Tunnel and Field Production Systems for Day-Neutral Strawberries in Eastern North America

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Presentation Outline

• Day-neutral strawberry production review
  - Benefits and challenges
  - Cultivars
  - Production requirements

• Field and high tunnel day-neutral strawberry research results from 2009-2011
  - Flower and runner removal
  - Plastic mulch ground cover
  - Plant spacing
  - General production in high tunnels and in the field
Benefits of day-neutral strawberry production:

- Opportunity to produce fruit in off-season (summer and fall) yields (12,000-20,000 lb/A)
- Season is extended from 5 weeks (Junebearing) to 4 - 5 months
- New market possibilities: on-farm sales, farmers’ markets, wholesale
- Price can be 2x that of Junebearing strawberries
Challenges of day-neutral strawberry production:

- Require intensive practices
- Management practices need to be followed
- High summer temperatures cause delay of fruiting without cooling practices
- Labor for harvesting over entire season
- Tarnished plant bug, botrytis, and fruit anthracnose control
Root-zone temperature stress in strawberry

Floral differentiation inhibited with increasing root-zone temperatures
Cultivars

**Tristar & Tribute**: excellent flavor, excellent disease resistance, good yields, medium-sized fruit (Tribute has a larger fruit size)

**Albion**: very large fruit, firm, medium yield, good flavor, good disease resistance

**Seascape**: very large fruit, sweet, medium yields

Average berry size in field trials in Iowa - incl. all berries:
  - Albion: 10 g
  - Seascape: 7.5 g
  - Tribute: 5.5 g

**Monterey, San Andreas, Portola**: from Univ. of CA (2009), “large fruit, high yields, good flavor”
‘Tribute’ and ‘Tristar’

‘Seascape’

‘Monterey’, ‘Portola’, ‘Albion’, and ‘San Andreas’

‘Albion’
Planting Establishment

- Plant as early as possible in spring with dormant crowns
- Raised beds with soil mulch (many options) and trickle irrigation
- High plant densities
  4 to 5 ft. between mulch rows
  9 - 12 in. with multiple plant rows
Mulch: Soil Cover

Cooling effects

- White on black
- Silver (metallic) on white
- Silver (metallic) on black
- Straw
Plant Management

Flower removal:
- Remove flowers after planting to aid in establishment

Runner removal:
- Remove throughout season

Harvest:
- 2 times per week & consider postharvest needs
Plant Management

Fertility:
- Use soil test prior to planting (also check K, Ca, B)
- Plants use: 7 lb N/acre/week can be supplied through irrigation

Water:
- Shallow-rooted plants need one inch per week, soil mulch helps but plant demand is high

Use annual plantings:
- Remove after last harvest (Iowa - Oct./Nov.)
Plant Management

Potential problems: watch preharvest intervals
• Tarnished plant bug
• Fruit anthracnose and botrytis
• Weeds
  Plastic mulch control most weeds
  Weeds in planting holes & between rows
• Pollination

Remember: flowers, developing fruits, ripe fruits all in same planting.
Presentation Outline

• Day-neutral strawberry production review
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  - Production requirements

• Field and high tunnel day-neutral strawberry research
Day Neutral Research Projects
2009-2011

Exp. 1. Flower and runner removal
Exp. 2. Polyethylene soil mulch
Exp. 3. Plant spacing
Exp. 4. General production in field and high tunnels
1a. Significance of runner and flower removal - field grown

• Objectives
  - Is runner removal necessary?
    • How beneficial is runner removal based upon total yield
  - Is flower removal necessary?
    • How long is it necessary (4, 8, 12 weeks)
    • How beneficial is flower removal based upon total yield?
    • Minimizing flower and runner removal: labor may be reduced throughout the season
Goal:
Large and multiple crowns
Exp. 1a. Significance of runner and flower removal - field grown

- Total yields were similar between flower removal treatments of 4, 8 & 12 weeks after planting.
- Production was shifted later – and first harvest dates depends on growing season.
- Yield was more for ‘Albion’ and ‘Seascape’ when runners were removed.
- Runner removal helps with air circulation and ease of picking.
Exp. 1b. Significance flower removal - tunnel vs field grown

• Treatments:
  – Flower removal 6 wks after planting
  – Flower removal 10 wks after planting

• Results
  – No differences in yield or plant biomass
  – Initial production was delayed with 10 wks flower removal treatment
Exp. 1. Significance flower removal - tunnel vs field grown

SUMMARY:
Flower removal: 4 - 6 wks after planting
Runner removal: throughout season

Goal: large, multiple crowns
Exp. 2a. Multiple layers of polyethylene mulch - field grown

• Objective
  – Can we increase plant growth in the spring and fall by adding additional layers of plastic mulch to:
    • warm the soil during cool periods, and
    • cool the soil during warm periods?

Treatment 1: Black, silver/white, black - 3 layers
Treatment 2: Olive, silver/white, olive - 3 layers
Exp 2a. Multiple layers of polyethylene mulch - field grown

- No differences between treatments for total yield = no yield benefit for additional layers of plastic to total yield.
- ... however there were cooling effects from the additional layers
- Thicker plastic mulch may be more beneficial to reduce soil temperatures during the hot summer months.
Yield over growing season

Soil temperature less than 60 °F, removal of silver mulch on Black/Silver/Black and Olive/Silver/Olive

2011 High Temp.
Exp. 2b. Multiple layers of polyethylene mulch – **tunnel vs field grown**

- **Mulch Treatments:**
  - Silver on white mulch
  - Silver on white over black (2 layers)
    - Silver on white removed when soil temp <60 F
Exp. 2b. Multiple layers of polyethylene mulch - tunnel vs field grown

• Results
  – No differences of yield or plant biomass between treatments
  – Required additional labor to remove additional layer of plastic
  – Use White on black or Silver on black (one layer)
Exp. 3. Increasing plant density – field grown

- Objectives
  - Can we increase plant density to maximize space in the field?
  - Does increasing plant density increase total yield?
  - Does increasing plant density negatively affect plant growth?

- Spacing was 12”, 10”, 8” & 6” between plants

With limited space in a field or high tunnel, maximizing the space available increases the potential profitability
### Treatment: spacing of plants
(plastic row width = 30"

<table>
<thead>
<tr>
<th>Plant Spacing</th>
<th>Row Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>6”</td>
<td>5 rows</td>
</tr>
<tr>
<td>8”</td>
<td>4 rows</td>
</tr>
<tr>
<td>10”</td>
<td>3 rows</td>
</tr>
<tr>
<td>12”</td>
<td>2 rows</td>
</tr>
</tbody>
</table>

- **6” plant spacing**
  - 5 rows
  - X X X X X
  - X X X X X
  - X X X X X
  - X X X X X
  - X X X X X

- **8” plant spacing**
  - 4 rows
  - X X X X
  - X X X X
  - X X X X
  - X X X X

- **10” plant spacing**
  - 3 rows
  - X X X
  - X X X
  - X X X

- **12” plant spacing**
  - 2 rows
  - X X
  - X X
6” plant spacing

8” plant spacing

10” plant spacing

12” plant spacing
Exp. 3. Increasing plant density – field grown

- Total yield per plant, average berry, and plant biomass were greater in the less dense plantings (12” spacing)

- Percentage marketable fruit was not different between treatments
Plant spacing showing yield over the season

(significance calculated from total yield, not each date)
Exp. 4. General conclusions of tunnel vs field production

- TIME OF PLANTING:
  - In 2010 plants established June 1 and harvest began in August
  - In 2011 plants established May 1 and harvest began in July
  - In 2010 higher total yield was observed in the tunnels than in field plots
  - In 2011, there was no difference in total yield comparing tunnel vs field plots.
Strawberries planted into the silver polyethylene mulch in the field with no cover.

Strawberries planted into the silver polyethylene mulch in the tunnel structures.
Exp. 4. General conclusions of tunnel vs field production

- TIME OF PLANTING:
  - Tunnel and field plots were very wet in May 2010, which pushed planting into June in 2010.
  - Tunnels were closed in February in 2011 to ensure early planting
  - Early planting in Iowa allows for a major second peak in production without going after October
‘Tribute’ yield over the season in 2010 and 2011
General conclusions of tunnel vs field production

• Total berry yield between cultivars showed: ‘Tribute’ > ‘Seascape’ > ‘Albion’ in both years

• Average berry size between cultivars showed: ‘Albion’ > ‘Seascape’ > ‘Tribute’ in both years
  – ‘Tribute’ are smaller, but are marketable

• No differences in marketability among cultivars or between tunnel and outside plots
General conclusions of tunnel vs field production

• Temperature is regulated in a tunnel
Benefits of growing in the tunnel?
General conclusions of tunnel vs field production

- Generally fewer pests in the tunnel
- Can be less inputs (fungicides) in tunnels
- Earlier planting and easier to cover for fall
- An “insurance policy” in bad seasons

- Space limited in a tunnel (prod. & people)
- Need to regulate temp in tunnel (sides and doors)
- Irrigation needs are higher without rainfall
Day-neutral strawberry production feasibility in tunnels vs. field plots

• They require growth for the full season to maximize production.

• If multiple crops used in one tunnel, cooler strawberry temperature requirements must be met.

• Need to consider the value of other specialty fruit and vegetable crops in a tunnel.
Day-neutral strawberry production feasibility in tunnels vs. field plots

• As a niche market and off season production, day-neutral strawberries are in demand.

• Due to the cost of the tunnel structure, growers should compare feasibility of day neutral strawberries in field vs. tunnel.
Day-Neutral Strawberry Research

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