The Effects of Planting Date and N Application Rate on *Brassica carinata* Production in North Florida

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

- Carinata
- Canola
- Camelina
Crop profile

- Drought and heat tolerant
- Low rates of seed shattering
- Amenable to existing production infrastructure
- Large seeded mustard (300,000 to 350,000 seeds kg\(^{-1}\))
- Non-dormant

<table>
<thead>
<tr>
<th>Stage</th>
<th>25 DAP</th>
<th>50 DAP</th>
<th>70 DAP</th>
<th>80 DAP</th>
<th>125/165 DAP</th>
<th>190 DAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergence/seedling</td>
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<tr>
<td>Vegetative establishment</td>
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<td>Bolting</td>
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<td>Flowering</td>
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<tr>
<td>Seed development/maturation</td>
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<tr>
<td>Seed dessication</td>
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</tbody>
</table>
Introduction

- Carinata was derived from the interspecific hybridization of *B. nigra* and *B. oleracea*

- It is a non-food industrial oil seed crop with long chain fatty acids for naphtha, jet, and diesel fuel production

- Carinata meal is a source of protein in livestock feed

- Development of best management practices are required to guide production in North Florida
Objective

To quantify the effects of planting date and N application rates on carinata grain and oil yield, yield components and oil composition
Methodology

Exp. I: Planting date and variety effects

- Studies conducted at NFREC, Quincy FL during the 2013/2014 winter/spring growing season
- Planted with Hege 1000 at 0.12 m row spacing, 6 rows per plot. Plot size: 1m x 4.6 m
- Experimental Design: RCDB with 4 reps
- Treatments: Factorial combination of variety and planting date
  - Variety (Agrisoma 814 and 994)
  - Planting date (Oct. 21, Nov. 13, and Dec. 13, 2013)
Methodology

Exp. I: Planting date and variety effects

- Applied 280 kg ha\(^{-1}\) 5-15-30 on Oct. 14, 2014 and 67 kg ha\(^{-1}\) 34-0-0 on Feb 4, 2014 to all PD

- Proline\(^{\circledR}\) applied at 0.42 l ha\(^{-1}\) on Dec. 17, 2013 to PD 1 & 2, on Jan. 13, 2014 to PD 2 & 3 and Mar. 4, 2014 to PD 3

- Harvested June 2, 2014 (224, 201 and 171 DAP) with Wintersteiger plot combine.
Methodology

Exp. II: N rate and tillage method effects

- Treatments: Factorial combination of N rate and tillage method
  - N rate (0, 45, 90 and 135 kg ha\(^{-1}\))
  - Tillage method (Disk and Chisel)
- Applied 280 kg ha\(^{-1}\) 5-15-30 on Oct. 14, 2014
- Planted Nov. 13, 2014
- Applied N fertilizer on Dec. 2, 2014
- Proline® applied at 0.42 L ha\(^{-1}\) on Dec. 17, 2013 and Jan 13 2014
- Harvested on June 3, 2014 (202 DAP)
Methodology

Data collection

- Freeze injury, stand count
- Plant height
- Grain yield (8% moisture)
- Yield components
- Oil profile (NIRS)

Data analysis

- Data were analyzed by ANOVA using PROC GLM in SAS.
- Fisher’s protected least significant difference (LSD, $\alpha = 0.05$) was used to compare treatment means.
Results

Planting date effect
Results

Weather conditions
Planting date effect

Carinata Plant Height and Plant Density

Variety effect ($P = 0.0012$)
Variety effect ($P = 0.04$)

Planting date effect ($P < 0.0001$)
Planting date effect ($P < 0.0001$)
Agrisoma 994
Jan. 15, 2014
Planting date effect

Carinata Freeze Injury

Variety Planting date interaction effect ($P = 0.02$)
Planting date effect

**Carinata Grain Yield**

Planting date effect ($P < 0.0001$)
# Planting date effect

## Carinata Grain Yield Components

<table>
<thead>
<tr>
<th>Planting Date</th>
<th>Primary Branches</th>
<th>Secondary Branches</th>
<th>Pods Plant(^{-1})</th>
<th>Pod Length</th>
<th>Seeds Pod(^{-1})</th>
<th>Seeds Plant(^{-1})</th>
<th>Dry Matter plant(^{-1})</th>
<th>1000 SW</th>
<th>Yield</th>
<th>Plant Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct. 21</td>
<td>20.3 a†</td>
<td>91.2 a</td>
<td>1727.3 a</td>
<td>55.3 ab</td>
<td>14.5 a</td>
<td>62.4 a</td>
<td>239.1 a</td>
<td>2.9 a</td>
<td>1308 c</td>
<td>12.8 c</td>
</tr>
<tr>
<td>Nov. 13</td>
<td>14.9 b</td>
<td>59.7 b</td>
<td>658.0 b</td>
<td>51.7 a</td>
<td>13.1 a</td>
<td>26.9 b</td>
<td>89.7 b</td>
<td>2.9 a</td>
<td>3989 a</td>
<td>65.7 a</td>
</tr>
<tr>
<td>Dec. 13</td>
<td>11.3 c</td>
<td>28.2 c</td>
<td>262.3 c</td>
<td>48.1 b</td>
<td>13.1 a</td>
<td>12.5 c</td>
<td>41.8 c</td>
<td>3.2 a</td>
<td>1737 b</td>
<td>43.5 b</td>
</tr>
<tr>
<td>LSD</td>
<td>3.1</td>
<td>16.8</td>
<td>357.2</td>
<td>2.7</td>
<td>2.3</td>
<td>13.2</td>
<td>43.8</td>
<td>0.4</td>
<td>858</td>
<td>16.8</td>
</tr>
</tbody>
</table>

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

## Carinata Oil Yield and Composition

<table>
<thead>
<tr>
<th>Planting date</th>
<th>Grain Yield</th>
<th>Oil Yield</th>
<th>Oil</th>
<th>Protein</th>
<th>C 16:0</th>
<th>C 18:0</th>
<th>C 18:1</th>
<th>C 18:2</th>
<th>C 18:3</th>
<th>C 20:1</th>
<th>C 22:1</th>
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</thead>
<tbody>
<tr>
<td>Oct. 21</td>
<td>1308 b†</td>
<td>621 b</td>
<td>38.1 b</td>
<td>30.1 a</td>
<td>3.2 a</td>
<td>1.1 b</td>
<td>13.7 b</td>
<td>18.5 a</td>
<td>12.4 a</td>
<td>9.6 a</td>
<td>35.0 a</td>
</tr>
<tr>
<td>Nov. 13</td>
<td>3989 a</td>
<td>1982 a</td>
<td>40.1 a</td>
<td>28.7 a</td>
<td>3.1 a</td>
<td>1.1 b</td>
<td>13.7 b</td>
<td>17.8 a</td>
<td>12.3 a</td>
<td>9.9 a</td>
<td>36.4 a</td>
</tr>
<tr>
<td>Dec. 13</td>
<td>1737 b</td>
<td>839 b</td>
<td>39.0 ab</td>
<td>29.8 a</td>
<td>3.2 a</td>
<td>1.2 a</td>
<td>15.0 a</td>
<td>18.6 a</td>
<td>11.9 b</td>
<td>9.4 a</td>
<td>35.9 a</td>
</tr>
<tr>
<td>LSD</td>
<td>858</td>
<td>462</td>
<td>1.71</td>
<td>1.48</td>
<td>0.13</td>
<td>0.04</td>
<td>0.99</td>
<td>0.86</td>
<td>0.25</td>
<td>0.52</td>
<td>1.43</td>
</tr>
</tbody>
</table>

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

N application rate effect
N Application Rate Effect
Carinata Plant Height and Plant Density

N rate effect \( (P = 0.03) \)
Jan. 15, 2014

0 kg N ha\(^{-1}\)  
90 kg N ha\(^{-1}\)  
135 kg N ha\(^{-1}\)  
45 kg N ha\(^{-1}\)
N Application Rate Effect
Carinata Freeze Injury

N rate effect ($P < 0.0001$), Tillage effect ($P = 0.0013$)
N Application Rate Effect
Carinata Grain Yield

N rate effect ($P = 0.0072$), Tillage effect ($P = 0.0014$)
## N Application Rate Effect

### Carinata Yield Components

<table>
<thead>
<tr>
<th>N Rate (kg ha⁻¹)</th>
<th>Primary Branches</th>
<th>Secondary Branches</th>
<th>Pods Plant⁻¹</th>
<th>Pod Length</th>
<th>Seeds Pod⁻¹</th>
<th>Seeds Plant⁻¹</th>
<th>Dry Matter plant⁻¹</th>
<th>1000 SW</th>
<th>Plant Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>no.</td>
<td>mm</td>
<td>no.</td>
<td>g</td>
<td>plants m⁻²</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>14.6</td>
<td>25.6</td>
<td>278.8</td>
<td>46.1</td>
<td>11.3</td>
<td>39.0</td>
<td>3.0</td>
<td>39.7</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>14.8</td>
<td>38.3</td>
<td>449.3</td>
<td>47.2</td>
<td>13.9</td>
<td>62.0</td>
<td>2.9</td>
<td>42.0</td>
<td></td>
</tr>
<tr>
<td>135</td>
<td>14.8</td>
<td>44.1</td>
<td>562.9</td>
<td>45.3</td>
<td>12.6</td>
<td>79.9</td>
<td>2.9</td>
<td>33.4</td>
<td></td>
</tr>
<tr>
<td>OPC†</td>
<td>ns</td>
<td>L***</td>
<td>L***</td>
<td>ns</td>
<td>L*</td>
<td>L**</td>
<td>L***</td>
<td>ns</td>
<td>L*</td>
</tr>
</tbody>
</table>

† *, **, *** Orthogonal polynomial contrasts significant at the 0.05, 0.01, and 0.001 levels, respectively.
## N Application Rate Effect
### Carinata Oil Yield and Composition

<table>
<thead>
<tr>
<th>N rate kg ha⁻¹</th>
<th>Grain Yield kg ha⁻¹</th>
<th>Oil Yield L ha⁻¹</th>
<th>Oil</th>
<th>Protein</th>
<th>Fatty acid composition %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>C 16:0</td>
</tr>
<tr>
<td>0</td>
<td>5342</td>
<td>2959</td>
<td>44.9</td>
<td>25.7</td>
<td>2.9</td>
</tr>
<tr>
<td>45</td>
<td>5262</td>
<td>2935</td>
<td>44.5</td>
<td>26.1</td>
<td>2.9</td>
</tr>
<tr>
<td>90</td>
<td>4940</td>
<td>2779</td>
<td>43.8</td>
<td>26.4</td>
<td>3.0</td>
</tr>
<tr>
<td>135</td>
<td>4713</td>
<td>2514</td>
<td>42.7</td>
<td>27.6</td>
<td>3.0</td>
</tr>
<tr>
<td>OPC†</td>
<td>L**</td>
<td>L***</td>
<td>L*</td>
<td>L*</td>
<td>ns</td>
</tr>
</tbody>
</table>

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

- November planting date was least affected by freeze damage and produced the highest grain and oil yields.

- N increased vegetative growth (branching, biomass) and pod and seed number per plant and increased freeze damage which decreased grain and oil yield.

- Relatively high grain and oil yields indicate viability in North Florida as a winter crop.
Summary and conclusions

- Studies will be repeated during 2014/2015 growing season

- Additional studies to address N use, recovery and partitioning in carinata