

Plasticulture Strawberry Production



Presenter: David Koester Boone County Extension Horticulture agent.



Plasticulture Production

- Fall planting
- ~\$10,000/A up front cost
- 9 months until return on investment
- 14,500 - 21,700 lb/A yield
- 1 year harvest



Start with a small planting

Plasticulture Strawberry

- What's the big deal?
 - Why do customers like it?
 - Even the most die hard NC matted row growers converted
 - Marketing benefits - 3 main ones
 - Earlier and longer season
 - Quality, size and ease of picking
 - Ready pick option
 - Cleaner fruit
 - Less fruit disease
 - No berry-soil contact
- Has profit potential in Ohio



Plasticulture Strawberry Production Essentials

- Long period for flower bud initiation in fall, winter and early spring
 - Otherwise, it won't pay...
- Produce top-quality berries
- Opportunity to get a good price
- Willingness and time to put in extra effort
- \$\$ to invest up front
- Willing to gamble (much risk involved)

Biological, Environmental and Market constraints; Management tools to Help Mitigate Risk



- Weather extremes
 - Summer drought
 - Cool falls and cold winters
 - Frosts
 - Spring heat
- Disease pressure
 - Botrytis
 - Anthracnose fruit and crown rot
 - Bacterial angular leaf spot
- Insect pressure
 - Spotted winged Drosophila
 - Spider mites

- Choice of cultivar
 - Limited options
 - Planting dates
- Concentrated harvest
 - Chandler avalanche
 - Cultivar

Key Requirements of Plasticulture Strawberry

Row covers



Plugs



Goal

35 Successful Blossoms/Plant
= 1.5 lbs/plant
= 26,250 lbs/acre



Plasticulture

- Soil fumigated?
- Planted 1st-2nd week Sept. using plug plants
- Drip & overhead irrigated
- Covered with floating row cover over the winter



Plasticulture Strawberry Production Essentials

- Long period for flower bud initiation in fall, winter and early spring
- Winter protection
- Produce top-quality berries
- Opportunity to get a good price
- Willingness and time to put in extra effort
- \$\$ to invest up front
- Willing to gamble (much risk involved)

Plasticulture

- Frost protection for spring
- Good quality clean berries.
- Yields are lower than they get in North Carolina.



Shipped

Locally grown

"Expectations"

- Market at \$4 -5/qt
- 14,500 plants/acre (1 quart = 1.5 lb)
 - 1.5 lbs/plant = 21,750 lbs or 14,500 qt/acre
or \$58,000/A @ \$4/qt
 - 1.0 lb/plant = 14,500 lbs or 9,666 qt/acre
or \$38,600/A @ \$4/qt
- What the numbers don't tell
 - Production skill of the grower
 - Labor management
 - Marketing skill of the growers
 - Seasons of "crop failure" due to rains, freezes, or spring heat waves
 - Plasticulture production is much riskier than matted row production

Kentucky Plasticsulture Strawberry Prices

2017

Price	Retail/qt	Wholesale/qt
Average	\$4.23	\$2.68
Low	\$3.00	\$1.08
High	\$6.00	\$4.50

2016

Price	Retail/qt	Wholesale/qt
Average	\$4.34	\$3.41
Low	\$3.25	\$2.50
High	\$6.00	\$4.50

Divide by 1.5 to get
price per lb

Prices in eastern Kentucky are
usually lower.

Row Covers are a Key Requirement of Plasticulture Strawberry in Ohio

- Fall: Long flower bud initiation
 - Enhance growth and development
 - branch crown # and flower #
- Winter: protection from sub-lethal temps
 - Timing of application is critical
 - Varies based on physiological state
 - Nov>Dec>Jan>Feb>March
 - April, dormancy breaks and cold sensitivity increases
- Spring: Frost protection
 - Marginal events (defined by the stage)
 - Most effective early in the spring
 - Flower and foliage damage in windy conditions
 - Poor pollination during extended periods of use



What previously grew in the berry site?

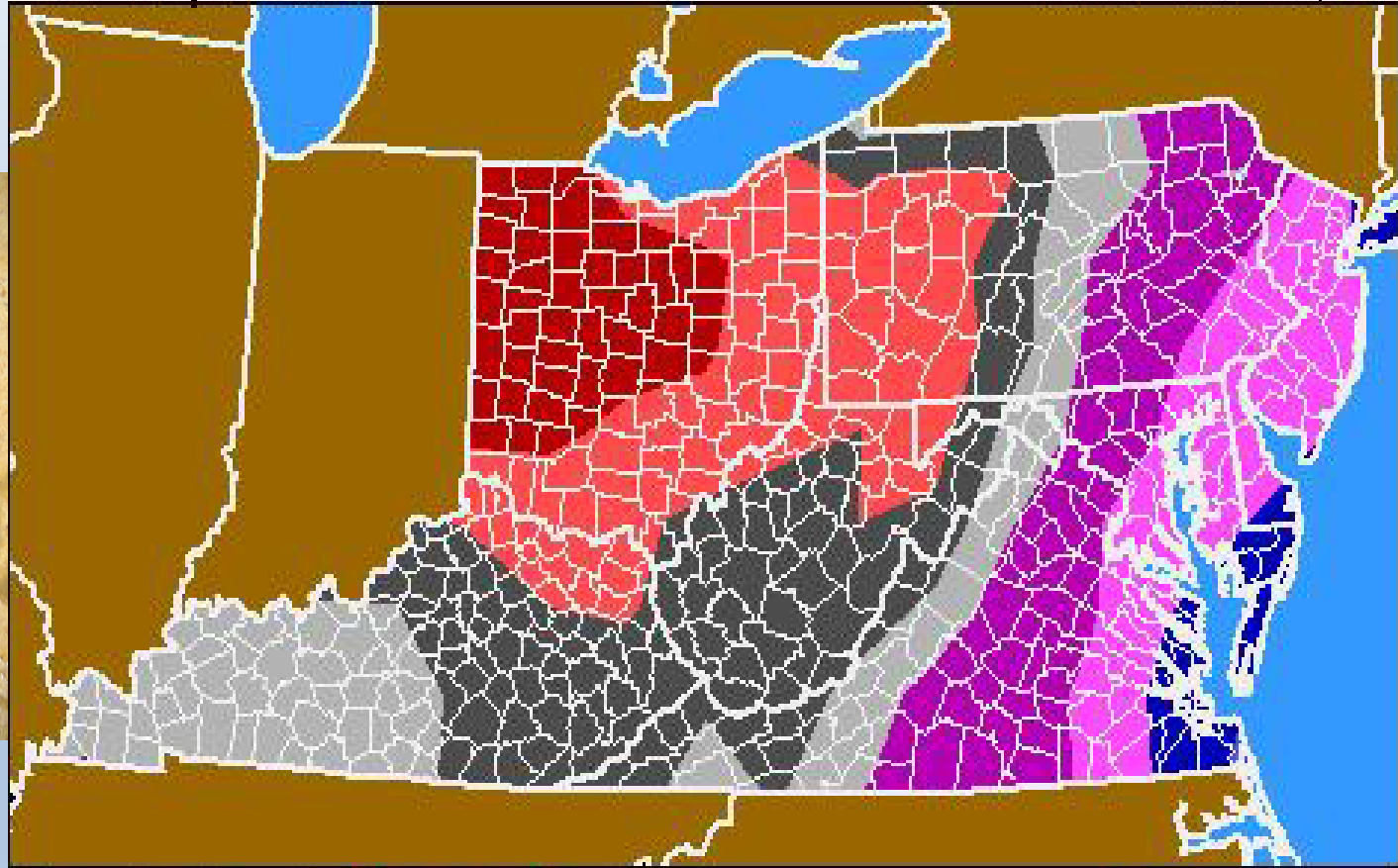
- Strawberries are susceptible to Verticillium wilt
- Spores can stay in the soil for many years
- No tomatoes, potatoes, eggplant, or any solanaceous crops during the last 3-5 years in soil site
- CROP ROTATION 3 to 5 years
- Fumigation? Another class 😊



Be prepared for the worse 1/7/14

MIN Temperature

VALID Tue 01/07



-20 -15 -10 -5.0 0 5.0 10 15 20

AWIS.com

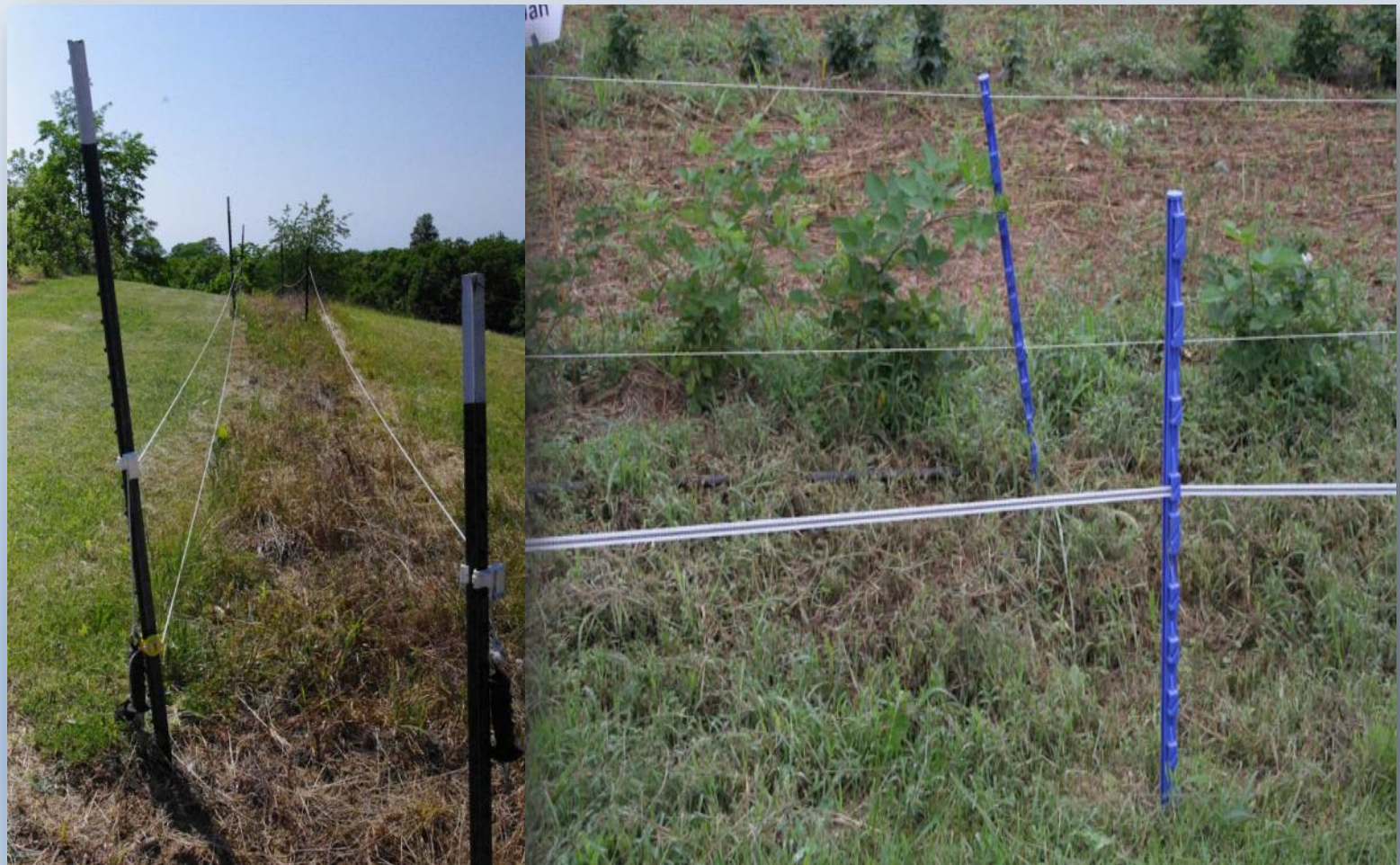


Site Selection

- High elevation - air drainage
- Well drained soil
- Good soil depth
- Irrigation availability
- Soil test
 - pH 6.0-6.2 for best growth
 - Bring P, K, & Mg up to recommended levels
- Row orientation
 - North & South optimal, but depends on site drainage
- Pests - deer, coyotes, birds
- Appropriate for marketing method



Three dimensional deer fence



Site Preparation

Get Perennial Weed Problems Under Control the Year Before Planting



Johnson grass



Thorny blackberry



Canada thistle



Yellow nutsedge



Bindweed



Site Preparation

- Grow a cultivated crop the year previous (eg. Corn, sudex, pumpkins)
 - Avoids problem weeds and insect
 - Builds up organic matter



- Avoid sites where potatoes, tomatoes, eggplants, peppers, tobacco, brambles or strawberries were grown at least 2 years previously to avoid Verticillium wilt.

Plasticulture Equipment

- Tractor (large)
- Disk
- Field cultivator
- Tractor Rotary Tiller
- Bed Shaper/Mulch Layer
- Transplanter
- Plastic Lifter
- Pesticide sprayer



Strawberry Plasticulture

- Plug plants used
- Plant late summer
- Less time for problems
- Expensive to establish
- Yields dependent on branch crown formation
- Cheaper to harvest
- Higher yields, improved fruit quality



\$\$\$

- Expensive system to establish
 - Up to \$10000/acre
 - Mulch layer/bed-maker that makes high beds
 - Trickle irrigation system
 - Plug plants
 - 14,700/a @ ~ \$.25 each = \$3675/a
 - Row cover
 - Overhead irrigation

Plant Responses to Environment

- Fall Runners - daylength > 10 hrs and temperature >70 F.
- Branch crowns - fall, cool temperatures, short days.
- Flower bud initiation - when daylength <14 hrs (early Aug.) if temperature <60 F. >60 F, needs daylength < 8-12 hrs.
- Cultivar dependent, also.

Varieties

- Chandler 80% + acreage
 - Harvest every other day
- Camerosa
 - Firmer berry
 - Have to leave on plant to get flavor
 - More susceptible to weather changes
- Sweet Charlie
 - Early
 - Excellent flavor
 - Low yield



Flavorfest

- Released 2012
 - Dr. Kim Lewers
 - 14 yrs evaluation before release
- Larger fruit than Chandler
- Softer fruit that don't hold as well
- Harvest season similar to Chandler
- Performs well in plasticulture & matted row systems
- Disease resistance
 - No susceptibility to Anthracnose crown & fruit rot
 - Tolerant most stem & leaf diseases & red stele
 - Probably slightly less susceptible to botrytis fruit rot





2.5



3



2



4



3



Chandler

4



2

Flavor
1=poor;
5=excellent



4.2

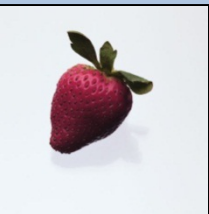
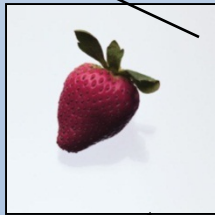
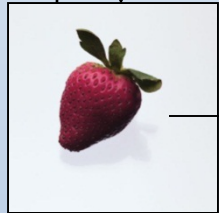


4.5



4

Variety Research



- Adopted Ohio Plasticulture Varieties
- (> 120 acres)
 - Chandler - ~70%
 - Camarosa - ~20%
 - Others? - ~ 10% San Andreas, Albion, Sweet Charlie
 - Continue to research potential varieties

Obtaining Timely Plants/Tips is an issue

- Due to early Ohio planting dates
- Purchase plants from a *reputable* plug producer but we are early?
- Shipping costs outrageous
 - Disease free
 - Virus indexed stock
- Arrange for on time delivery
- Order in advance (4 to 6 months)
- Border hassles
- Home grown tips? Still exploring, stay tuned!

Plug Plants

- New growers should consider purchasing plants rather than growing their own to reduce risk
 - \$.30 each
 - 14,500 plants/A @ \$.30 each = \$4,350
 - Disease free, virus indexed
- Order plants 4-6 months before needed



Malaga Greenhouse





50 cells/flat

Plug Plant Sources

Cottle Strawberry Nursery, Inc.
192 Cottle Lane
Faison, NC 28341
910-267-4531
theberryspot@intrastar.net

Danny Van Meter
164 Old Peonia Loop Rd.
Van Meter Family Farm
Clarkson, KY 42726
615-887-6229
vanmeterfamilyfarm@gmail.com

Malaga Greenhouse
51441 State Route 800
Jerusalem, OH 43747
740-472-1116
www.malagagreenhouse.com
Malagagreenhouse@gmail.com

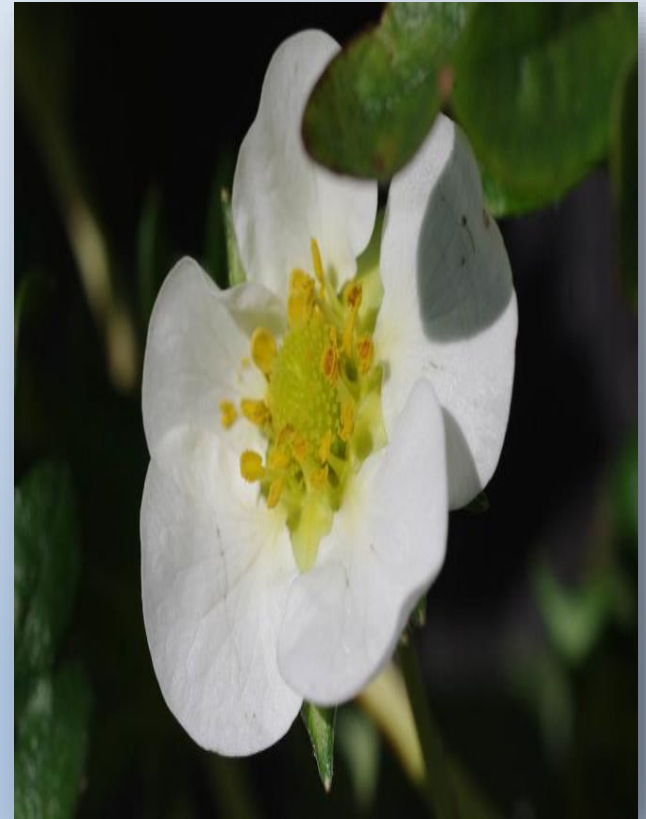
McKnight's Growers
78 Oak Ridge Lane
Carbondale, IL 62903
618-687-3563
www.mcnittgrowers.com/
mcnittgrowers@gmail.com



Plant Transport

Plasticulture Components

- Raised beds
 - 5-6 foot centers
 - 6-10" high x 30" width
 - Higher beds are best to hold heat in winter and keep fruit cleaner
- Trickle irrigation with fertilizer injection
- 1.25 mil black embossed plastic mulch
- Soil fumigation?



Prior to laying plastic

- Fall Fertilization
 - Apply 60 lb actual N per acre prior to bedding for fall growth
 - No benefit of additional P or K past soil test recommendation
- Irrigate prior to planting (maybe prior to laying plastic too)



Kennco Superbedder and Reddick bedders throw up some of the highest beds.

What to look for in a good plastic-laying job...



Weed control in plant holes

Chateau herbicide applied 30 days before transplanting and laying plastic

or

Devrinol 2-XT incorporated to depth of 2" 24-72 hrs after application before laying plastic

or

Ultra Blazer 2E herbicide may be banded on the beds after pre-bedding and before laying plastic.

Profits were lost here...



Effect of Mulch Type & Variety on Yield and Berry Wt.

Treatment	Yield (lb/A)	Avg. Berry wt. (g)
Black plastic Chandler	12,780 a	275 a
Bare ground Allstar	10,468 ab	256 ab
Bare ground Camarosa	10,232 ab	256 ab
Bare ground Chandler	9,712 ab	248 b
White plastic, Chandler	8,064 b	261 ab

Drip tube



- 8 mil tube, put down when plastic laid
- 1-2 lines per bed
 - 0.40 gpm or 24 gal/hr/100 ft
 - Install with orifices facing upwards
- May be buried 1-2 inches deep
- Tie off at end until hooked up

Row Middle Management

- Seed annual ryegrass before planting
 - 25 lb/half acre
 - Stunt with $\frac{1}{2}$ rate of Poast
- Straw between rows
- Herbicide choices
 - Chateau before planting
 - Devrinol in spring
 - Gramoxone rescue



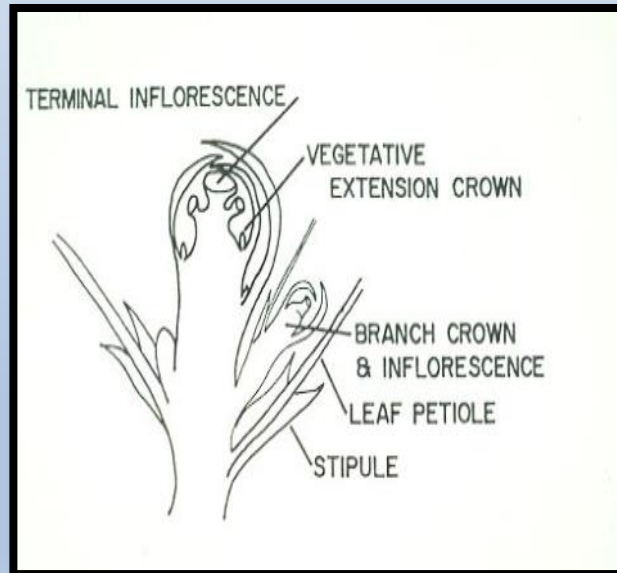
Courtesy Brad Bergefurd, OSU

Kentucky Transplanting Date

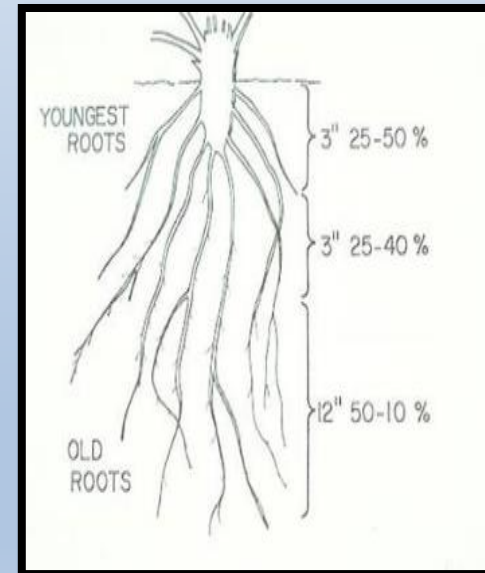
- Too early
 - Possible excessive plant growth
 - Runnering
 - Too many crowns
 - 8 crowns/plant produces excessive small fruit
- About right Sept 1-14
- Latest date (FSA)
 - Sept 20 East KY
 - Sept 20 Central KY
 - Sept 25 West KY

- Too late
 - Small plants
 - Low yield
 - <3 crowns/plant

- About Right
 - Depends on site
 - Obtain minimal runnering
 - 3-5 crowns in May
 - ~35 fruit/plant



Branch crowns develop when photoperiod is shorter than ~14 hrs.



Roots extend deeper under plasticulture

- Ideal plant is 4 weeks old
- Set plants with soil level at crown middle with a water wheel setter
- Starter fertilizer not needed if plants just coming out of fertilized mist propagation
- Plant spacing
 - Two rows 16-18" apart
 - Staggered rows
 - 28-30" wide bed
 - Plant spacing in row on 6' bed centers
 - 12" = 14,700 plts/A Most var.
 - 15" = 11,500 plts./A
 - Bigger plants, easier picking & larger berries at slightly wider spacing for Camerosa
- Check planting depth after planting and put a little soil over top of plug root ball to reduce wicking
- Fertilization should not be needed during fall if pre-plant fertilizer was applied



Irrigation

- Run drip irrigation immediately after planting
- Ideally, also run overhead sprinklers after planting during heat of day.
 - Cools plants and promotes growth
 - Day 1: 5 hrs
 - Day 2: 3 hrs
 - Day 3: 2 hrs



Fall Runnering

- Strawberry plants produce runners under long days.
- Remove these to promote crown formation and flower bud initiation
 - Don't pull them off as this may damage the crown
- Begin runner removal 3-4 weeks after transplanting
- Complete runner removal 6 weeks after transplanting



Fall Plant Development

- Goal
 - Strong, healthy, large vegetative plant
 - Same diameter as a large cantaloupe
- Small plants won't yield enough
- 3-5 branch crowns are ideal



Floating Row Cover

- Floating row cover
 - 1.25 -1.5 oz/sq. yd
 - 60 X 125' (2 people)
 - 60 X 250'
 - 60 X 300 (4 people)
 - 60' width will cover 10 rows on 5.5' centers
 - Limits sunlight!
- To enhance fall plant growth and increase flower bud initiation
- Apply when weekly temperature averages 50°F. Thanksgiving?
- Wind - field layout
- Can't move row covers when wet



Row Covers (Want 1.25 to 1.5 oz/sq yd)

Typar

GroGuard - 1.5 oz from Canada

Agribon - .55, .9, 1.25, oz (Least expensive) .55 oz tends to tear when wet. Apply .55 oz Nov. followed by .9 oz late Dec

Typar
Typar

More expensive but holds up for 10 years
Doesn't tear
 $60 \times 250' = 1/3 A = \sim \900



February



Gravel or sand bags
Every 10 steps
Every 4' for large covers

Concrete blocks are not recommended!

When to uncover?

- Around last week of February or first week of March
- Based on weather forecast
 - When day time temperatures are 40°F
- Re-cover for frost protection



Spring clean up (4/10)



Also hand pull
weeds at this time



After Leaf Removal



Production Calendar for Kentucky

- March
 - Get fertigation units set up, overhead irrigation ready
- First Bloom
 - Remove row covers
- April through May
 - Frost protection and weekly Nitrogen fertigation
- Late April to end of May
 - Harvest

Nitrogen Fertilization

- Nitrogen 120 pounds actual N total
 - 60 lb fall
 - 40-60 lb spring - Greenhouse grade calcium nitrate
- Spring nitrogen is fertigated beginning when first blooms are visible ~ April 1
 - Best to petiole test and apply N accordingly or-
 - 10 lb Calcium Nitrate/week/acre has worked well
 - For 8 weeks
- Too much N
 - Plants that are too tall
 - Reduced harvest efficiency
 - Increase fruit rots
 - Soft fruit

Fertigation



Irrigation

- Strawberry plants have shallow root systems
 - Most roots are in the top foot of soil
- A good irrigation program is essential
 - Plants require 1-2 inches/wk
 - Need a clean water source
 - Use a soil tensiometer or Watermark sensors



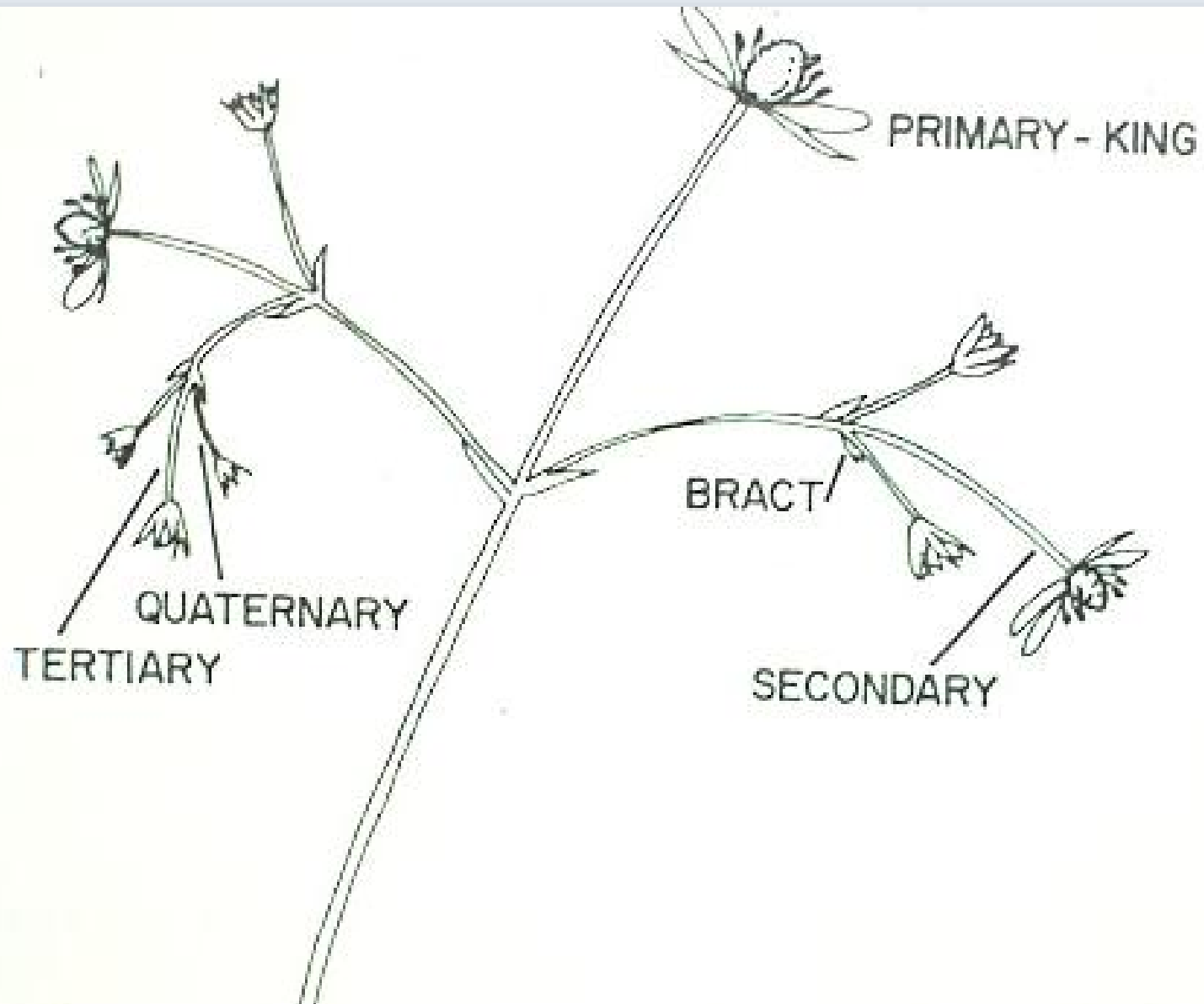
Bloom



- 2 hives honey bees recommended/A
- Careful with insecticide sprays
- Excellent pollination produces largest fruit



Flower Structure



Frost Protection

- Temperatures on the ground are usually several degrees colder than at the 5' height used by the NWS
- Digital thermometers inserted into a flower bud are excellent for monitoring flower temperatures
- Turn sprinklers on at 34°F





Frost Protected



Injured



Frost Protection

Developmental Stage	Critical Temperature
Emerged buds	10°F
Closed buds	22-27°F
Open flowers	30°F
Small green fruit	28°F

- Most Kentucky growers just pull row covers for frost and take risk
 - 1.25, 1.5, 2 oz/yd² row cover provides 4-6°F protection
 - Two covers are better than one
 - Floating row covers are heavy and you can't pull them by yourself!
- Irrigation with wobbler heads without row covers can be problematic if the temp. drops too low or there is wind.
- Complete protection is provided by combining row covers with overhead sprinklers



Inches of Water/hr. to Apply

Air temp. at canopy (F)	Wind speed at crop height (mph)				
	0-1	2-4	5-9	10-14	18-22
27	0.10	0.10	0.10	0.10	0.2
24	0.10	0.16	0.30	0.40	0.8
20	0.16	0.30	0.60	0.80	
18	0.20	0.40	0.70	1.00	

Freeze blankets protect tender blooms from frost and freeze

Use sprinkler irrigation on top of row covers
Monitor flower temperature beneath row covers

APR 24 2005



Frost Protection



Run irrigation until ice slides off plants



Disease Control

- Anthracnose Crown Rot
 - Get transplants produced from Canadian tips
 - Fungicide spray to plug trays or a spray to plants in the field after transplanting
 - Fall sprays if disease noted
- Anthracnose Fruit Rot
 - Bloom-harvest
 - Captan is backbone of spray schedule
 - Abound, Cabrio, Luna Sensation, Mervion, Pristine, Quadris Top are all excellent



Boom sprayer

Harvest

About 30 days from flowering



Production season is 4-6 weeks

Harvest



- Pick as ripe as possible for flavor/market
- Pick into shallow marketing containers



Cool fruit immediately after harvest to maximize shelf life

May store down to 35°F

U-Pick Harvest Containers



- Southern Container Corporation
- <http://socontainers.com/berry-fruit-packaging/>
- 4 quart plastic vented "Basket"
- 150/case

Harvest

- Timely harvest
- Skilled labor



Photos courtesy Brad Bergefurd, OSU

Marketing

- Retail
 - U-Pick
 - Picked
 - Farm market
 - Farmers' market
 - To order
- Wholesale
 - Farm-to-school
 - Auction
 - Supermarkets
 - Third party audit
 - CSA



Questions?



Sources

- ❖ Dr. John Strang Extension Fruit & Vegetable Specialist, University of Kentucky, Department of Horticulture
"Plasticulture Strawberry Production", Jan 2019
- ❖ Brad Bergefurd, Horticulture Specialist & Extension Educator
OSU Piketon Research & Extension Center and Scioto County Extension
"The Basics of Plasticulture Strawberry Production" Jan. 2017