A to Z of Annual Plasticulture Strawberry Production

Roy D. Flanagan III

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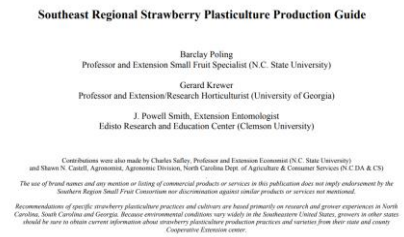
Some information gleaned from Dr. Allen Straw presentation from 2017

Southern Region Small Fruit Consortium- www.smallfruits.org

- https://smallfruits.org/files/2022/01/2022-Strawberry-IPM-Guide.pdf



Southeast Regional Strawberry Plasticulture Production Guide

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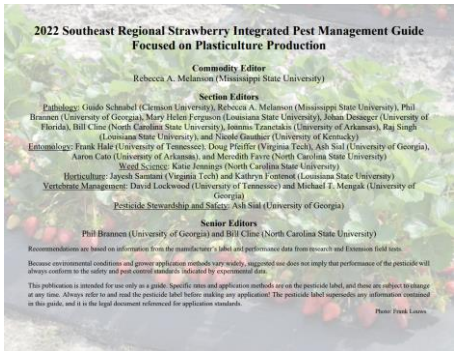
The use of brand names and any mention or listing of commercial products or services in this publication does not imply endorsement by the Southern Region Small Fruit Consortium nor discrimination against similar products or services not mentioned.

Recommendations of specific strawberry plasticulture practices and cultivars are based primarily on research and grower experiences in North Carolina, South Carolina and Georgia. Because environmental conditions vary widely in the Southeastern United States, growers in other states should be sure to obtain current information about strawberry plasticulture production practices and varieties from their state and county Cooperative Extension center.



2022 Southeast Regional Strawberry Integrated Pest Management Guide Focused on Plasticulture Production

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Recommendations are based on information from the manufacturer's label and performance data from research and Extension field tests.

Because environmental conditions and grower application methods vary widely, suggested use does not imply that performance of the pesticide will always conform to the safety and pest control standards indicated by experimental data.

This publication is intended for use only as a guide. Specific rates and application methods are on the pesticide label, and these are subject to change at any time. Always refer to and read the pesticide label before making any application! The pesticide label supersedes any information contained in this guide, and it is the legal document referenced for application standards.

Photo: Frank Louws

- https://smallfruits.org/files/2019/06/2005culturalguidepart1bs1.pdf
- https://strawberries.ces.ncsu.edu/strawberries-budgets/

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- VT small fruits website https://ext.vt.edu/agriculture/commercial-horticulture/small-fruit.html
- MyIPM app

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TO: Mid-Atlantic Strawberry Growers

FROM: Roy D. Flanagan III – Agriculture Extension Agent

SUBJECT: **Mid-Atlantic Strawberry Programs – February 28 & March 1, 2022**

DATE: February 8, 2022

I hope this letter finds you well and excited about the 2022 strawberry crop. This letter is to inform you of our upcoming **2022 Mid-Atlantic Strawberry Programs** to be held on **February 28 & March 1, 2022**. Our Strawberry Field Walk will be on February 28th from 12:30 p.m. until dark. Our Evening Program will take place immediately following the Field Walk and will be Soil Fumigant Certified Applicator Training (for VA growers this is required every 3 years, and this is the year) starting at 5:30 p.m. with a sponsored meal, followed by the training and certification at the Creeds Ruritan Community Complex. Our Strawberry School and Tradeshow is the following day, March 1st, at the Advanced Technology Center from 8:00 a.m. to 3:30 p.m. Additional details are enclosed on the reverse of this letter for your review.

For those attending from out of town, I have been able to secure a special room rate of $106 at the Fairfield Inns and Suites Virginia Beach Oceanfront. Here is the link: Book your group rate for Mid-Atlantic Strawberry Program or you can contact them directly at (757) 422-4885, and mention that you are with the ***Mid-Atlantic Strawberry Programs*** to receive the group rate.

Thanks to the amazing sponsorship from strawberry industry partners, these programs are all offered at no cost to attendees. ***Pre-registration is required for ALL our programs***. Please don't hesitate to contact me directly by phone at **(757) 385-4769/office or (757) 641-1434/cell** or by email at royf@vt.edu

Many thanks to everyone for helping to make this program a success year-after-year. I look forward to seeing you in just over a month!

If you are a person with a disability and desire any assistive devices, services or other accommodations to participate in this activity, please contact Jill Wright at the Virginia Beach Cooperative Extension Office at (757)385-4769 or TDD# (800) 828-1120) during the business hours of 8:00 a.m. and 5:00 p.m. to discuss accommodations five (5) days prior to the event.

Virginia Cooperative Extension programs and employment are open to all, regardless of age, color, disability, gender, gender identity, gender expression, national origin, political affiliation, race, religion, sexual orientation, genetic information, veteran status, or any other basis protected by law. An equal opportunity/affirmative action employer. Issued in furtherance of Cooperative Extension work, Virginia Polytechnic Institute and State University, Virginia State University, and the U.S. Department of Agriculture cooperating. Edwin J. Jones, Director, Virginia Cooperative Extension, Virginia Tech, Blacksburg; M. Ray McKinnie, Administrator, 1890 Extension Program, Virginia State University, Petersburg.

Mid-Atlantic Strawberry Programs – February 28 & March 1, 2022

Pre-registration is required for ALL programs.

Monday, February 28, 2022

Strawberry Field Walk: ***12:30 p.m. until Dark***
Beginning at Brookdale Farms-Chesapeake, 2133 Mount Pleasant Rd., Chesapeake VA 23322
Ending at Flip Flop Farm, 3244 New Bridge Road, Virginia Beach, VA 23456

Cost: Free

- **Brookdale Farm- Chesapeake**
  - Plantings include: Chandler and Ruby June
  - We will hear about row cover application for GDD accumulation on Ruby June and more.
- **Flip Flop Farm**
  - Plantings include: Chandler and Sweet Charlie varieties
  - We will see variances in planting dates and variances on plant supply
- **Speakers Confirmed:** Drs. Allen Straw, Jayesh Samtani, and Mr. David Dycus

Evening Program | EPA approved Fumigation Applicator Training & Certification 5:30 p.m. until we are done.
Location: 1057 Princess Anne Rd., Virginia Beach, VA 23457

Cost: Free/ Dinner is included
If you are traveling in from another state and would like to me to pursue approval from your Department of Agriculture, please let me know and I will seek this out. Roy 757-641-1434

Tuesday, March 1, 2022

Strawberry School and Trade Show: ***8:00 a.m. to 3:30 p.m.***
Virginia Beach Advanced Technology Center, 1800 College Crescent, Virginia Beach, VA 23453

Cost: Free / Lunch and snack included
Regional strawberry experts in the industry and leading universities will provide information on fertility programs, insect pests, diseases, understanding additives, stickers, spreaders, etc., overall strawberry production considerations, and a forecast for the 2022 crop. Exhibits from sponsors will be on site.

Updates and Annual Meeting of:

- Virginia Strawberry Association

Speakers Confirmed:

- **Dr. Lorena Lopez**, Postdoctoral Associate – Entomology
  Virginia Tech- Eastern Shore Agriculture, Research, and Extension Center
- **Mr. Jim Pearce**, Vice President Marketing and Product Development at Coastal AgroBusiness, Inc., Greenville, NC
- **Dr. Jayesh Samtani**, Assistant Professor and Small Fruit Extension Specialist
  Virginia Tech – Hampton Road Agriculture, Research, and Extension Center
- **Dr. Allen Straw**, Horticulturist, Southwest Virginia
- **Mr. David Dycus**, Agronomist, FCI
- **Maybe even a retired Pathologist, Dr. Chuck Johnson**

Pre-registration is required for ALL programs.

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Annual Plasticulture Strawberry Production

- Originally developed by the University of California who merged several technologies:
  - Drip Irrigation and Fertigation
  - Raised-beds and Plastic Mulch
  - Development of the “Chandler” variety
  - Availability of Methyl Bromide
  - Frost Protection – Row Covers and Sprinklers

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Summary

- The Annual Plasticulture Strawberry Production System:
  - Requires a significant capitol investment!
    ($7,000 to $9,000/A establishment costs)
    (easily hit $12,000/A total production costs)
  - Requires excellent management practices!
  - Producer's have a chance for excellent potential returns!
    ($20k - $50k /A potential gross returns)

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Things to consider

- Site Selection
- Soil Sampling
- Site Preparation
- Fall Fertilization
- Soil Fumigation
- Bed Formation
- Mulch Laying
- Seeding Cover Crop
- Transplanting
- Pest Management
  - Weed Control
  - Insect Control
  - Disease Control
- Frost Protection
- Potential Varieties
- Types of Transplants
- Nutrient Management
  - Irrigation and Fertigation
- Row Cover Management
- Harvest

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Site Selection

- This production system was designed for “warm climates” (i.e. Southern California), and adapted to the Southeastern U.S.
- Then to the Coastal regions of the Mid-Atlantic
- The technology has moved into the Piedmont and mountains of all Mid-Atlantic states and west to at least Ohio and Indiana

Site Selection (cont.)

- We need to pay attention to the following issues:
  - Field Location
  - Field Orientation
  - Soil Type
  - Air Drainage
  - Water Drainage

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Field Location

- Wind breaks on the North or Northwest side of the field can aid in reducing cold injury.
  - However, too much wind protection can reduce air movement, increase humidity, and subsequent disease.
- Close proximity to water
  - Irrigation supply for drip mostly, but also overhead if that is how you plan to frost protect
- U-Pick Considerations
  - Visible, accessible from the road
  - Parking

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Field Orientation- sorta matters

- Beds (rows) should be oriented in a North – South direction to encourage more uniform plant development and berry ripening.
  - East – West orientation results in plants in the North row being shaded by plants in the South row.
  - Therefore, plants in the North row are generally smaller and fruit ripens slower.
  - Greater yields from South row than North row.

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Field Orientation (cont.)

- Exposure
  - A South facing slope will warm sooner
    - Advantage – earlier harvest
    - Disadvantage – earlier frost protection
  - A North facing slope will warm slower
    - Advantage – delayed frost protection
    - Disadvantage – later harvest
- Ideal – NE or SE

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Soil Type

- Planting onto a raised bed allows the use of heavier (higher clay content soils) than matted-row production.
- However, sandy loam, loam, and clay loam soils are still preferable.
- Bed formation may be difficult on extremely sandy soil, high clay content soil, and rocky soils.
- Rocky soils are hard on trickle tape and plastic mulch.
- Need a soil deep enough to “pull” a 6” to 8” high bed. (this does matter)

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Air Drainage

- Locate fields for use in the annual plasticulture production system, where cold air will drain off of the field.
- This is especially critical when dealing with a Southern exposure.
- A slight slope with lower elevation below the field works very nicely.

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Water Drainage

- During frost protection, you can easily apply 1.5” to 2” of water / event (night).
- If you have to frost protect several nights in a row, that can add up to several inches.
- That water needs a place to go; therefore a slight slope to one end of the field works well for directing water off of the field without severe erosion problems.
- Many new growers opt to go with row covers for this very reason

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Steep Slopes

- In the Mountainous regions, too steep a slope may be a problem:
  - Erosion
  - Proper operation of trickle irrigation system
- If possible it is good to plant on a contour with about 1- 2 % slope to one end of the field
- Again this prevents severe erosion, as well as prevents beds from washing out.

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Soil Sampling

- Sample as soon as possible
  - 6 months prior to transplanting
    - Allows time for lime to react
  - Apply lime to adjust the pH to 6.0 to 6.5
    - 6.2 is optimum
- Take representative samples from the field
- Sample 6” to 8” deep
  - Sample as deep as beds are to be raised.

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Pre Bedding

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Site Preparation

- Fallowed Land
  - Plow **3 to 6** months prior to bed formation
  - This allows much of the residue to decay
  - Excess Residue
    - Clogs bedding equipment
    - Makes poor beds
    - Binds fumigant, reducing the effectiveness of fumigation
    - Will result in severe bed slumping the following spring

Site Preparation (cont.)

- General
  - Work soil deeply and thoroughly
  - Remove excess debris from the field
  - Remove trash from the field
  - Remove large rocks that would hinder bed formation

Fall Fertilization

- Apply fertilizer in the fall according to soil test recommendation.
- Rule of thumb:
  - Apply 1/3 to 1/2 of total N in the fall (60 lb/A)
  - Apply all of the phosphate in the fall (120 lb/A)
  - Apply 1/2 of potash in the fall (120 lb/A)
- Incorporate thoroughly in the soil used to form beds.
- Boron response on sandy soils? (1 to 2.5 lb/A Boron)

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BLENDED

10-10-20

PREMIUM FERTILIZER with SOP

GUARANTEED ANAYLSIS

TOTAL NITROGEN (N).....	10.00%
NITRATE NITROGEN (N):	
40% OF TOTAL NITROGEN.....	5.00%
AVAILABLE PHOSPHATE (P2O5).....	10.00%
SOLUBLE POTASH (K2O).....	20.00%
MAGNESIUM (MG).....	0.20%
0.20% WATER SOLUBLE MAGNESIUM	
SULPHUR (S).....	3.00%
BORON (B).....	.02%
IRON (FE).....	.10%
MANGANESE (MN).....	.05%
.001% WATER SOLUBLE MANGANESE	
ZINC (ZN).....	.05%

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Soil Fumigation

Soil Fumigation

- Apply Fumigant
  - Pic Chlor 60 (60% Chloropicrin 40% Telone)
    - 300 to 350 lb. / A (broadcast)
    - 6” to 8” deep (“)
    - 2-3 knives/30” bed
    - >21 days prior to transplanting
  - Telone C-35 (Telone + Chloropicrin 35%)
    - 30 to 40 gallon / A (broadcast)
    - 12” to 18” deep
    - 3 knives/30” bed
    - 21 days prior to transplanting

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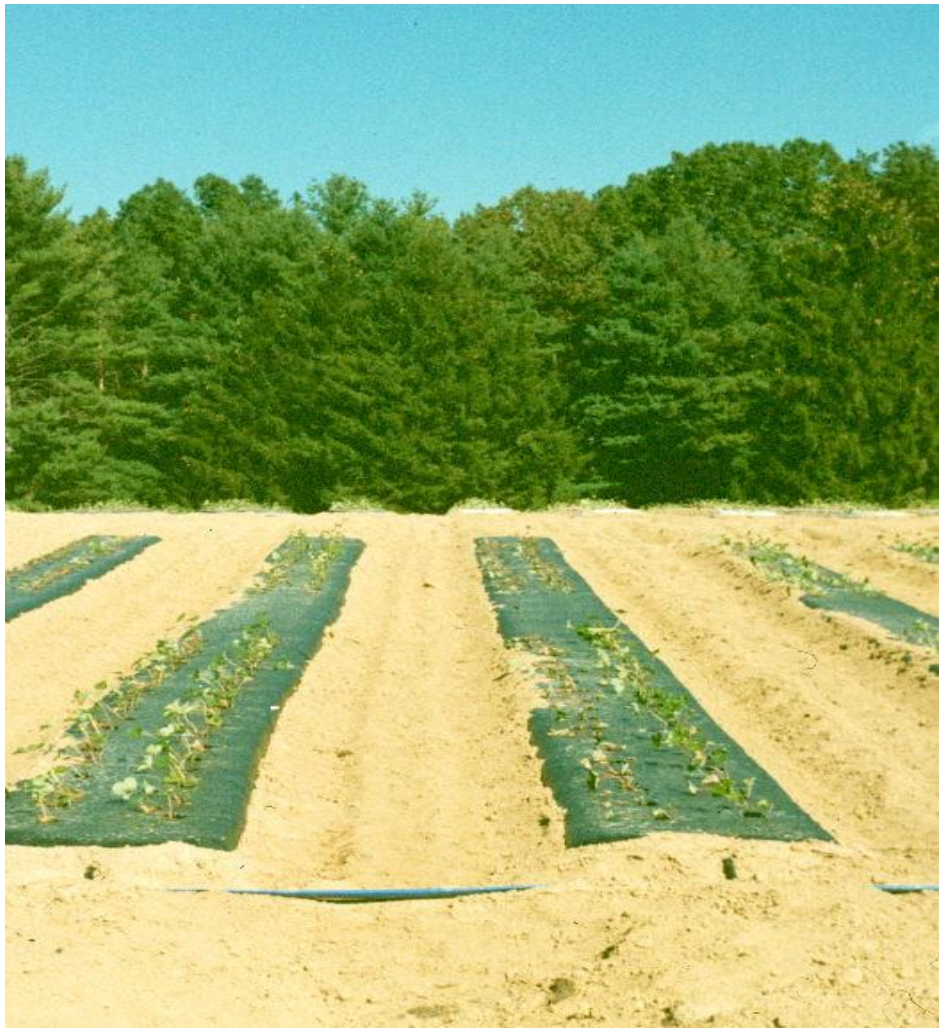

Know the history of your land, some herbicides have stout plant backs on strawberry

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Bedding Equipment

Laying Plastic Mulch

- Insert trickle irrigation tape
  - At least 10 mil. thick (15 mil. for multiple crops)
  - At least 1 inch deep
  - In the center of the bed
  - Two tapes/bed (?)
- Apply plastic mulch
  - 5’ wide is the standard and will cover 30” to 32” wide beds, 6” to 8” high
  - 1.25 mil. Is standard
  - Black is standard

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Seeding Cover Crop and Transplanting

- Seeding Cover Crop
  - Immediately after laying plastic mulch and before transplanting, broadcast cover crop
  - Use an annual grass that is easy to “control”
  - Do not use clovers!
- Transplanting and Varieties

  Double rows

  12” to 15” between rows

  12” to 15” apart in-row

  Varieties
  - Careful thought and consideration of marketing model needed for this decision

‘Chandler’

- Standard Variety
- Consistent performance under year to year variations environmental conditions
- Excellent eating quality when ripe
- Large fruit
- High yields
- Skin and flesh – deep red

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‘Camarosa’

- Very large fruit
- Attractive
- Very firm fruit
- Preferred for shipping
- Dark red skin before fully ripe
- Sweet and aromatic when fully ripe
- Purple when fully ripe

- Performance not as consistent as ‘Chandler’
- Poor quality in cool weather
- Adapted to warmer areas of the South
- Harvest at proper ripeness
- Very susceptible to anthracnose

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‘Sweet Charlie’

- Developed for winter production in Florida
- A week earlier than ‘Chandler’
- Often planted for early production
- Medium fruit size
- Medium red color
- Sweet flavor – less acid
- Appears to have some tolerance to anthracnose
- Fruit quality deteriorates quickly in warm weather
- Yields are significantly lower than ‘Chandler’
- Yield compensation
  - Plant earlier
  - Increase population

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Time of Transplanting

- ‘Chandler’ and ‘Camarosa’
  - September 15 at higher elevations
  - September 30 in warmer locations
- ‘Sweet Charlie’
  - September 1 at higher elevations
  - September 10 –15 in warmer locations

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Types of Transplants

- Bare-root plants
  - Not as common for plasticulture any more due to water requirements the week of planting
- Plug plants
  - Relatively easy to plant and easy to establish

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Bare-root Plants

- Predominant in much of the Southeastern U.S.
  - Daughter plants are removed from the field
  - Soil is removed from the roots
  - Plants are placed in cold storage
  - “Bare-root” plants are then planted in the field

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Bare-root Plants (cont.)

- Advantages
  - Cheaper – about half the price of plug plants
- Disadvantages
  - Harder to transplant than plug plants
- Disadvantages (cont.)
  - Quality
  - Variability
  - Stress
  - Injury during digging
  - Require large quantities of water
    - Expensive
    - Disease

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Plug Plants

- Advantages
  - Easy to transplant to the correct depth
  - Less water required for establishment (10%)
  - Minimal root damage during transplanting
  - Greater plant survival
- Disadvantages
  - More expensive
    - Twice the cost of purchased bare-root plants

Frost Protection

- Have frost protection system in place and working prior to first bloom.
- Minimum Requirements:
  - 70 gal. of water/A/min. (0.15”/hour)
  - Continual coverage of plants

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Row Cover Management

- Three functions of row covers
  - Fall and winter – to promote plant development, especially if late transplanting
  - Winter / spring – to promote bud and bloom development, (use in fall when growing 'Camarosa')
  - Winter / spring – to provide protection from cold temperatures, wind, and frost
- Possible use of row covers
  - Manage row covers to extend the harvest season

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Weight	Light	Application	Cost
Polypropylene			
0.5 – 0.6 oz	85%	Growth	$700/A
0.9 – 1 oz	70%	Growth, Frost	$1,000/A
1.25 oz	85%	Frost, Growth	$1,500/A
1.5 oz	50%	Frost	$1,800/A
2 oz	30%	Frost	$2,000/A

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Tissue Sampling

- Take tissue samples in the late winter or early spring when plants begin to actively grow
  - Take a representative amount of samples(leaves and petioles) from each variety and sample separately
  - The most recent fully expanded trifoliate is the best indicator of nutritional status
  - Remove petioles near the crown of the plant, partial petioles do not yield reliable results

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Tissue Sampling (cont.)

- Remove the leaves from the petioles
  - The leaves are used to determine concentrations of essential nutrients
    - Unless there are deficiencies, this should be the only sample of leaves you will need to take
  - Petioles are used for the SAP test
    - Measures nitrate concentration
    - Should be sampled on a weekly basis
    - You can run this analysis yourself using a Cardy meter

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Sufficiency Ranges

- N 3.0 – 4.0 %
- P 0.2 – 0.4 %
- K 1.1 – 2.5 %
- Ca 0.5 – 1.5 %
- Mg 0.25 – 0.45 %
- S 0.15 – 0.40 %

- Fe 50 – 150 ppm
- Mn 30 – 100 ppm
- Zn 15 – 50 ppm
- Cu 4 – 15 ppm
- B 25 – 50 ppm

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Petiole Levels

- Nitrate Nitrogen (NO_3-N)
  - October 800 – 900
  - November 600 – 800
  - March 600 – 800
  - April 10 300 – 500
  - May 10 200 – 500
  - June 1 200 – 500
- Potash (K_2O)
  - October 3000-5000
  - November 3000-3500
  - March 2500-3500
  - April 10 2000-2500
  - May 10 1800-2500
  - June 1 1500-2000

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Common Questions

- How often do I fertilize?
  - Every week?
  - Every other week?
- How much fertilizer do I apply?
  - How often are you going to fertilize?

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Answer

- Fertilize every week
- Many different products to accomplish fertility thru the drip (if dry, it must be greenhouse grade)
- One Rotation is
  - 50 lb of calcium nitrate / A (7.75lbs of N)
  - 50 lb of potassium nitrate / A (6.75lbs of N)

Irrigation and Fertigation

- Irrigation
  - Fall
    - Overhead irrigation after transplanting
      - Bare root or plugs
      - Heat and wind
    - Trickle as needed to maintain soil moisture
  - Spring
    - Once growth begins in late winter or early spring
- Fertigation
  - Once growth begins in late winter or early spring or at least by early bloom
    - Apply 7 to 10 lb of N/A/week
    - For 8 to 10 weeks
    - Alternate between 50 lb/A/week of calcium nitrate and potassium nitrate

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Spring Irrigation / Fertigation

- Irrigation
  - 1” to 1.5” / A / week
    - Monday
      - 1/3” to ½”
    - Wednesday
      - 1/3” to ½”
    - Friday
      - 1/3” to ½”
- Fertigation
  - Depending on soil type, you can do a weekly fertigation, but on heavier soils the strawberries will benefit from less fertility more often.

Pest Management

- Weed Control
  - Relying on:
    - Fumigation and plastic mulch to control weeds under plastic
    - Annual ryegrass
    - Clethodim or Sethoxidim for a kill off in spring of the annual ryegrass
    - Stinger for vetch control
- Insect Control
  - Similar practices to matted-row production
    - Scout for insects
    - Spray when economic thresholds are reached
  - Primary insect pests
    - Spider mites
    - Strawberry weevils (clipper beetles)

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Fall Pest Management

- Insects
  - Spider mites
  - Grasshoppers?

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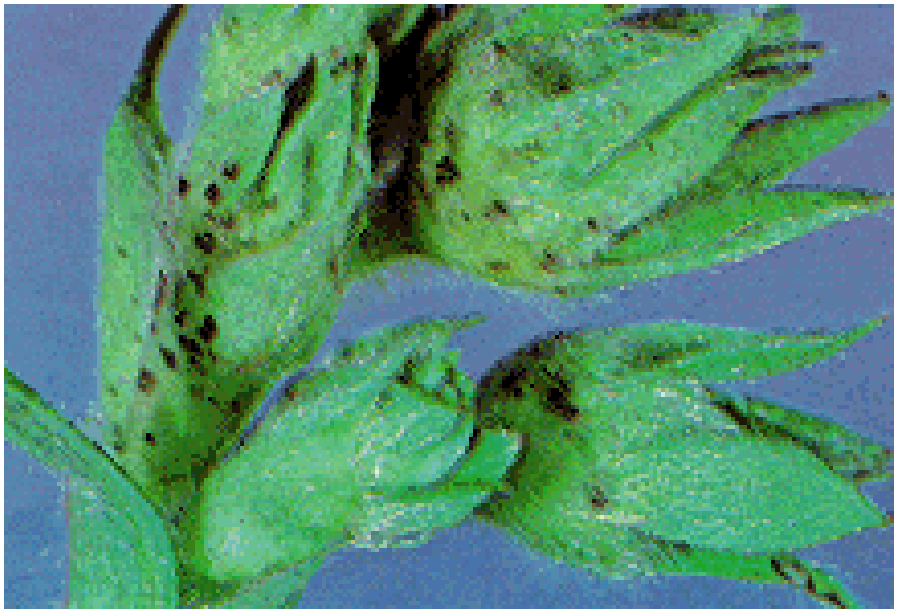
Strawberry Weevils

The strawberry weevil (enlarged about 8 times) is present during the flowering and bud formation period.



The holes in the side of the buds are where eggs are laid. Adult females will then cut the stem of a bud.

Disease Control

- Botrytis and Anthracnose
  - Debris Management
    - Remove dead plant material in late Feb. to early March
  - Preventative Sprays
    - Follow guidelines in the Southern Region Small Fruit Consortium IPM guide for strawberry

Botrytis (Gray Mold)

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Botrytis on Leaf

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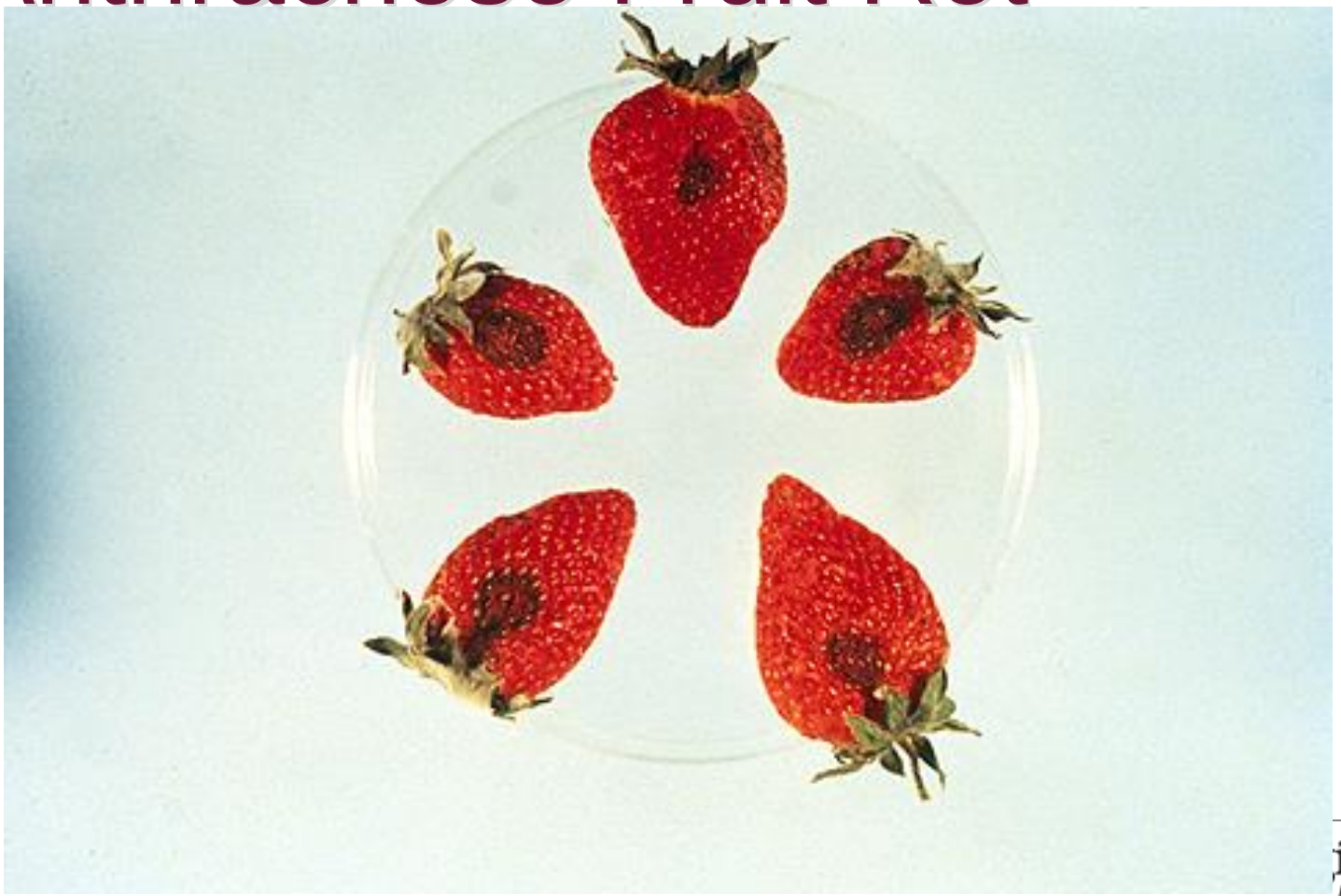
Anthracnose Fruit Rot



Anthracnose Crown Rot

Plug Plant Propagation

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Healthy Plug Plant

Questions- Reach out anytime

Roy Flanagan

Extension Agent, Agriculture and Natural Resources

A 1996 Graduate of Ferrum College with BS in Agriculture and a minor in Business. After college Roy worked for the local Southern States store for four years, then was farming full time until accepting the Conservation Specialist position with Virginia Dare SWCD, where he worked for over 8 years. Roy has been the Agriculture Extension Agent for Virginia Beach since February 2012. In his spare time he and his wife farm a little over 200 acres consisting of grain crops, sweet potatoes, vegetables, u-pick strawberries, and raise turkeys. Roy is a Virginia Certified Nutrient Management Planner, and a licensed VDACS Commercial and Private Pesticide Applicator.

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