“Thank goodness you’re back—the radio just quit.”
Plant Mapping

A Guide for Monitoring Growth and Development

Shane Osborne, Oklahoma State University
Plant Mapping

What is it?

&

Why should I consider it?
What is Plant Mapping?

Evaluating the crop’s health by taking key plant measurements

- Compare these measurements to known plant health guidelines in order to understand the current status and/or direction of the crop.
Why Should I Consider Plant Mapping?

Timing is Everything!
Benefits of Plant Mapping

1. Identifies key plant stages
2. Establishes current status and/or direction of crop
3. Allows management decisions to be proactive instead of reactive
Home Run!

Strike Out!

Resources & Environment
Objectives

• How do we map a cotton plant?
  - Plant anatomy/terminology
  - Identify key growth stages of cotton

• Putting the information to use
  - Monitoring overall crop condition
  - Identify management decisions that utilize mapping information
Approximate Cotton Growth Timeline

- **Planting**: Days 4-10
- **Emergence**: Days 25-35
- **Pinhead square**: Days 41-67
- **1st Bloom**: Days 102-127
- **1st Open Boll**: Days 120-140
- **Defoliation**: Days 127-150
- **Harvest**: Days 4-10

Days between:

- 21-25
- 45-55
- 14-28
- 7-21
Approximate Cotton Growth Timeline - Emergence

Days after planting: 4-10

Emergence: 4-10 days between
Seedling Stage (emergence)

Growing point (terminal)
new growth moves up from here, produces new mainstem nodes every 3 - 5 days

Seed leaves (cotyledons)
scars are opposite on main stem (node = 0)

Dr. Randy Boman
TAEX, Lubbock
The first node (true leaf)
Emergence Stage field data

- Stand uniformity
  uniform stands are easier to manage

- Plant population
  between 30k and 60k plants per acre
  minimum of 2 plants per foot (40 in rows)
4-Leaf Stage
Nodes vs Internodes

A node is a “bump” on a stem or branch.

An internode is located between two nodes.

Dr. Randy Boman
TAEX, Lubbock
Nodes vs Internodes

3rd Node (true leaf)

2nd Node (true leaf)

1st Node (true leaf)

Internode

Internode

Internode

Cotyledons
Remnants of cotyledons, node = 0
Approximate Cotton Growth Timeline – Pinhead square

Days after planting

- **Planting**: 4-10 days
- **Emergence**: 4-10 days
- **Pinhead square**: 28-45 days

Days between:
- 4-10
- 25-35
6-Leaf Stage
Pinhead square stage field data

• Node of 1\textsuperscript{st} fruiting branch
  - most varieties begin fruiting at 5 to 7 nodes
  - some full season varieties may be slightly later

• Average internode spacing (height to node ratio)
  - measure from cotyledons to terminal
    and count total nodes - (ht divided by total nodes)
  > one inch indicates moderate plant health
  < one inch usually indicates a stressful situation
Pinhead square stage field data

• Fertility
  - Any remaining fertility (nitrogen) needs should be addressed at this stage in order for the crop to utilize the application by blooming

• Plant growth regulators
  - earliest PGR applications may be started approximately 7-10 days later (matchhead square)
First Position Square (fruit)
Square Development

- Pinhead
- 7 Days
- 14 Days
- 21 Days
Determining Fruiting Position Number

First position fruiting site

Second position fruiting site

Third position fruiting site

Fourth position fruiting site
Paymaster HS-26

Dollar Amount Contributed to Total

<table>
<thead>
<tr>
<th>Fruiting Branch Number</th>
<th>Dollar Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>22</td>
</tr>
<tr>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>7</td>
<td>35</td>
</tr>
<tr>
<td>8</td>
<td>40</td>
</tr>
<tr>
<td>9</td>
<td>45</td>
</tr>
<tr>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>11</td>
<td>55</td>
</tr>
<tr>
<td>12</td>
<td>60</td>
</tr>
<tr>
<td>13</td>
<td>65</td>
</tr>
<tr>
<td>14</td>
<td>70</td>
</tr>
<tr>
<td>15</td>
<td>75</td>
</tr>
<tr>
<td>16</td>
<td>80</td>
</tr>
<tr>
<td>17</td>
<td>85</td>
</tr>
<tr>
<td>18</td>
<td>90</td>
</tr>
</tbody>
</table>

- **First Fruiting Site**
- **Second Fruiting Site**
Early Growth

Growing point (terminal)

Fruiting branch (square on short stalk on branch that comes directly off main stem)
Node of first fruiting branch = 6

Vegetative branch (square NOT on branch that comes directly off main stem)

Seed leaves (cotyledons)

Main stem node

Dr. Randy Boman
TAEX, Lubbock
Differences Between Vegetative and Fruiting Branches

**Main stem**

- **Large boll** (usually found above node 4)
- **Small boll**
- **Flower**
- **Square**
- **Fruiting branch** (usually found above node 4 - squares and bolls attached to a short stalk)

- **Short stalk**
- **Flower** (short stalk)
- **Square**

**Vegetative branch** (usually below node 7, but above node 4)

Dr. Randy Boman
TAEX, Lubbock
Approximate Cotton Growth Timeline - Pre-bloom

Days after planting

- **Planting**: 4-10
- **Emergence**: 4-10
- **Pinhead sq.**: 25-45
- **1st Bloom**: 41-67

Days between

- 21-25
Pre-Bloom Stage Field Data

1. Measure plant height from cotyledonary nodes to terminal

2. Count total main stem nodes (= 9)

3. Count main stem nodes to first fruiting branch (cotyledonary nodes = 0, so node of first fruiting branch = 6)

4. Count # of first position squares present

Main stem node
1st position square
2nd position square (do not count)
Vegetative branch square (do not count)
Prebloom Data

- 1st position squares
- 1st position square retention
  - calculated, must be careful to count squares in terminal
  - goal of at least 85%, if < 75%, field may have insect or other problems (environmental)
- Height to node ratio
  - < 1 indicates stress
Approximate Cotton Growth Timeline - 1st Bloom

- **Planting**: Days before emergence
- **Emergence**: Days after planting
- **Pinhead sq.**: 28-45 Days after planting
- **1st Bloom**: 41-67 Days after planting

Days between:
- Planting and Emergence: 4-10
- Emergence and Pinhead sq.: 25-35
- Pinhead sq. and 1st Bloom: 21-25
2. Count main stem nodes (cotyledonary nodes = 0, so total nodes = 17)

1. Measure plant height from cotyledonary nodes to terminal

- Main stem node
- White flower
- Pink flower (count as a boll)
- Boll
- 1st position square
- 2nd position square (do not count)
- Vegetative branch square (do not count)

Dr. Randy Boman
TAEX, Lubbock
3. Count number of main stem nodes above 1st position white flower (let white flower main stem node = 0 so NAWF = 8)

Terminal node = 17

NAWF = (17 - 9) = 8

Main stem node of white flower = 9

4. Record main stem node of 1st position white flower (= 9)

Cotyledonary node scars

Dr. Randy Boman
TAEX, Lubbock
Bloom Stage Field Data

5. Count number of 1st position squares present

6. Count number of 1st position squares missing

7. Count number of 1st position bolls present

8. Count number of 1st position bolls missing

Main stem node of white flower = 9

Vegetative branch (do not count)

Cotyledonary node scars

Dr. Randy Boman
TAEX, Lubbock
Bloom Stage Data

- Plant height
- Total nodes
  - goal: 13 - 14 at early bloom
- Total 1st position squares
Bloom Stage Data

Percent square retention
  – goal: 75 - 85% 14 days after early bloom

• Percent boll retention
  – goal: 50% for 3 - 4 plants / ft on 40 inch rows

• Nodes above white flower (NAWF)
  – > 7 - may be “growthy”, 6-7 - excellent, 5 stress evident, 5 or less - cutout

• Height to node ratio
  – if > 2, then growth regulator use may be considered, depending upon conditions
Approximate Cotton Growth Timeline – 1st Open Boll

- **Planting**
- **4-10** Days between
- **Emergence**
- **25-35** Days between
- **4-10** Days between
- **Pinhead sq.**
- **28-45** Days between
- **1st Bloom**
- **41-67** Days between
- **1st Open Boll**
- **102-127** Days between
- **1st Open Boll**
Boll Stage Field Data

1. Measure plant height from cotyledonary nodes to terminal

2. Count main stem nodes (cotyledonary nodes = 0, so total nodes = 21)

- Main stem node
- White flower
- Pink flower (count as a boll)
- 1st position boll
- 2nd position boll
- 1st position cracked boll
- 2nd position cracked boll
- 1st position square
- 2nd position square
- Vegetative branch boll or 3rd position boll

Vegetative branch boll or 3rd position boll (do not count)

Dr. Randy Boman
TAEX, Lubbock
3. Count number of main stem nodes above 1st position white flower (let white flower main stem node = 0 so NAWF = 5, 1st position white flower at node 16, terminal node at 21)

Main stem node of white flower = 16

- Main stem node
- White flower
- Pink flower (count as a boll)
- 1st position boll
- 2nd position boll
- 1st position cracked boll
- 2nd position cracked boll
- 1st position square
- 2nd position square
- Vegetative branch boll or 3rd position boll

Cotyledonary node scars
Vegetative branch (do not count)
Boll Stage Field Data

4. If a 1st position cracked boll is on the plant, count the mainstem nodes above it (to the uppermost unopened harvestable boll)

- Main stem node
- White flower
- Pink flower (count as a boll)
- 1st position boll
- 2nd position boll
- 1st position cracked boll
- 2nd position cracked boll
- 1st position square
- 2nd position square
- Vegetative branch boll or 3rd position boll

Dr. Randy Boman
TAEX, Lubbock
5. Count the total number of green bolls on the plant

6. Count the total number of cracked or open bolls on the plant
Boll Stage Data

- Plant height
- Total nodes
  - goal: ~ 18-20 when nearing cutout
- Height to node ratio
- Nodes above white flower (NAWF)
Boll Stage Data

- Total green bolls
- Total open bolls
- Percent open bolls
- Nodes above cracked boll (NACB)
Approximate Cotton Growth Timeline - Defoliation

- **Planting**: 4-10
- **Emergence**: 4-10
- **Pinhead sq.**: 25-45
- **1st Bloom**: 41-67
- **1st Open Boll**: 102-127
- **Defol.**: 120-140

Days after planting:
- 4-10
- 25-35
- 21-25
- 45-55
- 14-28

Days between:
- Dashed lines indicate the approximate timeline for each stage.
3 methods to determine when to apply harvest aids

1. Percent open bolls method
   - defoliants 50 - 70% open
   - desiccants 80% open

2. Physiological maturity method

3. Nodes above cracked boll method
   - defoliants and boll openers 4 NACB
   - desiccants 2 NACB

Dr. Randy Boman
TAEX, Lubbock
Nodes Above Cracked Boll Method

Uppermost 1st position cracked boll

2nd position boll (do not count)

Uppermost harvestable 1st position boll

Node 5 (above cracked boll)

Count as node 1

From the uppermost 1st position cracked boll on the plant, count the mainstem nodes above it to the uppermost harvestable 1st position boll. Sample 10-12 representative plants across the field, then average.

Mainstem node number

Veg. branch

Dr. Randy Boman
TAEX, Lubbock
Objectives

• How do we map a cotton plant?
  - Growth stages of cotton
  - Plant anatomy/terminology

• Putting the information to use?
  - Making decisions based on mapping information
Areas where plant mapping can help us manage the plants resources and environment

- Herbicide and Insecticide applications
Identification of Critical Growth Stages for Pesticide Applications

- Broadcast vs. post-directed applications of Roundup (4 lf in RR cott)
- Label requirements for some post-directed applications (Aim-12 inch height restriction)
- Thrip-safe cotton (4 leaf stage)
- Fleahopper applications (5-8 leaf stage)
- Insect-proof stage (4 nawf)
Areas where plant mapping can help us manage the plants resources and environment

- Herbicide and Insecticide applications
- Identifying fruiting problems
Identifying Fruiting Problems
Identifying Fruiting Problems
Identifying Fruiting Problems
Early Identification of Fruiting Problems

- Missing early 1st position fruit (could mean fleahopper damage)
- Missing fruit following herbicide application (potential injury from herbicide)
- Mid to late-season fruit shed (water stress or insect damage)
Areas where plant mapping can help us manage the plants resources and environment

- Herbicide and Insecticide applications
- Identifying fruiting problems
- Plant growth regulators
Plant Growth Regulators ?? ??
(Pix, Mepiquat Chloride, Pintia etc.)

- Do I need one?
- Is it time to apply?
- How much should I use?
Areas where plant mapping can help us manage the plants resources and environment

- Herbicide and Insecticide applications
- Identifying fruiting problems
- Plant growth regulators
- Irrigation management
Areas where plant mapping can help us manage the plants resources and environment

- Herbicide and Insecticide applications
- Identifying fruiting problems
- Plant growth regulators
- Irrigation management
- Harvest aid timing
Approximate Cotton Growth Timeline – Harvest

- **Planting**: Days before planting (4-10)
- **Emergence**: Days from planting to first visible emergence (25-35)
- **Pinhead square**: Days from emergence to first pinhead square (21-25)
- **First Bloom**: Days from pinhead square to first bloom (45-55)
- **First Open Boll**: Days from first bloom to first open boll (14-28)
- **Defoliation**: Days from first open boll to defoliation (7-21)
- **Harvest**: Days from defoliation to harvest (120-140, 127-150)

Days after planting:
- **41-67**: Days between pinhead square and first bloom
- **102-127**: Days between first bloom and first open boll
- **120-140**: Days between first open boll and defoliation
- **127-150**: Days between defoliation and harvest
Summary

• Plant mapping is a valuable tool for tracking the development of the crop

• Fairly easily learned

• Relying on 1st position fruit reduces time required, yet allows good observations

• Identifies stages for pesticide app.’s

• Identifies possible fruiting problems

• Determines need for growth regulators

• Helps determine critical irrigation timing

• Determines timing of harvest aid app.
"Nurse, get on the internet, go to SURGERY.COM, scroll down and click on the 'Are you totally lost?' icon."