### **Strwberry Pre-Plant Considerations**



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### Overview

- Step 1: Land Preparation: Soil sampling, Varieties, Nutrition, Drainage, Cold spots, Erosion!
- Step 2: Pre Plant: Pre-plant herbicides, Fumigation, Plastic
- Step 3: Transplanting: Bare-root vs. plug plants
- Step 4: Post Transplant: First few months
- **Step 5: Dormancy:** Cold Protection during dormancy
- Spring: Tissue Sampling

## Land-Preparation- General Considerations **NC STATE**

- Windbreaks in north/northwest of field
- Can you crop rotate?
- Row orientation: Soil drainage first. North-South second.
- Wildlife (deer, rabbits, turkey, birds, etc.): Fences!



### Step 1: Air-Drainage





### Step 1: Land-Preparation: Soil

- Soil Content: Sandy Loam/clay-loam!
- Soil pH: 6.0-6.2
- Drip Irrigation (1-2 drip lines).



### Step 1: Land-Preparation (3 months before transplanting)

- Disk the ground
- Get your soil tested and follow recommendations!
- Use lime (Ca CO<sub>3</sub>) if pH is too low
- Look at Effective Calcium Carbonate Equivalent (ECCE)
- Plant Cover Crop!
- Total Cost: approx. \$600/A

Liming material	Neutralizing agent	CaCO <sub>3</sub> equivalent of pure material (%)		
Dolomitic limestone	CaCO <sub>3</sub> •MgCO <sub>3</sub>	110–118		
Papermill lime sludge	Mainly CaCO <sub>3</sub>			
Marl	Mainly CaCO <sub>3</sub>	variable		
Calcitic limestone	CaCO <sub>3</sub>	100		
Water treatment lime waste	CaCO <sub>3</sub>	variable		
Wood ash	K <sub>2</sub> CO <sub>3</sub> , CaCO <sub>3</sub> , MgCO <sub>3</sub>	20–90		
Fly ash	CaO, Ca(OH) <sub>2</sub> , CaCO <sub>3</sub>	variable		
Hydrated lime	Ca(OH) <sub>2</sub>	135		
Air-slaked lime	Ca(OH) <sub>2</sub> + CaCO <sub>3</sub>	100-135		

### Step 1: Land-Preparation (3 months before transplanting)

- Low soil pH is the most significant problem identified on soil samples submitted from strawberry fields in NC.
- This problem <u>cannot be corrected in a timely</u> <u>manner</u> if the crop has already been planted.
- Low Ca and Mg also usually come with low pH.
- Correct with dolomitic lime

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### Step 1: Land-Preparation (3 months before transplanting)



 Sampling depth: 8 inches!



### Step2: Pre-Plant (3-0 months before transplanting)

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June:

• Order transplants and supplies

July/August:

- Rotovate Cover Crops
- Subsoiling
- Break up soil clods



### Step2: Pre-Plant (3-0 months before transplanting)

August/September:

- Assemble Irrigation System
- Irrigate for fumigation
- Rotovate for fumigation
- Preplant fertilizer
- Preplant fumigations
- Lay plastic
- Drip Tape
- Seed ryegrass in aisles (EROSION)!



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### Step2: Pre-Plant Pre-Plant Fertilizer



NCDA&CS Agr	onomic Divisi	on	Phone:	(919)73	3-2655	Web a	ite: www	/.ncagr	.gov/ag	ronomi/						1	Report	No: 1,	3086		
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### Step2: Pre-Plant Pre-Plant Fertilizer

Based on your soil samples Send soil samples to <u>www.ncagr.gov/agronomi/sthome.htm</u> Broadcast fertilizers

Fertilizer rule of thumb:

- Half the Nitrogen (ca. 60 lbs/A)
- All the Phosphorus (ca. 60 lbs/A)
- All the Potassium (ca. 120 lbs/A)
- Too much N will likely produce excess vegetative growth and set fewer fruit.
- Consider applying sulfur if sulfur index is below 30.
- 15-20 lbs/A sulfur
- Boron!!! 1-2 qt per season in the spring!

### Step2: Pre-Plant Pre-Plant Fertilizer

- Pre-plant phosphorus, potassium, magnesium and micronutrients should be applied based on soil test results.
- Fall fertilization should meet the nutritional needs of the crop until growth begins in the spring.
- As a general rule a tobacco blend of fertilizer ex. 6-3-18, 10-5-23 etc. work well for our soil needs and have low levels of Cl.

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### Step2: Pre-Plant Pre-Plant Fertilizer

Commonly used pre-plant fertilizers:

6-6-18; 6-3-18; 10-5-23: Work well for soils with low CI!!

Phosphate:

- Phosphate-Diammonium phosphate (DAP, 18-46-0)
- Triple superphosphate (0-46-0)

Potassium:

- Potash-potassium nitrate (13-0-44)
- Potassium Sulfate or Chloride

Nitrogen:

- DAP (18-46-0)
- Ammonium sulfate (21-0-0)
- Potassium Nitrate (13-0-44)

### Step2: Pre-Plant: Plasticulture

- Double rows of plants are set through black on raised beds in early fall when day length is decreasing
- Plants produce flower buds in the fall, but flower in spring!
- Fruit is produced in the spring (spring production)
- Plants are removed after harvest
- high inputs, high returns
- Pest problems minimized because of replanting each year



### Step2: Pre-Plant: Plasticulture



Planting Space based on: Variety, Experience and Vigor of plant

- 12 Inches = 17,500 plants/A
- 14 Inches = 15,000 plants/A
- 15 Inches = 14,000 plants/A



Figure 9: Finished Strawberry Bed

### Step2: Pre-Plant: Plasticulture

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- With 60 Inch center: 8712 linear feet / A
- Use a 64-66 Inch plastic roll!!
- Use deep bed shaper (not vegetable bed shaper)



60"

### **Short-Day Varieties**

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- Chandler
- Camarosa
- Rocco (NC State variety): Short-day. Early season. Consider as a Sweet Charlie alternative.
- Liz (NC State variety): Short-day. Mid-late season. Consider as a Camarosa alternative.
- **Ruby June (Lassen Canyon variety):** Short-day. Mid-season. Consider a Chandler alternative.
- Merced (UC variety): Short-day. Mid-season.
- Camino Real (UC variety): Short-day. Early-mid season.

**Recommendations:** 

- Try a few 100 plants of a new variety
- Rely on min two different plant sources if possible

### Step2: Pre-Plant Drip Irrigation

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Recommended: 1 or 2 drip lines per bed,

1 drip line: center

2 drip lines: one per side, about 3-2 Inches from the center (requires a straight, bed without clods)

Usually done: One drip line in the bed center



### Step2: Pre-Plant Plastic Mulch



Plastic	Costs	Fumigant efficacy	Control efficacy
PE Films	Cheap	Not good	
Metalized Films	More costly	better	May control insects by distraction (may affect soil temperature)
VIF	Costly	better	
TIF	Costly	good	

### Step2: Pre-Plant Plastic Mulch



Plastic	Costs	Pathogens	Insects (high tunnel?)
PE Films	Cheap	low	low
Metalized Films	More costly	low	May control insects by distraction (may affect soil temperature)
VIF	Costly	Low-medium	
TIF	Costly	Medium-high	

### Step2: Pre-Plant Plastic Mulch



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Ruijun Qin (USDA-ARS) Suduan Gao Husein Ajwa David Sullivan Dong Wang Bradley D. Hanson: Journal of Environmental Quality Abstract 2011, 40 (4), 1195-1203

Fig. 2. Concentration changes of 1,3-dichloropropene (1,3-D) in soil profile in the soil-gas phase in polyethylene (PE)- and totally impermeable film (TIF)-covered fields. The legend shows sampling time (h) after fumigant application.

Fumigants

Pic-Clor 60/80 (300-350 lbs/a, 14-21 days)
 Chloropicrin (60/80%) + 1,3D (40/20%)
 Telone (30-40 gal/a, 21 days)
 Chloropicrin (17-35%) + 1,3-D (65%)

Paladin (14 days)
 Chloropicrin (21%) + Di-Methyl Disulfide (79%)
 Vapam/Kpam/Sectagon and others
 Metam Sodium

### Step2: Pre-Plant Fumigants

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'Bio'Fumigants

#### Dominus

Allyl Isothiocyanate (AITC, synthetic; 200-350 lbs/a)

#### Mustard

Allyl Isothiocyanate (AITC, natural)

#### Mustard Seed Meal and Pelleted Mustard Allyl Isothiocyanate (AITC, natural)

# Arugula Nematode Control

### Fumigants



#### Fumigant and activity

Fumigant	Nematode	Disease	Nutsedge	Other weeds
Telone C 35 + VIF/TIF	+++++	+++++	+++	+++
Telone C 35	+++++	+++++	+	+
In-Line	+++++	+++++	+	+++
Metam Sodium	++	+++	++	+++++
Dominus	++	+++	++	+++
Pic-Clor 60	+++++	+++++	+	+++
Chloropicrin	+	+++++	-	-

### Respirator



- Fit Test!
- Medical Exam
- Make sure it forms a seal
- Store at dry and cool place (not in garage/shop)
- Clean regularly
- Change cartridge regularly
- Never use a cartridge AFTER expiration date

### Fumigants

Equipment	Cost
Full Face Respirator	\$ 150 – 200
Cartridge	\$ 30 – 50 (frequent costs)
Chemical resistant gloves	\$ 20 – 40 / pair (frequent costs)
Rubber Boots	\$ 20 – 60 / pair
TiVac	\$ 20 – 30 / piece (frequent costs)
TOTAL	\$ 170 – 230 one time
	\$ 70 – 120 frequent

### Fumigants: look at label!!!!



Fumigant	Short-Term Exposure	Long-Term Exposure
Chloropicrin	Sever irritation of skin, eyes, respiratory tract	Long-lasting Nausea, vomiting, diarrhea
	Difficulty breathing, Headache, Nausea	Affects respiratory tract
1,3 Dichloropropene	Chest Pain, breathing difficulties	Nasal tract, respiratory tract, Urinal bladder
		Maybe carcinogen

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#### Step 1: Calculate the rate of fumigant per 'row acre'

#### 'row acre' =

Number of linear feet of row that equal one acre of ground



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#### **Step 1:** Calculate the rate of fumigant per 'row acre'

'row acre' =

43,560 sqft / row spacing





Step 1: Calculate the rate of fumigant per 'row acre'

**Example: Row-Spacing is 5 feet** 

43,560 sqft / 5 = 8,712 linear ft of rows = 1 acre!!!

100 rows x 200ft = 20,000 linear ft

Row acres = 20,000 / 8,712 = 2.29 acres

Row acres = 100 rows are equivalent to 2.29 acres



Step 2: Calculate Broadcast equivalent rate

# Total amount of fumigant applied to the treated area (ROWS) divided by the TOTAL LAND

- Total area within the perimeter of the fumigated part of the field
- Pounds/gallons of product per treated acre (rate of product applied in the bed)
- Total treated area: Bed with (bottom), row spacing

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#### Step 2: Calculate Broadcast equivalent rate

- Bed with at bottom
- Row spacing
- Product applied per treated area
- Application block size
- Ditch size

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Step 2: Calculate Broadcast equivalent rate

Example:

- Bed with at bottom: 32 inches
- Row spacing: 60 Inches
- Product applied per treated area: 350 lbs
- Application block size: 5 acres
- Ditch size 0.25 acres

Size of beds and furrows (without ditches) = 5 acres – 0.25 acres = 4.75 acre



Step 2: Calculate Broadcast equivalent rate

Example:

Size of beds and furrows (without ditches)

= 5 acres – 0.25 acres = 4.75 acre

Divide the bed width at the bottom by the row spacing = 32 Inches / 60 Inches = 0.53

Determine the **proportion** of the application block to be treated

= 4.75 acres / 5 acres = 0.95

0.53 \* 0.95 \* 350 lbs/A = 176.22 lbs (Broadcast equivalent rate)





# Aim: Measuring and adjusting equipment performance

- Check with your equipment service (e.g. TriEst)
- Technique varies from equipment to equipment

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#### **Flow Meter**

- Usually calibrated for water!
- Higher density = slower movement!!!

Fumigant	Boiling point (°F)	Specific gravity*	Vapor pressure (mm Hg at 20°C)**
1,3-Dichloropropene	219	1.21	34
Chloropierin	234	1.65	18
MITC (dazomet, metam potassium, metam sodium)	246	1.06	13
Methyl bromide	38	1.73	1420
Dimethyl disulfide	229	1.05	17

of water.

"mm Hg = millimeters of mercury.

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#### **Flow Meter**

Must be corrected!

Example:

- Swath width of the rig is 6 feet

#### Determine the time to treat an acre:

- 100 foot rig test: 22 sec. for 600 sqft (6 \* 100)
- 22 sec. / 600 sqft = 0.036 sec./sqft
- 0.036 sec./sqft x 43,560 sqft/ac = 1568 sec./acre = 26.1 min/acre

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#### **Flow Meter**

Must be corrected!

Example:

- Time to treat an acre = 26.1 min
- 100 % flow rate (Water) = 2gpa
- Telone EC (93.6 % 1,3D) = 2 x 0.913 = 1.83 gal/min
- 20 gal/a

#### **Determine the flow meter setting**

- Total gal/acre = 26.1 min \* 1.83 gal/a = 47.7 gal (100%)
- FlowMeter (water): (20/47.7) \* 100 = 41.9%



- Let professional service check your equipment service (e.g. TriEst)
- Let them help you calibrate your equipment
- Let them help you advising on fumigation rates and plastic choice

### Step3: Transplanting



- There are two types of plants
  - Bare roots (fresh dugs)
  - Plug Plants
- Water source and labor availability are factors in choosing plant types most suitable for your operation (fresh dugs>plugs)







### Step3: Transplanting

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Fresh dugs v. plugs

- less expensive
- more water to establish
- planting depth tricky
- Plugs easy to plant
- Easy to punch holes with plugs

### Step3: Transplanting



### Bare roots/ cut offs/ fresh dugs: plant earlier than plugs Irrigate after transplanting!

### Total costs transplanting: approx. \$ 4,000 /A

### Step4: Post-Transplant

Replant (2%)

**Disease and Pest Control:** 

- Ridomil Gold EC (drip system)
- Anthracnose Spray
- Mites
- Botrytis crown rot

Deer/Bear control?

Runner Removal (ca. 4-5 weeks after transplant)

Total costs: approx. \$600/A



### Step5: Dormancy

Clean and hand-weed beds

Remove runners

**Disease control (Captan)** 

Apply floating row covers!!!!

Order supplies for Spring



Row covers are applied and removed based on weather

Remove dead foliage and weeds in early Spring

Total Costs: approx. \$ 2,400/A (row covers: \$1,300/A)

### Step5: Dormancy

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Row covers:

- Can be used to increase flowering buds
- Used to frost protect (min temperatures < 22F in dormancy)



### Step5: Dormancy: Cold Damage





### Step6: Pre-Harvest

- Tissue Sampling (bi weekly)
- Pull plants and weeds
- Fertilize (.75 lbs N/day)
- Scout for pests (mites?)
- Botrytis control
- Powdery Mildew control
- Pollinate with bees!!!!!
- Fireants
- Frost Protect
- Find labor
- Total cost: approx. \$2,300/A



### Step6: Pre-Harvest



Table 1. Critical temperatures of strawberries at various stages of flower development

Stage of Development	Critical Temp. (°F)
Tight bud	22.0
"Popcorn"	26.5
Open blossom	30.0
Fruit	28.0

Source: Perry, K.B. and E.B. Poling. 1986. Field observation of frost injury in strawberry buds and blossoms, Advances in Strawberry Production 5:31-38.

### **Tissue Sampling**

- Collect the most recently mature trifoliate leaves (MRML)
  - Has three leaflets and a petiole
  - Is full-sized and dark green
  - Is healthy--no diseases, insects or harsh environmental conditions (predictive)



### **Tissue Sampling**

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- Detach the petioles
  - Snap leaves off at the stem then separate the blades from the petioles



#### Measure NO3-N on petioles

A great predictor of soil N availability

### **Tissue Sampling**



Growth	Week	NO <sub>3</sub> -N Sufficient	Nitroge whe	Nitrogen recommendation when petiole NO <sub>3</sub> -N				
Stage		Range (ppm)*	Below-	Within-	Above-			
			the sufficient range					
	1	600-1500			None			
	2-3	4000-6000		5.25 lb				
	4	3500-6000						
D / F	5-8	3000-5000	7 lb					
D/ Г	9	2000-4500	N/a/wk	IN/d/WK				
	10	2000-4000						
	11	1500-3000						
	12	1000-2000						

### Information

- NC Strawberry Association: <u>https://ncstrawberry.com/</u>
- NCSU Strawberry Portal: <u>https://strawberries.ces.ncsu.edu/</u>
- Southern Regional IPM Center: <u>https://www.smallfruits.org/</u>
- Berry-Mg: Newsletter NCSU:

Email to: mj2@lists.ncsu.edu. Text in message body: 'subscribe berry-mg'

#### **NEW: Strawberry Youtube Channel:**

https://strawberries.ces.ncsu.edu/2019/08/strawberry-youtube-channel/

### Thank you!



### Thank you for your attention

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