

Integrated Pest Management for Apple Insect Pests in Home Gardens



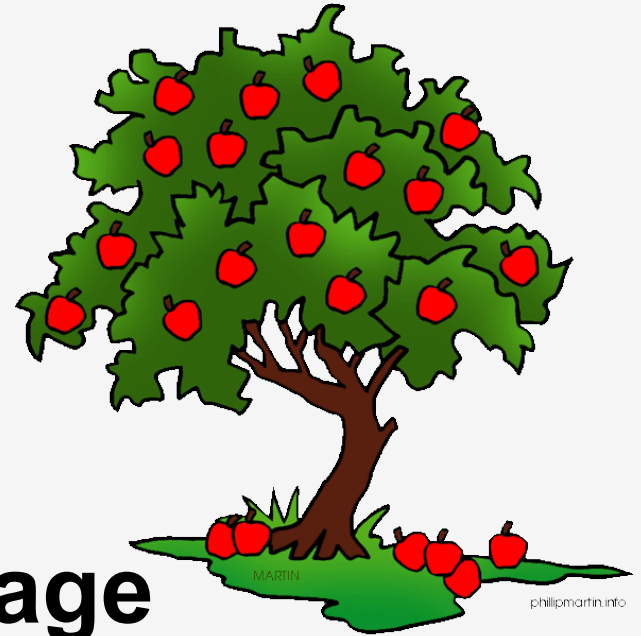
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**THE OHIO STATE
UNIVERSITY**



Growing apples...



- **Accept** insect pest damage
(typically on ~40% of fruit)

or

- Work to **prevent** insect damage
 - Calendar approach
 - IPM approach

IPM for apple

- **Monitoring**
- **Predictions**
- **Preventive tactics**
- **Curative tactics**



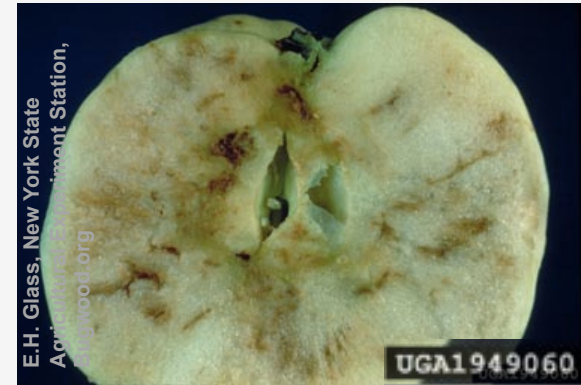
Key insect pests of apples



**codling
moth**



**plum
curculio**



**apple
maggot**

Occasional pests of apples



**San
Jose
scale**



**stink
bugs**



**rosy
apple
aphid**



**woolly
apple
aphid**



**tarnished
plant bug**

Occasional pests of apples:

some induced if natural enemies killed by insecticides used on key pests



**San
Jose
scale**



**stink
bugs**



**rosy
apple
aphid**



**woolly
apple
aphid**



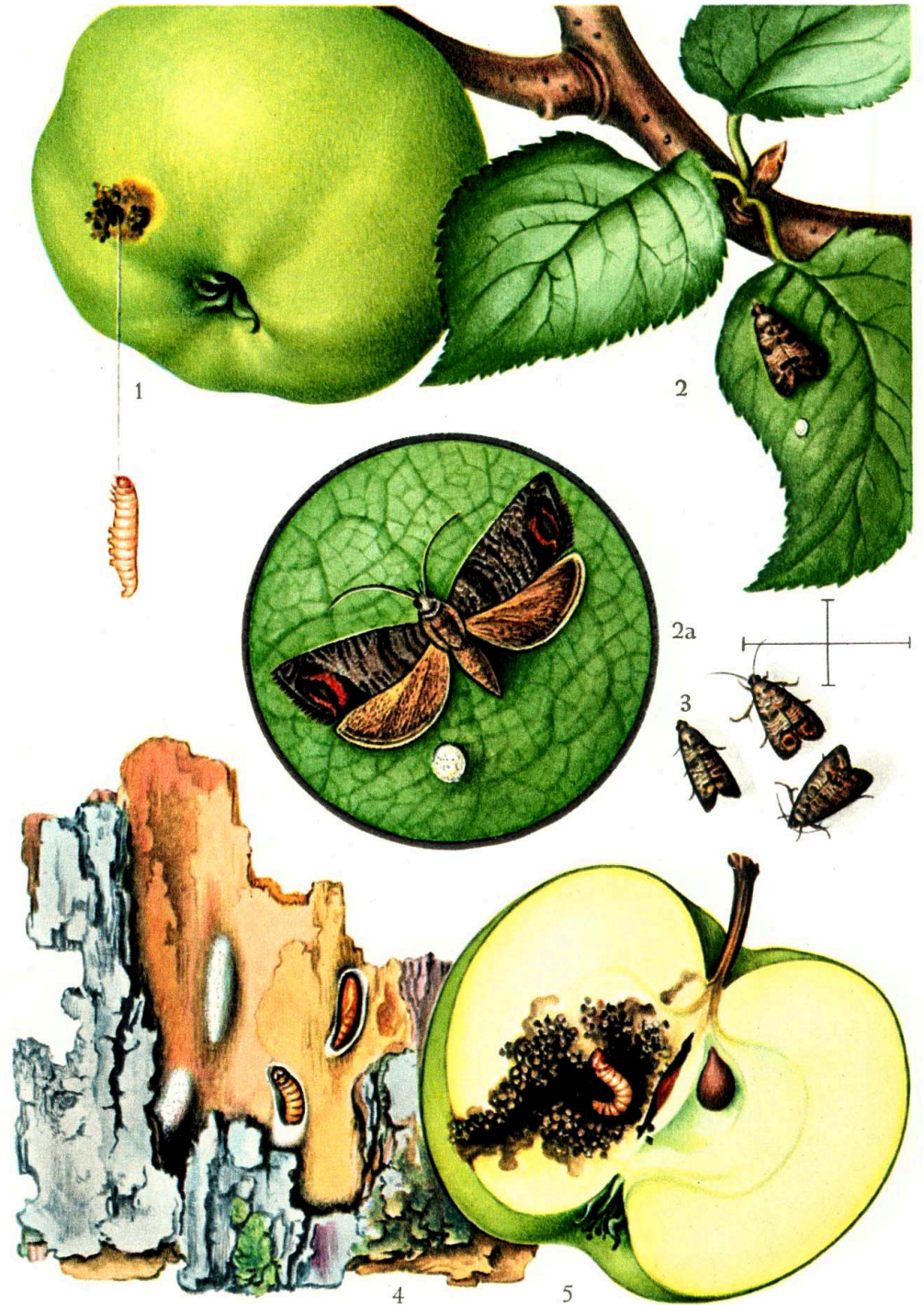
**tarnished
plant bug**

Codling moth



- The key pest in apple fruit (& pears too)
- Young larva enters fruit, tunnels to seeds at core

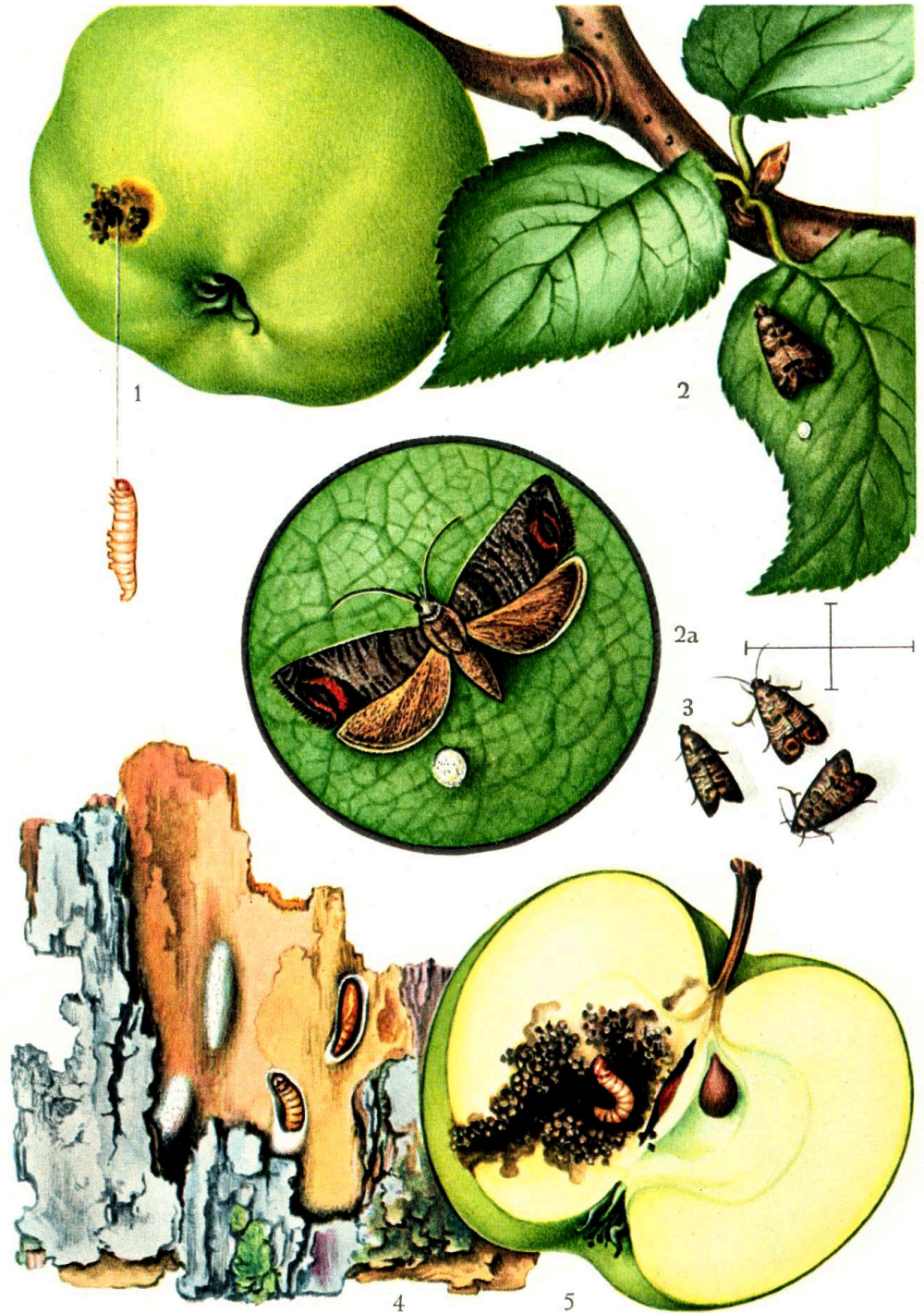
Codling moth life cycle



Codling moth life cycle

**1st generation
in May/June**

**2nd generation
in July/August**



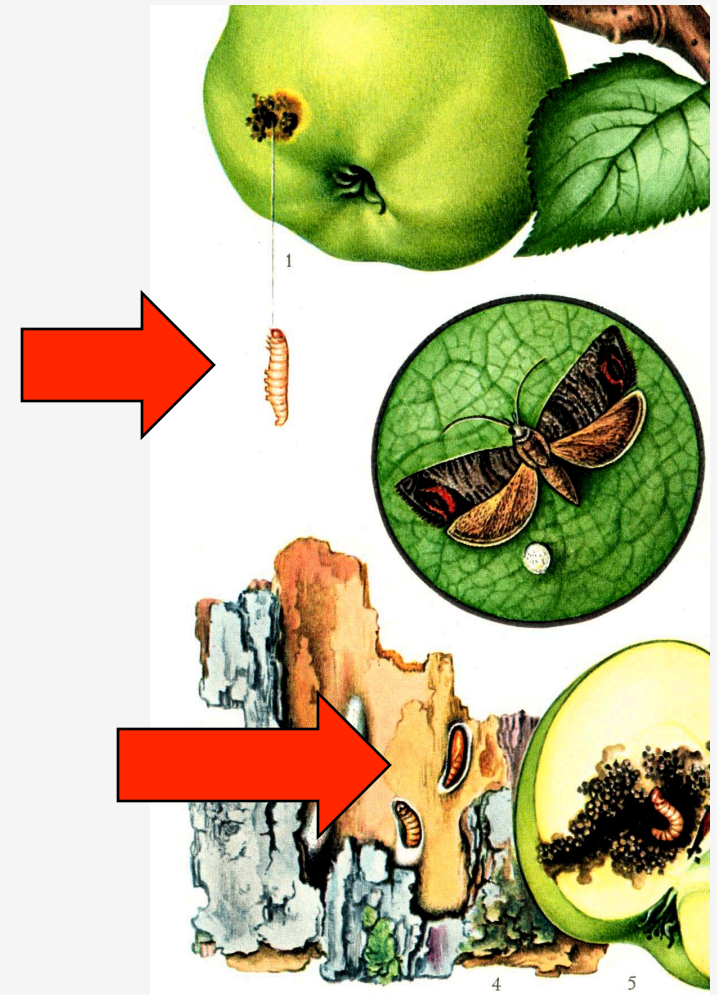
Mechanical **controls of** **codling moth**

- **Trunk bands**
- **Fruit bagging**

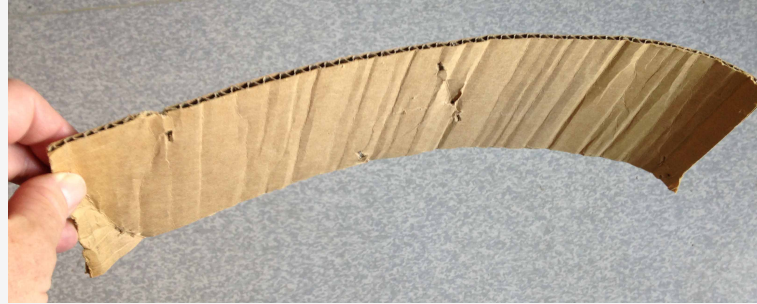


Trunk bands: the idea

- Larva exits fruit
- Crawls under bark scale to pupate
- Bands offer **shelter**
- Destroy the shelter!

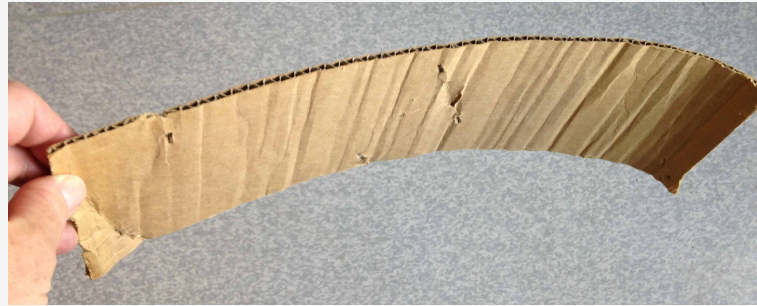


Trunk bands:
4 - 6" corrugated cardboard
on trunk & main branches



Trunk bands:

**4 - 6" corrugated cardboard
on trunk & main branches**



<i>Target</i>	<i>Install</i>	<i>Remove & destroy</i>
1st generation	mid-May	Late June
2nd generation	mid-July	November

Fruit bagging

- **Supplies:**
 - 2-layer Japanese bags
 - Or brown paper bags + twist ties



Fruit bagging



- Install on fruit $\frac{1}{2}$ - $\frac{3}{4}$ " diameter (~2 – 3 weeks after petal-fall)
- Remove 2 weeks before harvest
- Labor intensive!



Apple bud stages



Dormant



Silver tip



Green tip



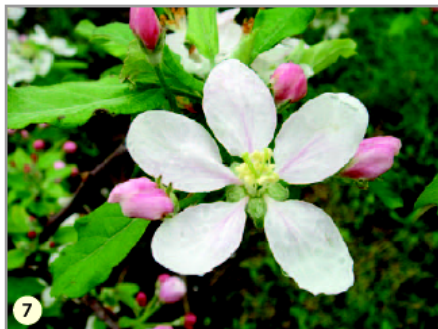
Half-inch green



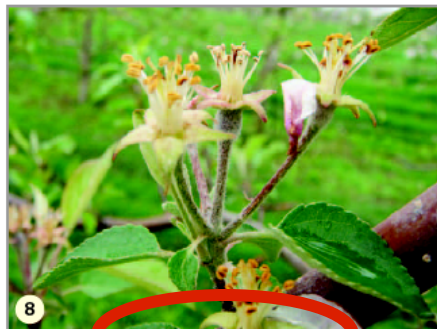
Tight cluster



Pink



Bloom



Petal fall



Fruit set

Cultural controls of codling moth

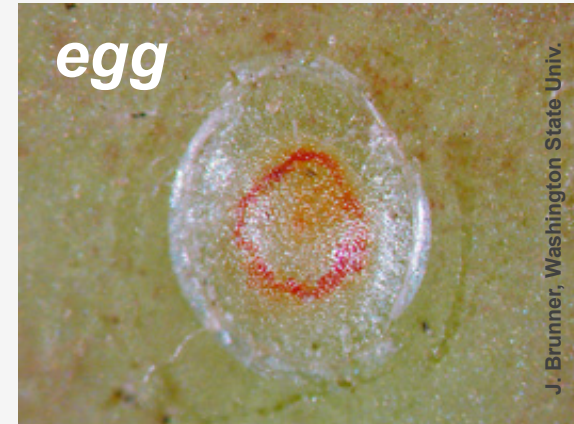
- **Sanitation:**
 - Scrape cocoons from picking crates, fences
- **Host reservoir elimination:**
 - Cut down abandoned trees

Insecticide for codling moth?



- **Calendar approach:**
 - Spray every 2 weeks from petal-fall until harvest (= 9 sprays)
- **IPM approach:**
 - Use 2 sprays @ 2 generations**
 - 1st spray at 1st egg hatch
 - 2nd spray 14 days later

When do codling moth eggs hatch?

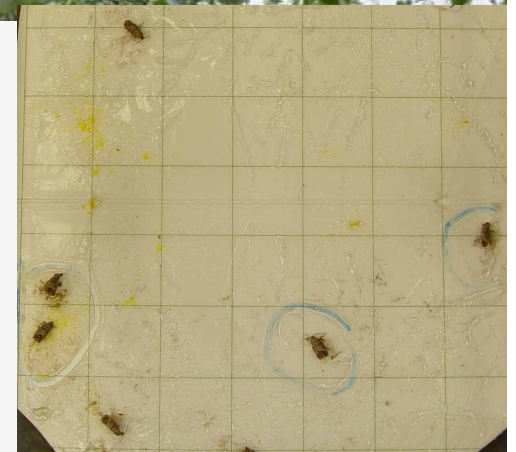


- Hatch begins:
 - 2 to 3 weeks after moths begin to fly
 - 250 degree-days (base 50°F) after moths begin sustained flight
- Use pheromone trap for moth flight
- ‘**Biofix**’ is date sustained flight begins

Traps for monitoring codling moth



- **Trap choices:**
 - Sticky trap
 - Bucket trap
- **Use pheromone lure**



Apple pests & 'integrated' control

- Chemical control
 - Needed for codling moth
 - Use selective insecticide
- Biological control
 - Of aphids, mites, other leaf pests
 - **Conserve** natural predators



Insecticides for codling moth

- **Organic**

- spinosad
- B.t.
- kaolin
- azadirachtin + pyrethrins

} shorter lived &
more selective
(narrow
spectrum)

- **Conventional**

- carbaryl
- malathion
- acetamiprid
- esfenvalerate
- gamma-cyhalothrin

} longer lived &
less selective
(broad
spectrum)

- **Natural but not OMRI**

- pyrethrins + PBO

‘Multi-purpose fruit spray’? (for insect + disease control)

- **malathion + carbaryl + captan**
 - Bonide Fruit Tree Spray Concentrate
 - Gordon’s Liquid Fruit Tree Spray
- **pyrethrins + sulfur**
 - Bonide Citrus, Fruit & Nut Orchard Spray
- **pyrethrins + PBO + extract of neem oil**
 - GreenLight Fruit Tree Spray Concentrate
 - Ferti-lome Fruit Tree Spray
- **lambda-cyhalothrin + pyraclostrobin + boscalid**
 - Bonide Fruit Tree & Plant Guard Concentrate

‘Multi-purpose fruit spray’? (for insect + disease control)

- **malathion + carbaryl + captan**
 - Bonide Fruit Tree Spray Concentrate
 - Gordon’s Liquid Fruit Tree Spray

} beware fruit thinning for 30 days after bloom
- **pyrethrins + sulfur**
 - Bonide Citrus, Fruit & Nut Orchard Spray

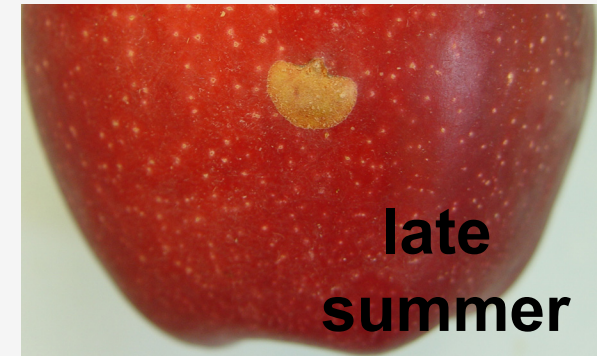
} only organic option
- **pyrethrins + PBO + extract of neem oil**
 - GreenLight Fruit Tree Spray Concentrate
 - Ferti-lome Fruit Tree Spray
- **lambda-cyhalothrin + pyraclostrobin + boscalid**
 - Bonide Fruit Tree & Plant Guard Concentrate

kaolin: 'Surround At Home'



Plum curculio: external damage

- Egg-laying scar: crescent
- Late-season feeding damage: ragged hole



Plum curculio: adult



- Hides during day
- Active at night
- Active when $>65^{\circ}\text{F}$, humid, calm
- Falls when disturbed

Plum curculio: control



- **Not many effective tactics**
- **Mechanical :**
 - Limb jarring ('beating') on first warm humid nights near petal-fall
- **Chemical :**
 - permethrin at petal-fall
 - kaolin ('Surround') at petal-fall & weekly for 2 more weeks

Apple maggot: damage



- A key pest in northern USA
- Not a pest in southern USA
- Variable in latitude of Ohio

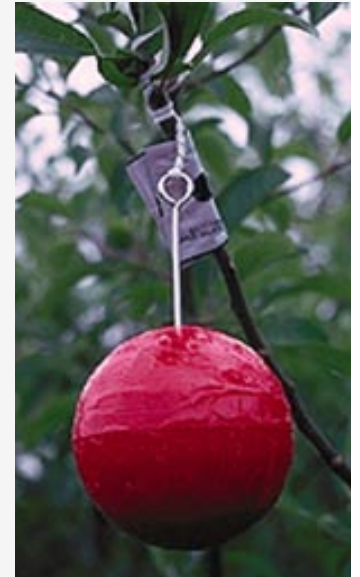
Apple maggot: life stages



- Adult fly lays egg on fruit
- Larva tunnels through fruit
- Pupate in soil

Apple maggot: mechanical control

- Adult female fly attracted to round red object
- **Sticky ball trap**: 1 trap per 100 real fruit
- **‘Tanglefoot’**
- Clean with **mineral spirits**
- Optional: fruit volatile lure



Apple maggot: chemical control

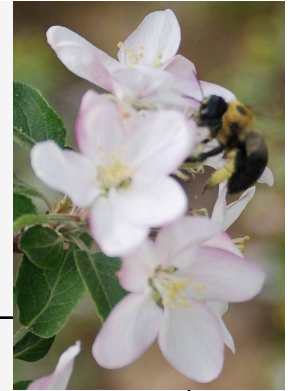


- Spray **every 2 weeks** in July & August
- Products:
 - acetamiprid
 - carbaryl
 - esfenvalerate
 - spinosad

Mechanical tactic summary

<i>Timing</i>	<i>Activity</i>
Fruit $\frac{1}{2}$ - $\frac{3}{4}$" diameter (~2 weeks after petal-fall)	Place bags over fruit
~4 weeks after petal-fall (early June)	Put strips on trunk
~6 weeks after petal-fall (mid-June)	Place red ball traps
~10 weeks after petal-fall (mid-July)	Remove & destroy strips
~12 weeks after petal-fall (early Aug.)	Put strips on trunk
~14 weeks after petal-fall (mid-Aug.)	Remove red ball traps
2 - 3 weeks before harvest	Remove bags
Late autumn	Remove & destroy strips

IPM & chemical control



<i>Principle</i>	<i>Action</i>
Avoid killing pollinators (bees)	Do not spray during <u>bloom</u>
Avoid killing natural enemies	Use '<u>selective</u>' insecticide or short-lived chemical
Avoid development of insecticide resistance	<u>Rotate</u> chemical groups

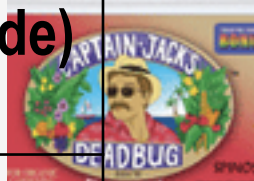


Chemical tactic summary




<i>Timing*</i>	<i>Target</i>	<i>Organic</i>	<i>Conventional</i>
petal-fall	plum curculio	kaolin	permethrin
1 st cover	codling moth, gen. 1	spinosad	acetamiprid
2 nd cover	codling moth, gen. 1	spinosad	acetamiprid
3 rd cover	apple maggot*	spinosad	acetamiprid
4 th cover	apple maggot	spinosad	acetamiprid
5 th cover	codmoth-2 + maggot	pyret+azad or pyrethrins	gam-cyhalothrin
6 th cover	codmoth-2 + maggot	pyret+azad or pyrethrins	gam-cyhalothrin
7 th cover	apple maggot	pyret+azad or pyrethrins	carbaryl or pyr+PBO
8 th cover	codling moth, gen. 3*	pyret+azad or pyrethrins	carbaryl or pyr+PBO

*** cover sprays at 2-week intervals**

*** in gray: only if pest known to be present**

Common insecticides

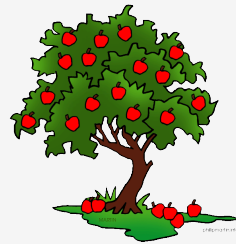
<i>Ingredient</i>	<i>Representative product: Organic</i>	
spinosad	-Captain Jack's Deadbug Brew (Bonide) -Entrust (Dow)	
kaolin	Surround At Home (Gardens Alive)	
pyrethrins	PyGanic (MGK) Bug Buster-O (Monterey)	
pyrethrins + azadirachtin	Azera (MGK)	

<i>Ingredient</i>	<i>Representative product: Conventional</i>	
pyrethrins + PBO	Fruit & Vegetable Insect Killer (Garden Safe)	
acetamiprid	Ortho Flower Fruit & Veg. Insect Killer (Scott)	
carbaryl	Sevin (Garden Tech)	
gamma-cyhalothrin	Spectracide Triazicide Insect Killer (Spectrum)	
permethrin	Eight Insect Control (Bonide)	

Resources

- **Codling moth trapping & degree-day egg hatch model (1 page)**
- **Degree-day methods (1 page)**
- **List of insecticides for apple:
common name & brand names (5 pp.)**
- **Bulletin on traps for fruit pests**
- **Fact sheet on fruit bagging, from
Kentucky**

the end



Questions?

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