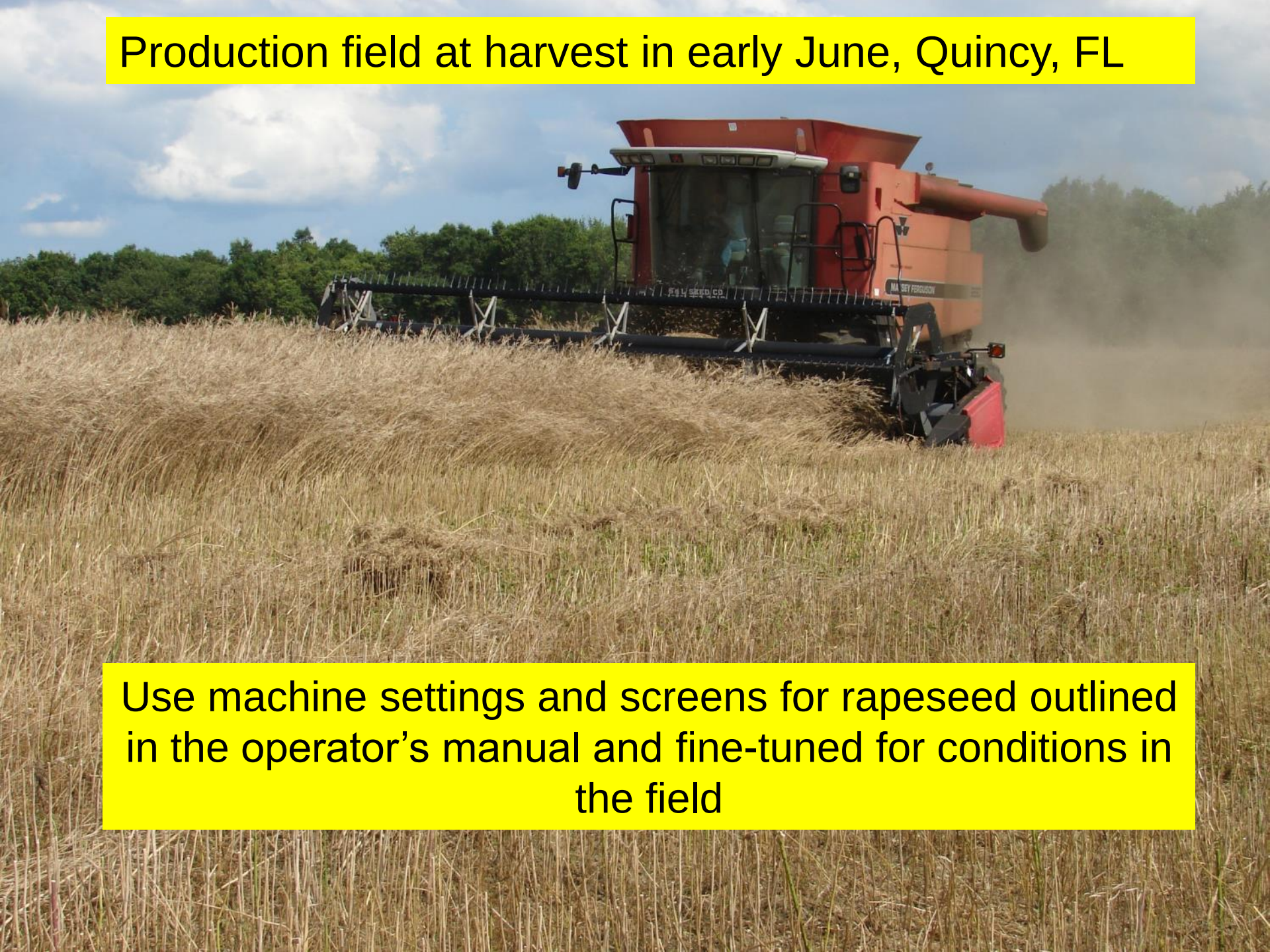
Desiccation date	Harvest date	Seed yield lb/acre	Oil content %
13-May	20-May	1552 c†	36.2 a
20-May	27-May	1676 c	35.4 a
27-May	3-June	2230 b	37.0 a
3-June	11-June	2308 ab	35.5 a
Control	11-June	2475 a	35.4 a
LSD		177	2.1

† Within columns, means followed by the same letter are not different ($P > 0.05$)

Harvest Management

Desiccant	Rate	Application volume	Timing	Notes
Reglone (diquat dibromide)	24 – 30 fl. oz/acre	For ground: minimum 20 gal/acre and For air: minimum of 5 gal/acre.	Physiological maturity	Always use a nonionic surfactant (NIS).
Sharpen (saflufenacil)	1.0 – 2.0 fl. oz/acre	For ground: minimum 20 gal/acre and For air: minimum of 5 gal/acre.	Physiological maturity	Thorough spray coverage and a methylated seed oil plus ammonium-based adjuvant are required for optimum desiccation activity. Do not use NIS as a substitute for MSO.

Production field at harvest in early June, Quincy, FL



Use machine settings and screens for rapeseed outlined in the operator’s manual and fine-tuned for conditions in the field

Crop Rotation

- At least one year, preferably two or three years, between carinata crops
- Fields that have carinata every second year will need frequent scouting and different modes of action for pest control
- Sclerotinia white mold risk increase with short rotations in the same field
- Use normal weed control for carinata volunteers before spring planting
- Carinata has no effect on cotton, peanut or soybeans yield

Crop Rotation

Effects of carinata on yield of row crops, Quincy, FL

Cropping History	Peanut	Cotton	Soybean
	lb/acre		bu/acre
	2014		
Carinata-	6140 a†	1333 a	60 a
Fallow-	5600 b	1284 a	58 a
LSD	276	442	8
	2015		
Carinata-	5924 a	1056 a	41 a
Fallow-	5813 a	1055 a	41 a
LSD	783	141	11

† Within columns, means followed by the same letter are not different ($P > 0.05$)

Crop Rotation

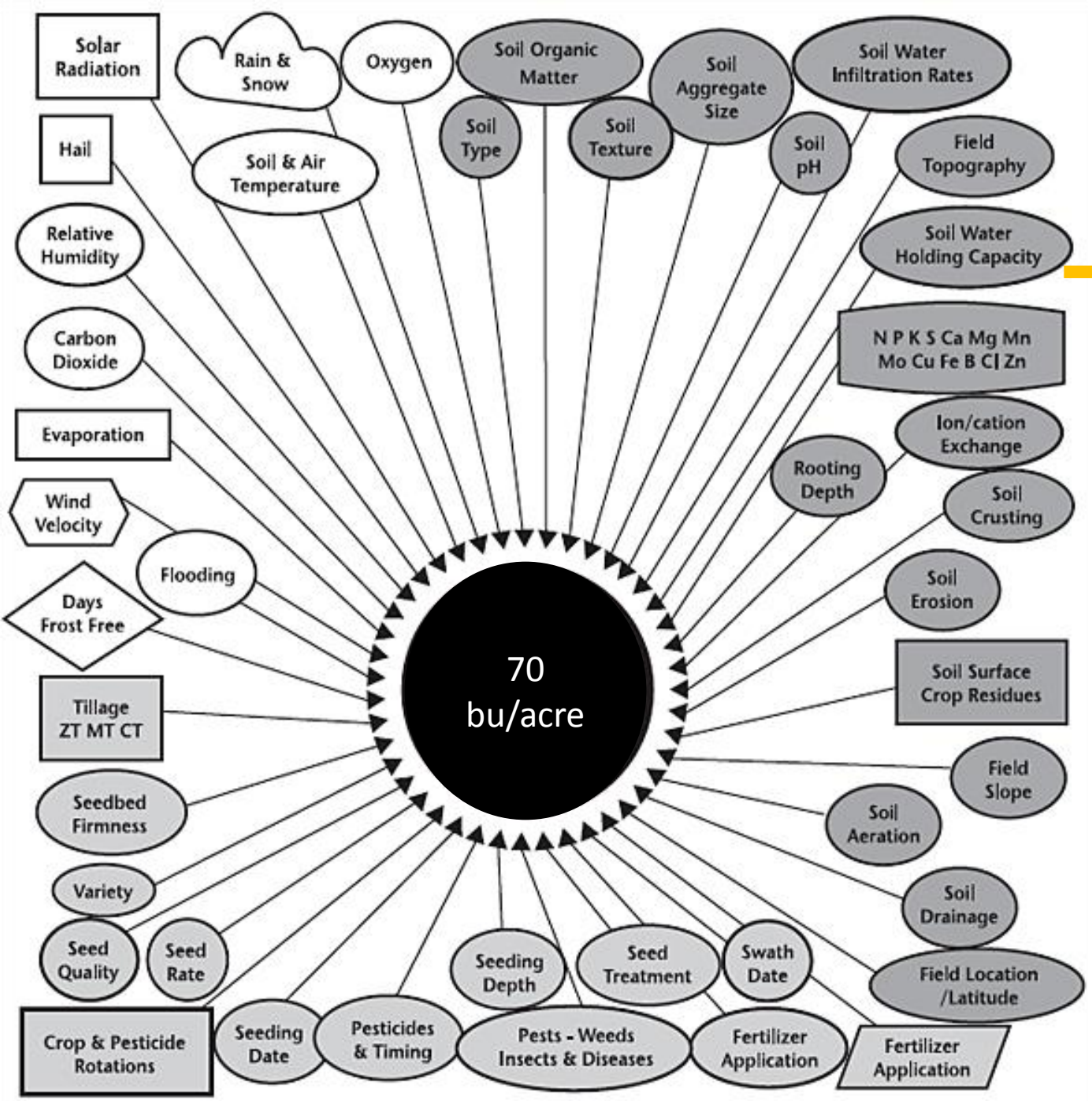
Effect of planting date on summer crop yields, Quincy, FL

Planting date	Peanut	Cotton	Soybean
	lb/acre		bu/acre
	2014		
Optimum time	6500 a (126)†	1260 a (118)	–
Late planted‡	5870 b (168)	1309 a (168)	59 (168)
	2015		
Optimum time	6500 a (126)	1422 a (112)	43 a (168)
Late planted	5869 b (167)	1055 b (168)	41 a (169)

† Numbers in parentheses are the Julian days of the corresponding year

‡ Mean of fallow and carinata predecessor crop

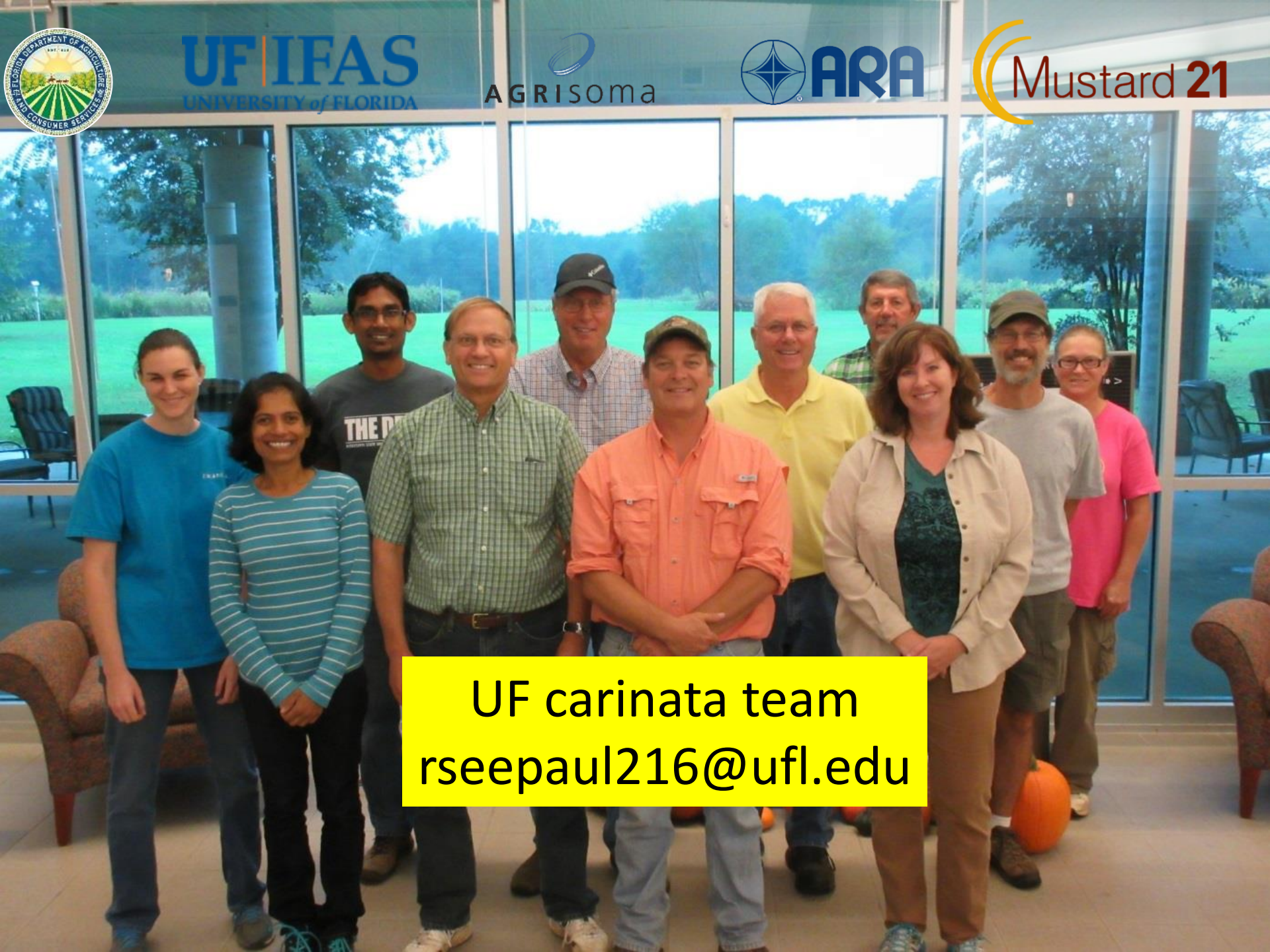
Factors affecting yield



http://www.canolacouncil.org/crop-production/canola-grower's-manual-contents/chapter-1-the-basis-of-canola-yields/the-basis-of-canola-yields

Key Management Strategies

- Rotations (winter crop before soybean, sorghum, sesame, etc., ALS herbicides?)
- Variety selection - yield, maturity
- Fertility (soil test P, K, Ca, Mg, micros, pH)
- Planting date (Nov. 1-15)
- Chisel plough or deep tillage (10-20 bu/ac increase)
- Seed at 5-6 lb/A into a firm, moist seedbed ½ to ¾” deep
- Use 14” row spacings (10-40 bu/ac increase over 7 or 21” rows)
- N applied at 20-40 lb/acre at planting followed by 20-40 lb/acre late Jan. early Feb.
- Insect and disease control- scout and apply pesticides as needed
- Direct combining at 8-10% moisture, dessication can be used to hasten harvest maturity


UF IFAS
UNIVERSITY of FLORIDA
AGRISOMA
ARA
Mustard 21
UF carinata team
rseepaul216@ufl.edu


Carinata Economics

Estimated cost of production per acre

Variable Costs	Lower range	Upper range	Lower range	Upper range
Establishment			*18*	*14*
Land preparation	15	20		
Seed	20	30		
Crop Maintenance			*53*	*59*
Fertilizer	100	140		
Irrigation	0	30		
Crop Protection	5	35		
Fuel and harvesting			*22*	*19*
Fuel	4	7		
Harvest	40	50		
Delivery	0	10		
Insurance	*15*	*25*	*8*	*7*
Total	199	347		
Average		**273**		

Net returns per acre

Function of yield and price

- 2015/2016 contract price is $0.17 cents per pound flat price or $8.50 per bushel or $340.00 per ton, net of dockage.
- Anticipate dockage at 3-4% from historical production
- Maximum moisture is 10%, >10% can cause heating issues.

Price ($/bu)	Yield (bu/ac)			
	40	**50**	**60**	**70**
8.0	45	125	205	285
8.5	65	150	235	320
9.0	85	175	265	355