



Plasticulture Strawberry Production

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Varieties

Recommended Varieties¹

Each variety has susceptibilities and resistance to different diseases, and none are completely resistant to any disease. Be aware that AC Wendy and Flavorfest are especially susceptible to angular leaf spot, a bacterial disease. Galletta and Flavorfest are fairly resistant to anthracnose fruit rot, while Camarosa, Chandler, and Ruby June are especially susceptible. Sweet Charlie and Flavorfest are very susceptible to Phytophthora diseases. Day-neutral varieties are susceptible to anthracnose fruit rot and powdery mildew.

Short-day			Day-Neutral
Early	Midseason	Late	
AC Wendy	Benicia (coastal VA, shipping only)	AC Valley Sunset	Albion ⁵
Galletta	Camarosa ³ (shipping only)		San Andreas ⁵
Ruby June (trial)	Camino Real ⁴ (VA and DE)		Seascape
Sweet Charlie ²	Chandler		Sweet Ann ⁶ (VA)
	Flavorfest		
	Rutgers Scarlet (trial)		

Rotation, Soil Borne Diseases

Very Susceptible to Root Diseases



Beneficial Rotations



Fumigation and Alternatives

Fumigation Benefits



Fumigation Alternatives



Mustard
Seed
Meal



BIOPESTICIDE FOR AGRICULTURAL SOIL TREATMENT USE

A Broad Spectrum Pre-Plant Soil Biofumigant For The Control Of
Certain Soil Borne Fungi, Nematodes, Weeds And Insects

ACTIVE INGREDIENT:
Allyl isothiocyanate..... 96.3%
OTHER INGREDIENTS:..... 3.7%
TOTAL:..... 100.0%
Contains 8.19 lbs. active ingredient (allyl isothiocyanate)
per gallon. This product weighs 8.5 lbs. per gallon.



Manufactured for:
Isagro USA, Inc.
430 Davis Drive, Suite 240
Morrisville, NC 27560

High Crowned Beds

This



Not This



Tight Plastic

**Tight
Lay in heat of day.**



**Loose transfers less heat
to soil.**







Weed Control

Holes



Between Plastic



Cover Crop Between Strawberry Beds??



Plastic Color

**Black for spring
production**



**White for summer, day
neutrals**



Planting Date

Early September - Goal 2-3 branch crowns by early winter



Early and Late Planting Issues

- Too early and you may have too many branch crowns leading to smaller berries
- Too late and you will get too few of branch crowns and much reduced yield



Transplant Quality

**Diseases – Pythium and
Phytophthora on roots,
Anthracnose, Viruses**

Plugs vs Bare Root



Plugs infected with *P. cactorum*



Frigo plant



Green top



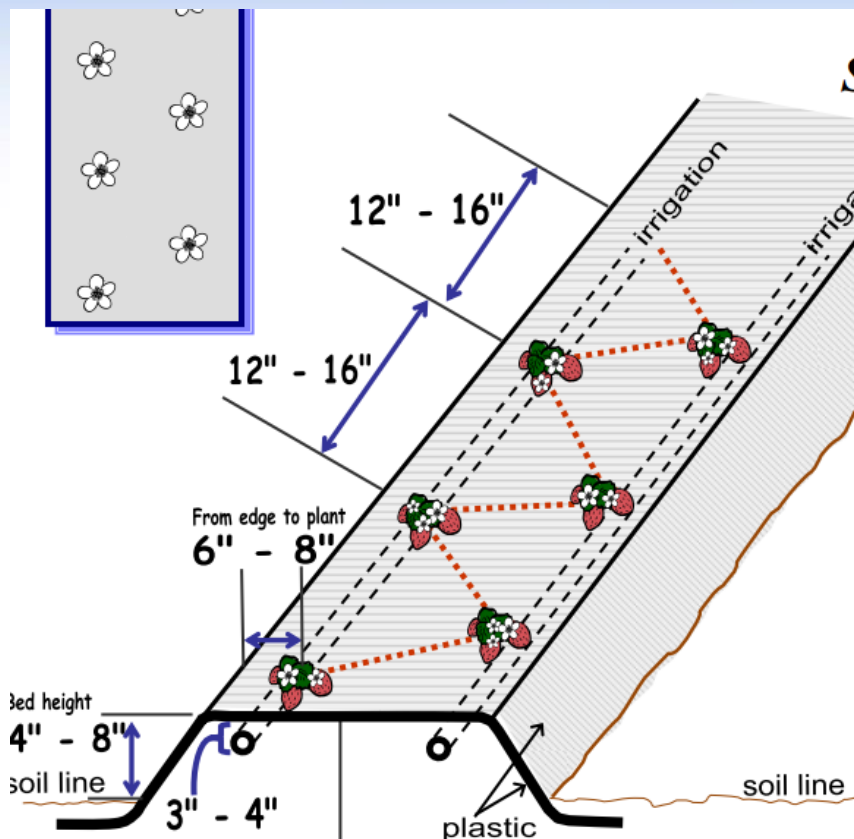
Mini-tray



Tray plant

Spacing

Two Row 12-14" inrow
12-18" between (*depends on plastic width*)



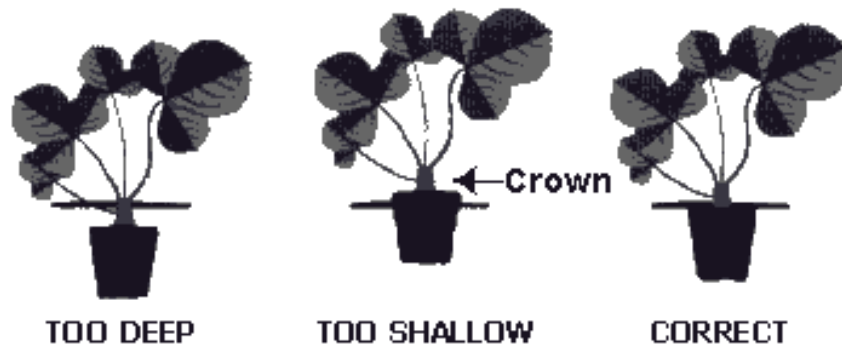
Three row system 12" inrow
12"x12"x12" between row
Best system for Albion



Planting

**Setting plugs – avoid
shallow or deep**

Depth



Irrigation after Planting

Overhead for establishment



Drip after establishment



Fall and Winter Crown Formation

**Fall – Need 2 branch
crowns**



**By Spring 3-5 branch
crowns**



Too many branch crowns



Runner Management

Runners take energy from main plant, source for diseases

Starting 3-4 weeks after planting remove runners.



Fall Fertilizer

Prior to bed formation

- Adjust pH at least 4 months before (6.0 target)
- Phosphorus and Potassium per soil test
 - 30 lbs P replacement value in high P soils
 - Maintain K in high or optimum level
- Boron 1 lb/a
- Sulfur 15 lbs/a

Nitrogen

- 60-75 lbs/a N with bed formation
 - DAP (18-46-0)
 - ammonium sulfate (21-0-0)
 - potassium nitrate (13-0-44)
- Some varieties such as Flavorfest will put on too much growth and need less N

Fall and Winter Row Cover

**Cover before first hard
freeze. 0.9-1.5 oz row
cover**

**Early Cover?
No Cover?**



Edges – gravel or sand bags



Monitoring Growth, Temperatures Under Covers

Growth



Temperature



Avoiding Pests Under Covers

**Apply miticide/insecticide;
fungicide if needed before
winter cover**



**Control weeds or mow
covercrop before covering**



Deer damage in fall will greatly lower yields



Late Winter Cleanup

Dead leaves need to be removed



Fully Cleaned



Late Winter - Early Spring Row Cover Management

Remove covers during warm snaps to delay too early flowering, leave on if more growth is needed

Once buds emerge they can be damaged by a freeze (<25 F)



Flowering, Bees

Bees = bigger fruit

Bumblebee vs Honeybee

Rowcovers need to be removed

Greenup to flowering

about 3-4 weeks

Flowering to ripe fruit ~30 days



Poor pollination green fruit



Poor pollination ripe fruit



Nitrogen – additional 50-60 lbs N usually needed

- Sources
 - calcium nitrate (15.5-0-0)
 - potassium nitrate (13-0-44)
- First signs of green
 - Weekly program
 - 5-7 lbs N at greenup
 - Up to 7 lbs N per week thereafter depending on tissue testing
 - 2 shot program
 - 15-25 lbs of N at greenup
 - 15-25 lbs of N 2 weeks after first flowering

Potassium, other nutrients

- Often use a 1:1 ratio N to K in spring fertilization
- 7-14 lbs/a K if low in tissue testing
- Sulfur?, Calcium?, Boron?



Frost and Freeze Protection

**Row covers on and off
best for frost protect
during early period**



**Double covers, sprinkler,
sprinkler plus cover for
freezes**



Frost and Freeze Damage During Flowering – Flowers damaged < 30 F

**Black Centers – frost or
freeze damage**



**Deformed berries because
of cold injury**



Botrytis Management

**Removal of dead leaves
critical**



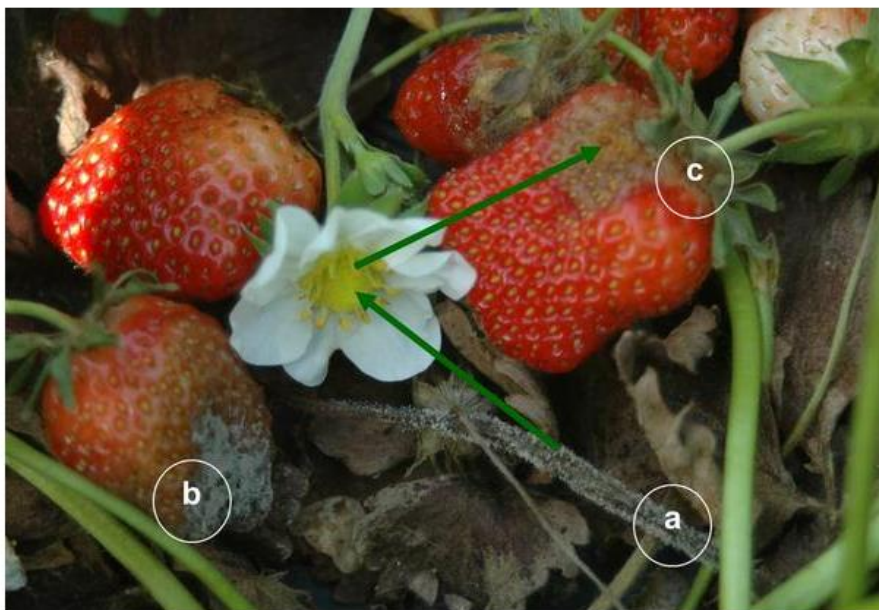
**Fungicide programs start
just before flowering, first
flowering. Some
fungicide resistance in the
region**



Botrytis Management

Infections

Figure SS-3: Infection cycle of *B. cinerea* in strawberry plantings. Gray mold on different parts of strawberry; a) Sporulation on dead petiole and leaf; b) fruit infection from colonized dead tissue; c) fruit infection that came through the flower.



F.J. Louws

Remove overripe fruit from field



Harvesting

**Clean pick – do not let
fruit go to overripe stage,
tips need to be full color**



Controlling U-Pick



Handling

Pick without excess field heat into sales container



Forced air cooling



Insect Management

Potential insect/mite pests

- Aphids
- Leafhopper
- Sap beetles
- Strawberry Clipper
- Spittlebug
- Thrips
- Two spotted spider mite
- Tarnished plant bug



Monitor, Apply controls as needed

- Apply mite controls early
- Remove overripe fruit to control sap beetle



Heat

Temperatures in the high 80's limits further strawberry flowering



Techniques to deal with heat

- Sprinkler evaporative cooling
 - Issues with disease
- Blowers
- Irrigate beds early to keep beds cooler longer
- Shade cloth? Other types of covers?

Wet Conditions

Rain during harvest a major issue



Tight fungicide schedule, picking management



Other Diseases – Anthracnose, Viruses

Anthracnose



Virus problem 3 years ago



Other Diseases – Pythium and Phytophthora

Pythium



Phytophthora



— Carryover – can be profitable, But... —

**Removal of dead
materials, mow above
crown**



Crown thinning



Day Neutral Management

Multiple planting systems

- Plant at different times
 - September for spring black plastic
 - April for late spring- early summer white plastic
 - May for mid summer white plastic
 - July for fall white plastic



Carryover systems

- Spring plant white plastic
- Late spring-early summer harvest
- Summer renovation
- Fall harvest
- Overwinter
- Spring-early summer harvest

Shade cloth?

Matted Row Culture

Recommended Varieties¹

Early	Midseason	Late
AC Wendy	Allstar (VR, RSR) ^{2,3}	AC Valley Sunset
Earliglow (RSR) ²	Darselect ⁴	Jewel
	Flavorfest	
	Honeoye ⁵	

Matted row patch at bloom



Strawberry planting systems

ground or bed – Strawberries are Edge Bearers

- **Matted Row**
 - 18"-30" between plants
 - 36 to 48" row spacing
 - Beds 12-18" wide
 - Runners encouraged
- **Spaced Plant**
 - 6" between plants
 - 36 to 48" row spacing
 - Single plant row
 - Runners removed



Growing Brambles

Raspberries and Blackberries



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Cooperative Extension

Brambles Are an Aggregate Fruit



- Aggregate (many small fruits called drupelets)
 - 50-100 blackberry
 - Up to 200 raspberry
- Self-fruitful and self-pollinating
- Benefit from cross pollination – bees

Difference Between Raspberries and Blackberries - Receptacle



Cultivated Brambles

- Red and Yellow Raspberries
 - Summer fruiting
 - Fall Fruiting (red)
- Black Raspberries
- Purple Raspberries
- Blackberries
 - Thorny and thornless
 - Summer and Fall Fruiting
- Requirements
 - Well drained site
 - Avoid root rots
 - Full sun
 - Good air movement
 - Limit disease, especially botrytis



Temperatures

- Red Raspberries
 - 70° F Optimum
 - Heat
 - Reduced Fruit Size
 - Reduced Yield
 - Reduced Quality
- Black Raspberries
 - Higher Temps
- Blackberries
 - 80° F Optimum
- Sun Scald



Recommended Red Raspberry Cultivars for DE

- Summer Bearing

- Early

- Esta
 - Lauren
 - Moutere
 - Reveille
 - Prelude**

- Midseason

- Amos
 - Killarney
 - Latham
 - Nova

- Fall Bearing

- Early

- Jaclyn
 - Caroline **
 - Joan J
 - Polka

- Midseason

- Autumn Britten

- Late

- Josephine

Other Raspberry Cultivars

- Yellow – poor yielders due to heat
 - Anne
 - Goldie
 - Fall Gold
 - Kiwi Gold
- Purple – many do not like flavor but does well
 - Royalty
- Black – Does well in heat
 - Bristol (E)
 - Jewel (M)
 - Mac Black (L)

Blackberry Varieties

Erect and Semi Erect

- Thornless Floricane
 - Chester
 - Triple Crown
 - Navaho
 - Arapaho
 - Ouachita
 - Apache
 - Natchez
 - Doyles
- Primocane
- Thornless
 - Prime-Ark Horizon
 - Sweet-Ark Ponca
 - Sweet-Ark Caddo
 - Prime-Ark Traveler
 - Prime-Ark Freedom
- Thorny
 - Prime-Ark 45

Florican Blackberries

Triple Crown



Natchez



Primocane Blackberries

Prime Ark45

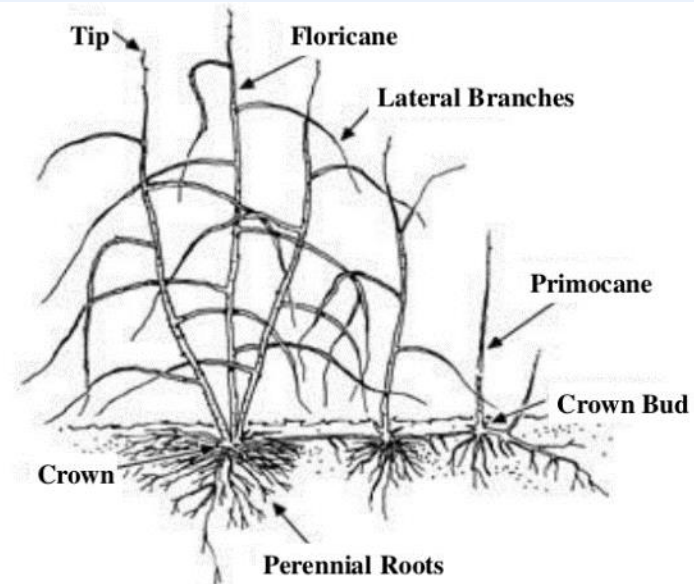


Prime Freedom



Raspberry and Blackberry Plants

- Woody perennial
 - Crown
 - Roots
 - Canes - Biennial
 - Primocanes
 - Floricanes
 - Leaves
 - Flowers
- Fruiting
 - Annual
 - Fall, mow after done
 - Biennial
 - Fruit on second year floricanes
- Plantings can last 8+ years, vigor loss due to viruses



Delaware Planting Recommendations

- In Row
 - Red Raspberries 24"
 - Gold Raspberries 24"
 - Black Raspberries 30"
 - Purple Raspberries 36"
 - Thorny Blackberries 36"
 - Thornless Blackberries 48"-72"
- Between rows '2'
- Planting dates nts = March/April
 - Rooted plants = May
- Plant at nursery depth



Site considerations

- Drainage
 - Avoid wet spots, low areas
 - Ridge if unsure
- No perennial weeds
- No wild brambles near
- High organic matter
- Access



Fertility – Planting

- Before Planting - Correct fertility fall before
 - Soil test
 - pH 6.0-6.5
 - Phosphorus moderate
 - Potassium moderate to high
- Spring – Work in low amount of N before planting.

Fertilization – Future years

- Nitrogen – sidedress with Calcium Nitrate or other N fertilizer
- First application in spring before leaf out and second application by early July

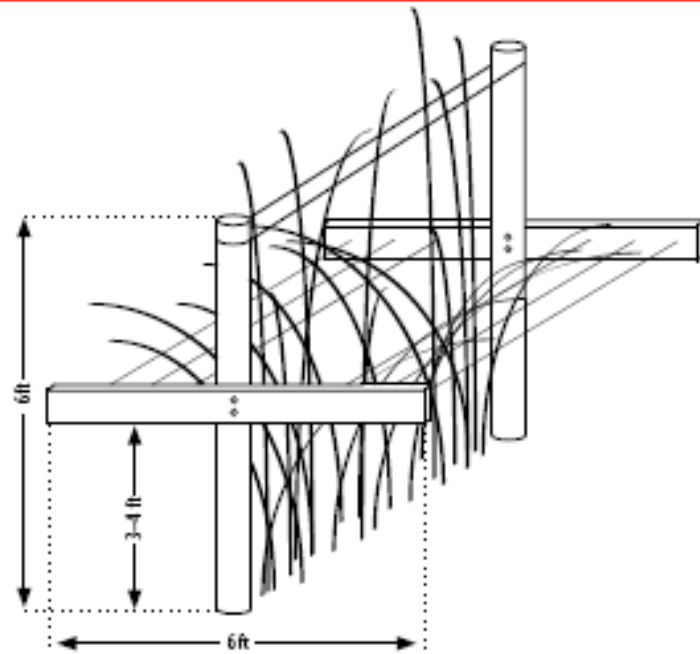


Figure 8.4. Tor Lincoln trellis.

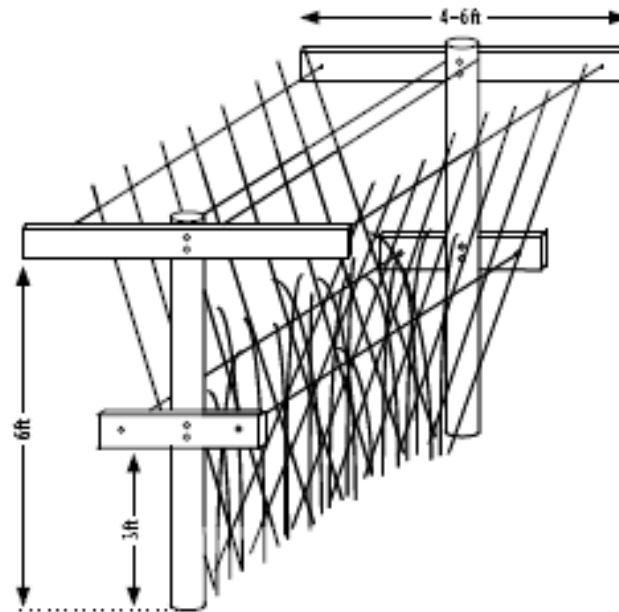
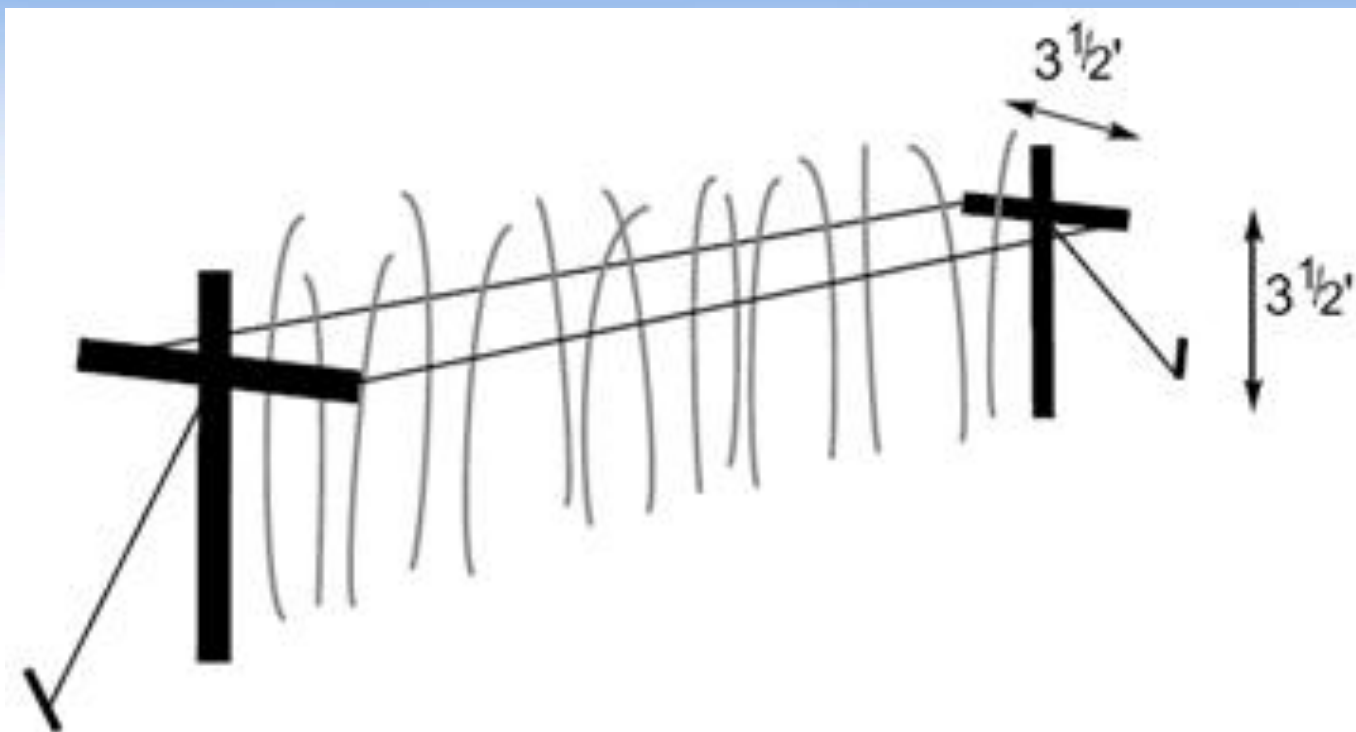


Figure 8.5. V trellis.

Trellises for Floricanes types

Simple Trellis for Fall Bearing Types



Pruning Floricane Fruiting Red Raspberries

- **Summer**

- Remove spent floricanes

- **Dormant**

- Head floricanes by $\frac{1}{4}$ or desired level
- Remove weak or damaged wood
- Thin canes to 4-6 per foot of row
- Reduce row to 1 foot wide

Photo, W Lord



Photo, W Lord



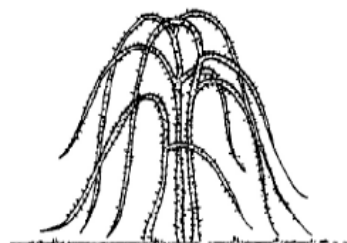
Pruning Black and Purple Raspberries

- Summer
 - Remove spent floricanes
 - Top primocanes at 3'-4' once they reach that size
- Dormant
 - Remove weak wood
 - Thin to 5-10 canes per plant
 - Head back lateral branches to 6 inches
 - Remove very low laterals

Black/Purple Raspberry

•Before Dormant Pruning

1. Black raspberry before winter pruning

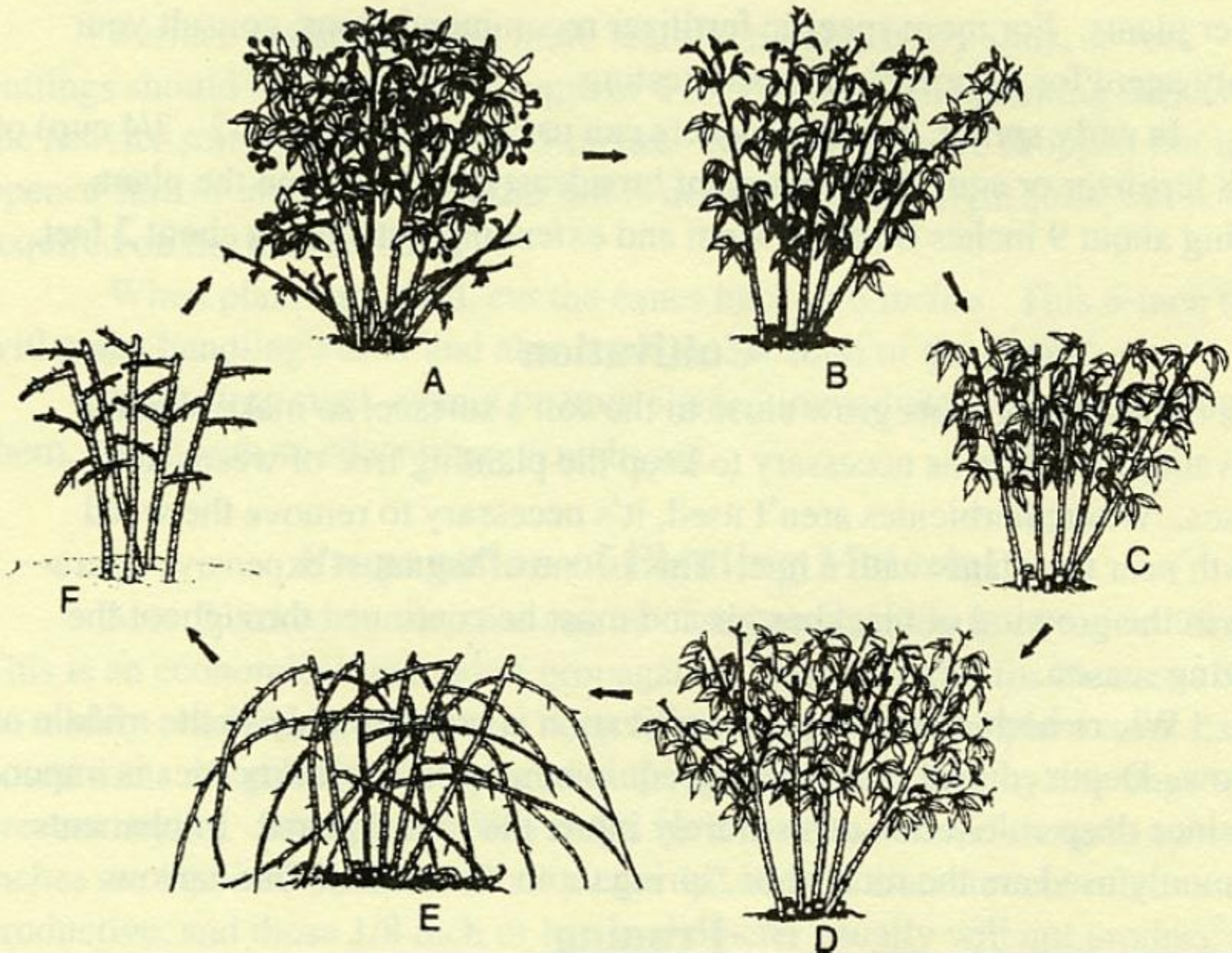


•After Dormant Pruning

Black raspberry after winter pruning



Pruning Blackberries



Harvesting

- Red, yellow, & black raspberries
 - The cap pulls clean leaving the receptacle
- Blackberries
 - The receptacle is removed along with the fruit



Harvest Season



- Summer Raspberries
 - June-July
- Fall Raspberries and Blackberries
 - Late July-Frost
- Summer Blackberries
 - July-August

Harvesting Considerations



- Botrytis susceptible
 - Harvest regularly, remove all ripe
- Individual drupelets held together by hair and wax
- High respiration rate
 - Remove heat quickly
 - Harvest morning

Japanese Beetle



HGIC/University of Maryland Extension

Spider Mites

- Two spotted spider mite
- Hot, dry weather conditions promote rapid population increase
- Injury to leaves appears as speckling, russeting, brown spots
- Webbing
- Dirty



TSSM



Speckling injury



Russeting, brown spots



Spotted Winged *Drosophila*

Diseases

- **Botrytis – Gray Mold**
- Root Rot
- Virus Diseases

