Brassica carinata: A Biofuel Feedstock Ready for Takeoff

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University of Florida

AGRISOMA

UF IFAS UNIVERSITY of FLORIDA

ARA

UF Carinata Program

http://programs.ifas.ufl.edu/carinata/

David Wright

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Brassica carinata: from seed to seed

Emergence/seedling establishment

25 DAP

Vegetative

70 DAP

Bolting

95 DAP

Flowering

120 DAP

Seed development/ maturation

145/175 DAP

Seed desiccation

190 DAP

Carinata research at UF

- identifying early adopters across SE
- improving system fit
- minimizing risk across supply chain

Field days, summits, outreach engaging multiple stakeholders for production and market updates

Over 10,000 acres of carinata produced from 2014 onwards through farmer contracts

High yielding, cold tolerant variety identified in 2015-now launched as commercial variety

ARA uses carinata oil for DoN campaign-2014

$1.1m grant from FDACS Office of Energy to demonstrate feedstock development in FL -2013

First jet flies on CH process based drop-in fuel from carinata - 2012

Carinata research plot trials initiated - 2011-UF/Agrisoma/ARA

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Why Carinata?

Desirable oil chemistry and agronomics

- Non edible industrial oil feedstock with proven conversion technology
- Highly desirable fuel chemistry for ‘drop in’ aviation fuels
- Superior agronomic traits (drought, heat tolerant, little seed shatter, non-dormant)

Infrastructural fit

- Fits current agricultural infrastructure of harvesting, handling, storage, transportation, processing etc.
- Crush facilities available

Opportunity for value enhancement

- High value seed meal as well as chemical co-products

Why Carinata?

Crop timing conducive for production and consistent feedstock supply

- Planted on fallowed underutilized lands
- Planted in fall and harvested in spring in the southeast
- Low water footprint
- Double cropped for increased farmer revenue-leaving May-October for summer crop

Ecosystem services

Improve soil quality

- Increase soil organic matter
- Improve soil structure, quality, tilth
- Reduce soil erosion
- Enhance soil microbial biodiversity
- Reduce soil compaction

Improve soil fertility

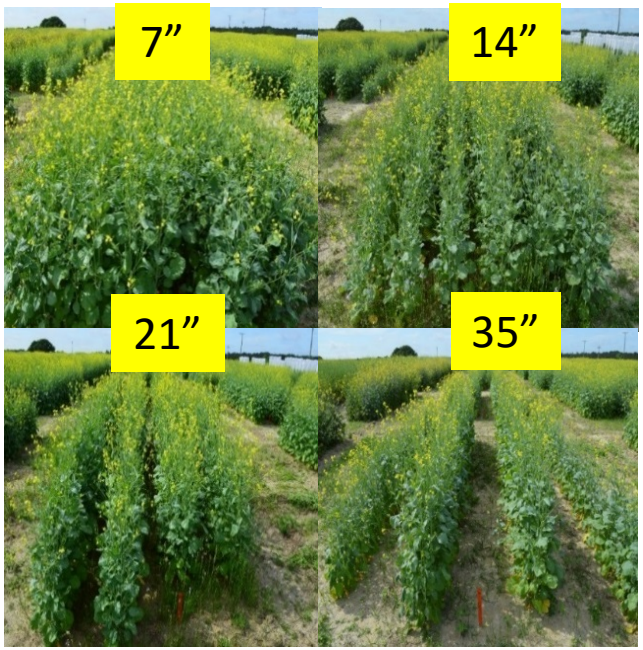
- Reduce nutrient leaching
- N, P, K scavenger
- Increase nutrient cycling

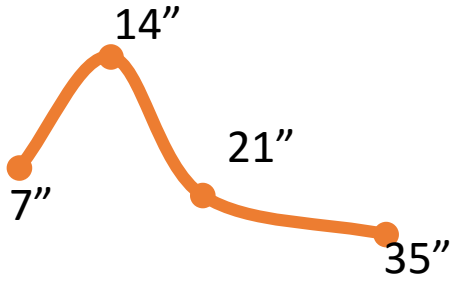
Pest reduction

- Suppress weeds
- Reduce nematodes

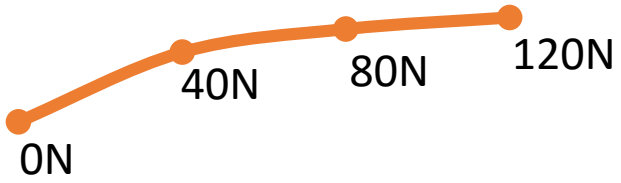
Carinata Best Management Practices

Row spacing





Nitrogen nutrition



First carinata production guide produced for 2014

UF | IFAS Extension
UNIVERSITY of FLORIDA

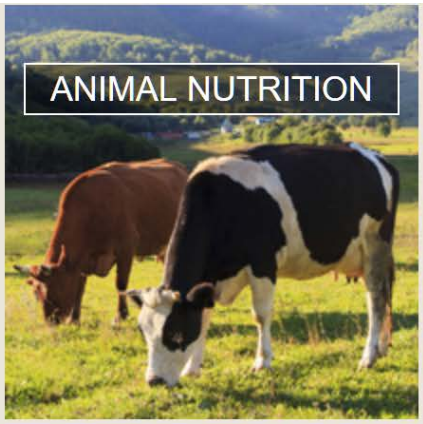
SS-AGR-384

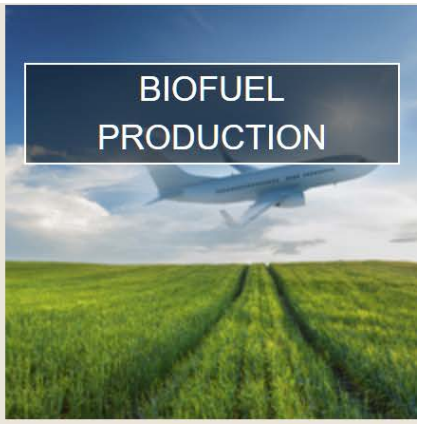
Carinata, the Jet Fuel Cover Crop: 2016 Production Recommendations for the Southeastern United States[1]

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

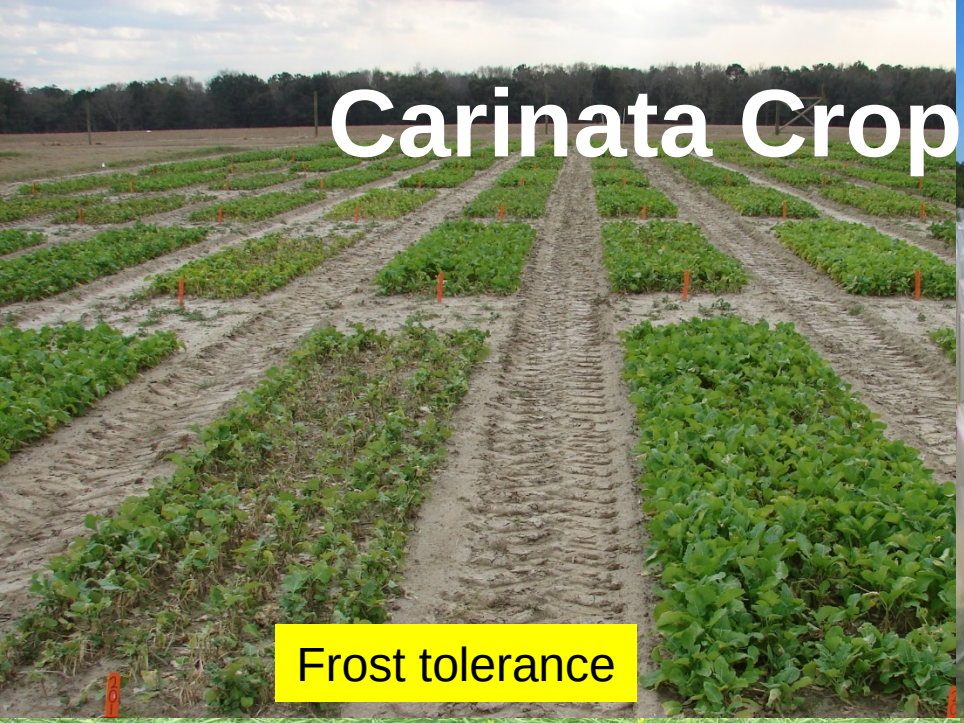
Brassica carinata (carinata) is an oilseed crop with great potential for profitable cultivation in the southeastern US. Its high oil content and favorable fatty acid profile make it suitable for the biofuel industry as a biojet fuel. The UF/IFAS North Florida Research and Education Center (NFREC) in 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

UF-Agrisoma partnership





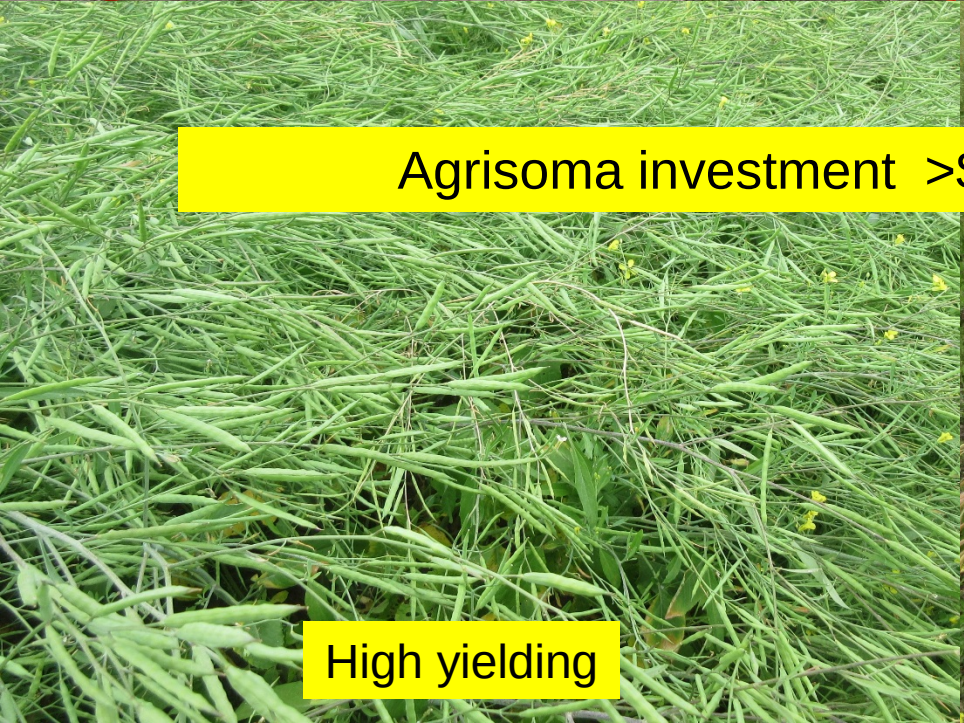
Carinata Crop Improvement



Frost tolerance

NAM population

Agrisoma investment >$3 million in SE US to date

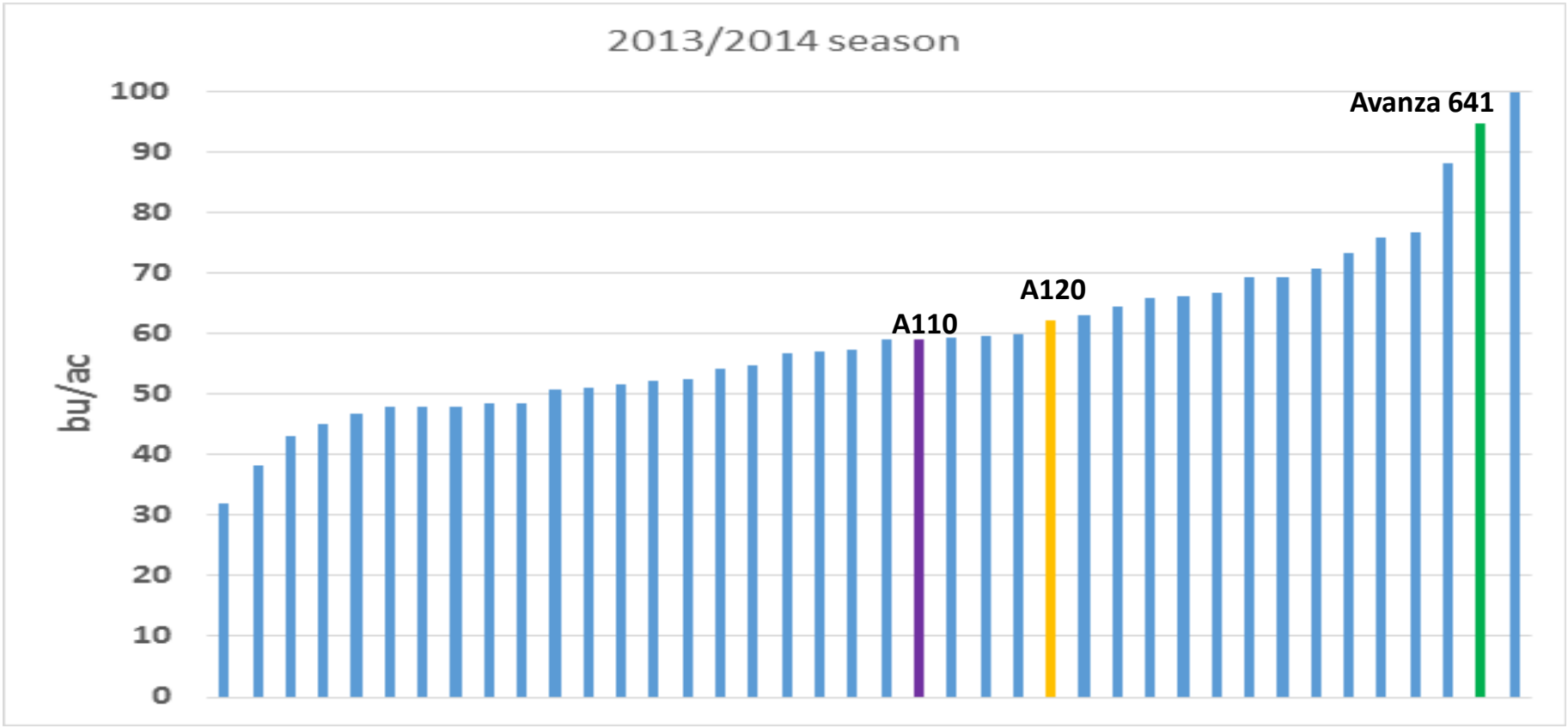


High yielding

Early maturing

Advancing carinata genetics

Value of variety or genotype testing –each evaluated for maturity, cold tolerance, disease resistance, yield and oil content and quality



AGRIsoma

Extension Efforts

Regional Production Meetings

Research & Production Summits

Plot Tours

Farm Field Days/Tours

Research translated to initiation of commercialization

Partnering with John Deere on combine setup

First shipment of carinata loaded at Cargill's port facility in Tampa from SE production

Production Goals

3500 lb seed/acre

200 gal oil/acre

$200-300 profit/acre

UF-ARA partnership

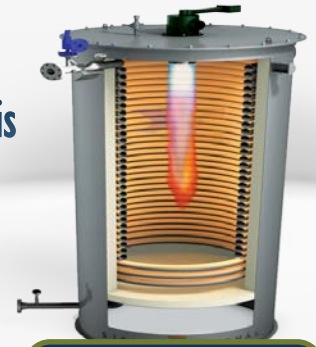
Biofuels ISOCONVERSION Process (BIC)

Converts fats, oils, and greases from plants, animals, or algae into “drop-in” renewable fuels

ARA

Catalytic Hydrothermolysis (CH)

- Supercritical water
- Produces crude oil containing the same hydrocarbon types as petroleum crude



2 Minutes
Converts fats oils and greases to crude oil

CLG
Chevron Lummus Global

Hydrotreating

- Saturates olefins
- Removes residual oxygenates

Conventional
Refinery Processes

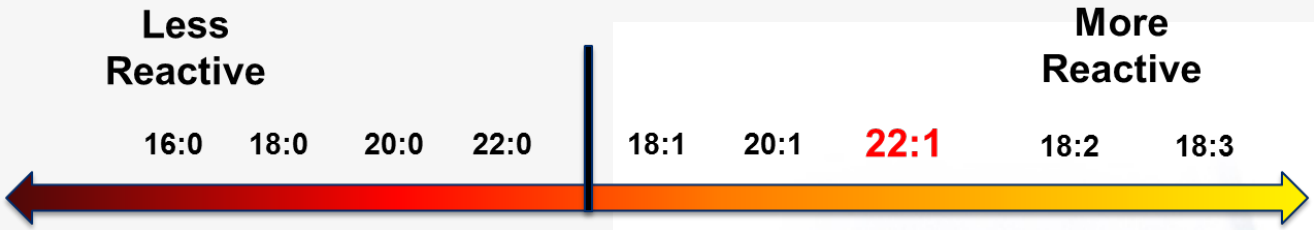
Fractionation

- Produces finished fuels
- Jet and diesel that meet
- Meets petroleum specs without blending
- Renewable chemicals, and naphtha

Conversion of Carinata Oil

High concentration of Erucic acid (22:1)

ARA investment >$2.6 million in SE US to date

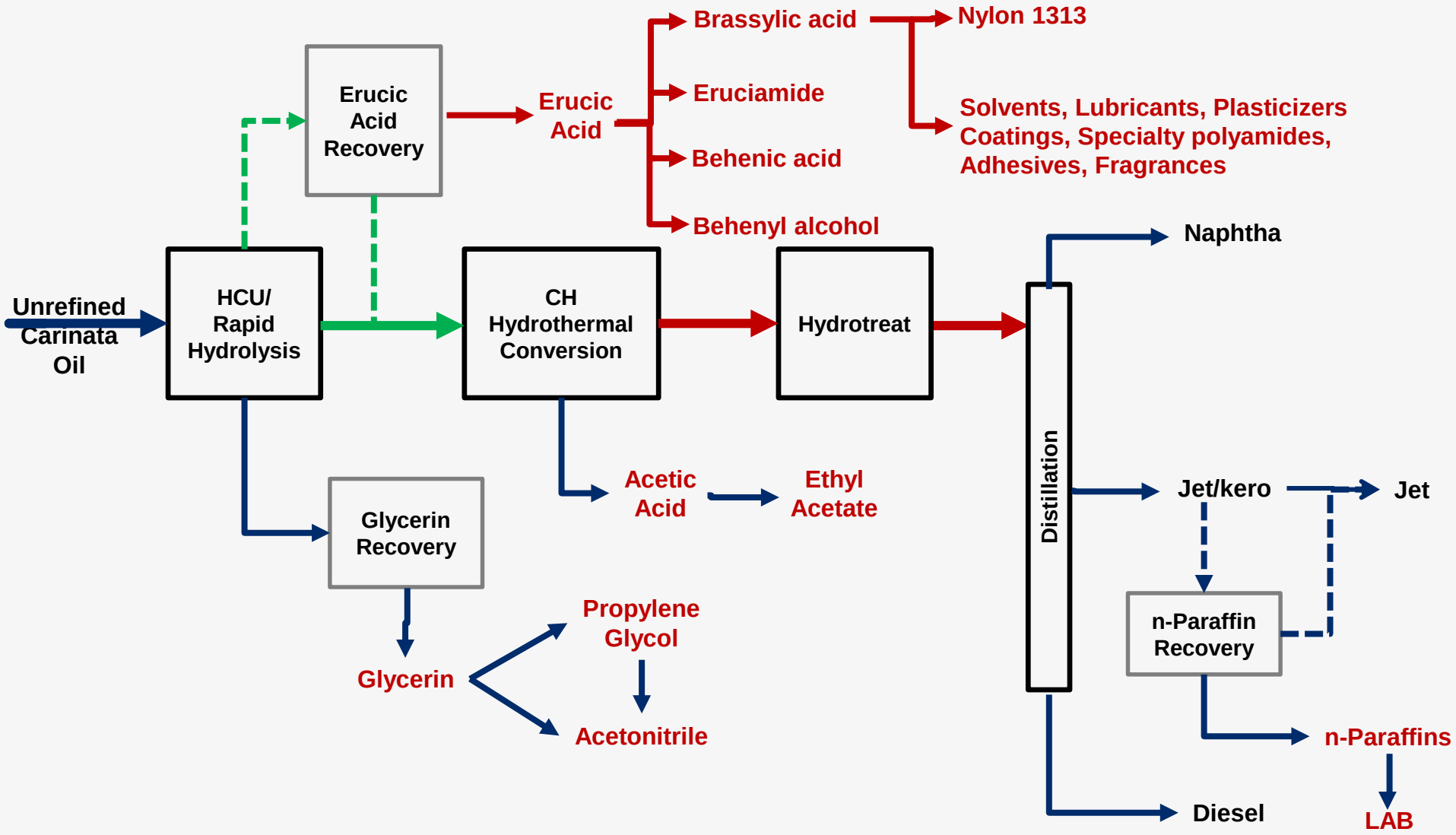


- High yield of cycloparaffins & aromatics
- High density and energy content
- Excellent low-temperature properties

Higher molecular weight than Soybean, Canola, Jatropha

- Higher yield of hydrocarbon fuels & chemicals than C18 oils
- Potentially 2 wt% net increase in hydrocarbon yield
- Equates to ~100 bbl/day for a 5000 bbl/day commercial refinery
- Potential to add over $3M/year in revenue

ARA's Oil Conversion and Co-products



Production of Certification Fuel for DLA-Navy

- Navy certification - neat, unblended CHJ
- CHCJ-5 fuel production
  - Crude oil produced by CH conversion in St Joseph, Missouri, 100 bbl/day pilot
  - Finished fuel hydrotreating and distillation – Centauri – Pasadena, TX

	JP-5 (CHCJ-5) 60°C Flash Jet	F-76 (CHCD-76) 60°C Flash Diesel	Gallons Total
U. S. Navy (DLA)	72,000	79,000	151,000
Other*	9,000		9,000
Total	81,000	79,000	160,000

Others performing tests:

- Lufthansa, AFRL, U.S. Army, and Swedish Military

SECNAV
F-18 Flight Test
100% CHCJ-5

Nine
F-18 Flight Tests
Completed

Positioning Carinata for Take-off

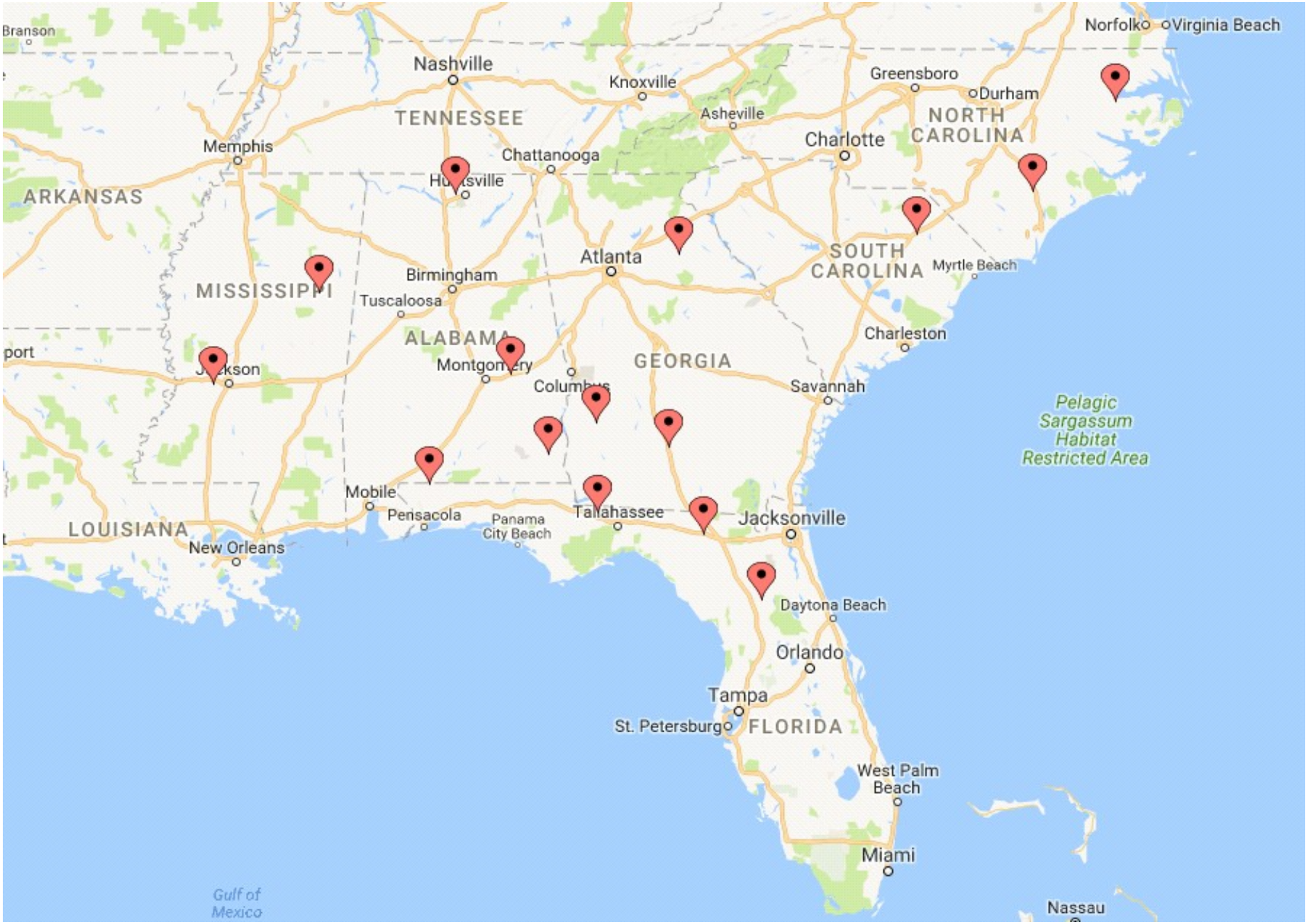
Carinata Feedstock Readiness Level
(FSRL, Scale 1 – 9)*

Categories	Current Status	5 Yr Goal
Production	3.2	8
Linkage to Conversion	6.2	9
Market	4.2	8
Policy	1.5	4.2

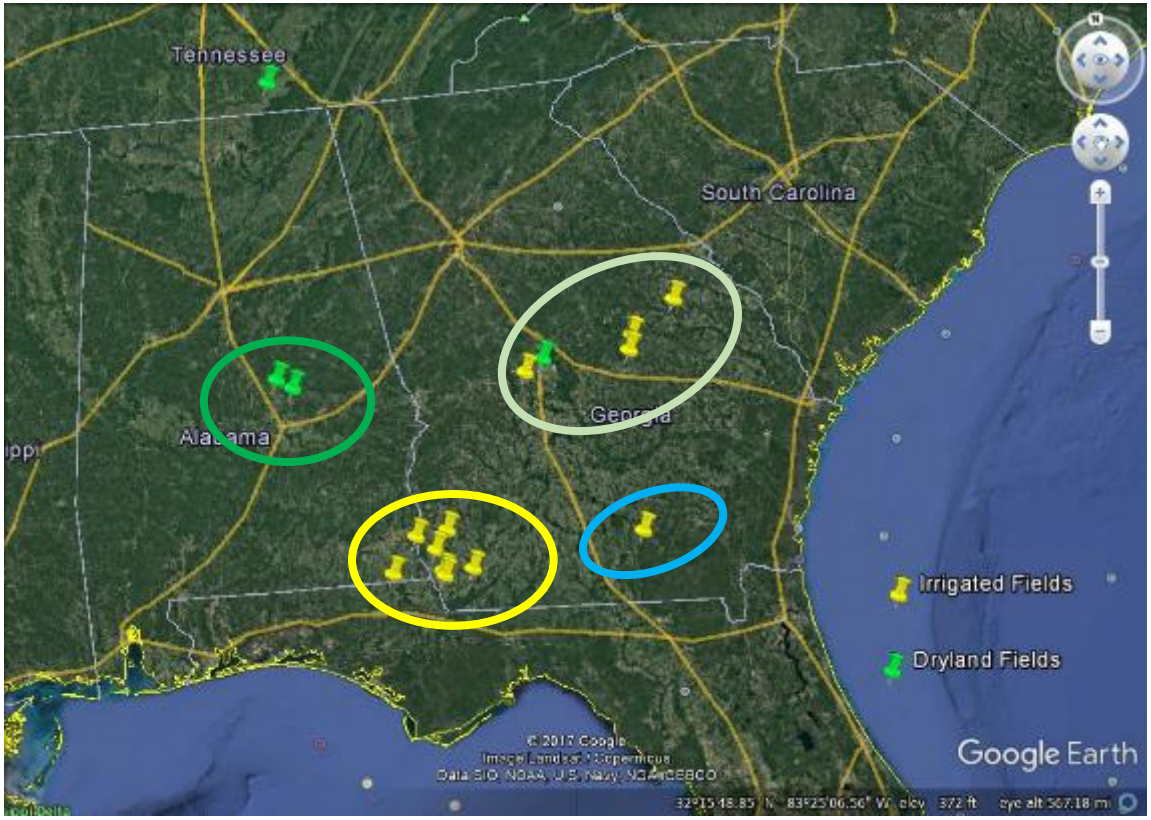
* From concept (1) to full commercialization (9)

Risk management along the carinata supply chain

- Eliminating barriers to production and managing risk along the supply chain
- Best management practices for production
- Evaluation of carinata breeding material and advanced varieties
- Cropping systems study and Life Cycle Analysis
- Integrated disease/pest/weed management for carinata


Branson
Nashville
Knoxville
Greensboro
Durham
Norfolk
Virginia Beach
TENNESSEE
Asheville
NORTH CAROLINA
Charlotte
Memphis
Chattanooga
ARKANSAS
Atlanta
SOUTH CAROLINA
Myrtle Beach
MISSISSIPPI
Birmingham
Tuscaloosa
ALABAMA
Charleston
GEORGIA
Montgomery
Columbus
Savannah
Pelagic Sargassum Habitat Restricted Area
Mobile
Pensacola
Panama City Beach
Tallahassee
Jacksonville
LOUISIANA
New Orleans
Daytona Beach
Orlando
Tampa
St. Petersburg
FLORIDA
West Palm Beach
Miami
Gulf of Mexico
Nassau

2016-17 Commercial Field Locations/Zone



Zone 1: SW GA, S. AL, N. FL
7 Farms

Zone 2: Central AL
2 Farms,

Zone 3: Central GA
5 Farms,

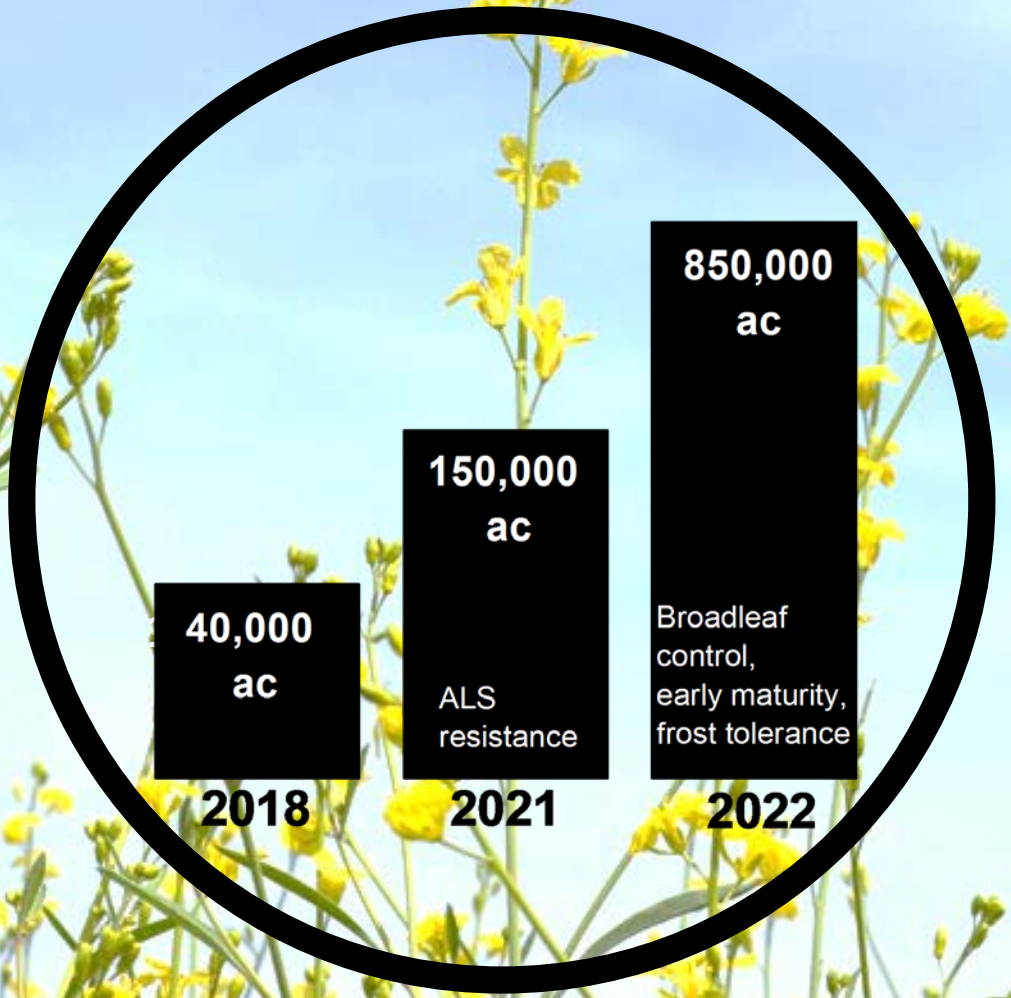
Zone 4: SE GA
1 Farm

2017-18 Program Goal: 25,000 acres (MS, AL, GA, FL)

2018-19 Program Goal: Acre expansion - TBD

Carinata Commercialization in the SE

5 years



AL, FL
GA, MS
SC, NC

Vision for Commercial Deployment

Demonstrate capacity

- Refine feedstock production and expansion for maximum productivity
- Develop risk mitigation and optimization tools to support scaling
- Establish communities of practice and stakeholder consortia spurring sustained interest and investment

Increase Demand

- Provide renewable fuel and co-product samples to multiple endusers
- Demonstrate value of meal based co-products
- Demonstrate value along entire supply chain

Ramp up capacity

- Policy informed by scientific process and stakeholder engagement
- Scale SE US carinata production
- Drive infrastructure establishment to support carinata enterprise

Build resilient supply chain

- Develop comprehensive support system- from producer to end user
- Ensure economic value and low risk across supply chain through robust supply chain modeling
- Build workforce to sustain carinata supply chain


Questions?
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