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Organic Fruit Tree IPM for Backyard Orchards

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The College of Agricultural, Consumer and Environmental Sciences is an engine for economic and community development in New Mexico, improving the lives of New Mexicans through academic, research, and Extension programs.

Outline

- Quick History of Fruit
- Overview of Insect
- Pests & Damage
- -Apple codling moth
- Apple maggot
- Pests of Stone Fruits
- Microbial pests











NM state

Tian Shan Mountains; Almaty region, Kazakhstan

Almaty: *'Full of Apples' Alma: Apple*





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Apple Migration

- Apple arose in Tian Shan mountains of central Asia
- Passed along the Silk Road connecting China to the middle east
- Romans allegedly first encountered apples in Syria, spread through Europe



Pears, Peaches, **Apricots**, Sweet Cherries





Apple Culture

- Grafting widespread by 900 BCE
- Grafting revolutionized production and spread of apple varieties





Temperate Fruit Latitudes





Apple (Malus sieversii)

- Fruitwood forests evolved as savannas between conifer forests and desert steppe and in wide river valleys – sound familiar?
- Diverse stands of poplars, plums, apricot, rose, hawthorn, and ash
- Rolling hills, grassy understory
- Not far from evolutionary origin of horses
- Loamy, well drained, fertile soils
- Wide range is possible hence the world distribution
- Elevation range 3000-6200ft above sea-level

- Likely tracking climate changes and elevations during Pleistocene glacial periods

Hard seed passes through digestive tract of mammals and some* birds



Wild Fruitwood Forests in Eurasia

Savannas between mixed conifer and grassland Diversity: Apple, Plum, Apricot, Hawthorn, Poplar, Ash Elevation range 3000-7000ft above sea-level Forests likely shifted elevations during Pleistocene glacial periods



Fruit Trees in New Mexico

History in New Mexico

- One of the first seeds brought into NM, several periods of apple expansion
- Extensive knowledge of orchard systems throughout Spain
- Apples and Apricots were in Santa Fe by 17th century
- 1880s-1940s industrialization of agriculture begins in New Mexico with the apple
- Many of the large orchards across the state were planted at this time in what was becoming a new style of orchard – monocultures for export
- Great resource: Fruit, Fiber, and Fire: A cultural history of modern agriculture in New Mexico, Carleton, 2017





Apple harvest, New Mexico by Aaron Craycraft, 1905 - 1918





OFFICIAL SCENIC HISTORIC MARKER

SADIE ORCHARD (1860-1943) ▼

Arriving in the silver mining boomtown of Kingston in 1886, Sadie Jane Creech Orchard is argunbly the most colorful woman in New Mexico history. Sadie opened brothels, worked as a prostitute, built and operated botels, restaurants, and co-owned and drove for a regional stagecoach line. During World War I she tended to the less fortunate, and in the 1918 flu pandemic nursed children and cared for the sick and dying. New Mexico writer Erna Fergusson wrote of her. "For a bad woman, Sadie was one of the best:"

Apple Trees (Malus sieversii) in wild

- Major pests are from moths
- Apple Ermine Moth, Rosebush Leaf Roller and Hawthorn Leaf Roller defoliators
- Codling Moth Eurasia
- Apple Maggot native to North America
- Pear/Cherry Slugs world-wide distribution
- How could that be?

North American Native crabapples and plums





Wild Crabapples

- *Malus coronaria, M. fusca, and M. ioensis* native to North America
- 36 species of *Malus* worldwide, the majority of which are crabapples
- Pests evolved in regions along with wild *Malus* species
- Wild apples (Malus sieversii) along with hybridization of crabapples gave most of the genetics to Malus domestica – the cultivated 'orchard apples' that we know today



Fruit Tree IPM

Problem

- Integrated Pest Management aim of management of pests through integrated approach – <u>not a single approach</u>
- Can be applied to insect or disease issues
- Uses ecological principles knowledge of all ecological entities; pests, alternate hosts, natural predators, etc.
- Tools include; Cultural, Physical, Biological, Chemical
- Pest *management*, not *elimination*

- Goals are for greater survival of beneficials, slower development of resistance, less pest resurgence, less negative environmental impacts, and better worker safety



Fruit Tree IPM

IPM Strategy should include,

- 1. Pest identification
- 2. Monitoring and assessing pest numbers and damage
- 3. Guidelines for when management action is needed
- 4. Preventing pest problems
- 5. Using a combination of biological, cultural, physical/mechanical and chemical management tools
- 6. After action is taken, assessing the effect of pest management
- What is your treatment threshold?
- Includes economic, practical, and ethical decisions



Integrated Pest Management





Plant Pathology Concepts

Plants under stress are more susceptible to disease than plants that are growing strong

Pruning, understory management, and irrigation are all important!

Healthy trees (with a healthy soil microbial world) <u>can</u> withstand pathogen and pest pressures better!



Recommended reads:

Integrated Pest Management (IPM) Strategies for Insect Pests of Fruit Trees in New Mexico



COOPERATIVE EXTENSION SERVICE + GUIDE H-184



Holistic Orcharding with MICHAEL PHILLIPS







Major Insect Pests of Apples

Codling Moth

• Apple Maggot







Codling Moth (Cydia pomonella)

- Native to Europe, introduced to North America in early 1700s
- Primary pest of apple fruits* in New Mexico
- Also infests quince, pear, and stone fruit
- 3 generations per year possible
- Density dependent population, 100% control is not achievable





Copper colored metallic bands on wing tips











Codling Moth Life Cycle







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How do mates find each other?

Pheromones

- Female moths release the pheromone *codlemone*
- Limited window
- Energetically expensive, so only in evenings
- Male moths can detect and locate when winds are between 1-5 mph



Using Pheromones - Mating Disruption

- Mating disruption uses pheromones lots of them to overwhelm adult CM ability to find females
- Only effective on larger scales, uniform apple blocks, >5 acres
- Probably not effective in most NM orchards
- Can actually increase damage in smaller orchards

How mating disruption works

Mating disruption involves the use of synthesized sex pheromones to prevent male insects from finding females and mating.







Codling Moth Life Cycle

- Development through life cycle is dependent on 'growing degree days' -GDD
- Accumulated hours between 50F-88F
- Developmental threshold = 50F
- Growing degree day (GDD) units are accumulated when the average temperature for day is 1 degree above developmental threshold
- So if the average temperature (min+max/2) is 60F = 10 GDD have been accumulated
- Appx 250 GDD between egg laying and hatching
- Appx 350 GDD to 10% hatch <- effective control point
- @ 950 GDD, the 2nd generation adults are flying



2024 GDD for Taos





ZiaMet Weather Station Network

	Home	About	ZisMet	CoCoRaHS	Products	Climate in N
Home Zi	eMet Taos SWCD	Request Data				
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State-wide network of publicly available weather station data – lots of data!





NM State Climatologist Dr. Dave Dubois at a ZiaMet Station



Seasonal Phenology of Generations

Apr	May	Jun	Jul	Aug					
	1 1								
	Population Dynamics and Flight Phenology Model of								
	Codling Moth Differ between Commercial and Abandon								
Bloom	Apple Orchard Ecosystems								
	September 2016 - Frontiers in Physiology 7								
	DOI:10.3389/fphys.2016.00408								
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Codling Moth Populations



Recall, in most places – 3 generations of CM are possible



2024 Taos County Codling Moth Captures



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So how do we treat waves of codling moths?





Codling Moth IPM



Late Winter/Early Spring: Pruning & Sanitation

- Pick up and remove any fallen apples throughout the growing season and after harvest and dispose of
- Do not throw away apples in places where you also store apples
- Harvested apples may contain codling moth larvae, that might exit the fruit and seek shelter in the storage area
- Storage structures like a garage or barn may be a source of codling moths the next spring



Codling Moth IPM

Spring:

Foliar Spray of dormant oil before budbreak (Apr 1)

- 3 Applications: mid-May, mid-July, early-September
- Early morning, before temps are >75F

Application of Surround (Kaolinite Clay)

 3 applications to canopy and trunk; At petal drop, followed every 4-6 weeks

Deploy CM Monitoring Traps (at petal drop)

- Traps w/ pheromone lures
- 2 per acre sufficient (for backyard orchards, 1 is good)



Kaolinite Spray



- Trade name 'Surround', a fine kaolinite powder, mixed in with water
- Spray to coat fruits
- Kaolinite surface irritates and confuses pests
- Must be reapplied if washed off with rain
- Keep in suspension while spraying
- Always add clay to water
- ALSO EFFECTIVE FOR GRASSHOPPERS
- Sunblock for leaves = bonus





Pheromone Traps



Eye-level, outside of tree

If possible, consider wind direction (upwind preferred – the pheromone should 'drift' into the orchard)





Codling Moth Monitoring Traps

Monitoring Traps

- Check traps often,
- When first moths are trapped mark that date as 'biofix' a starting point (Call your agent!)
- Calculate GDD from there, 350 GDD later, 10% eggs are hatching <- time when pesticide application is most effective

Decision Point

- Several organic approved sprays (Spinosad or Bt) exist on the market (do not need PRAP license)
- Entrust SC Spinosad-based
- Monterey Bt Bacillus thuringiensis-based* ?efficacy?

After initial application, repeat 3x every 10 days



Codling Moth IPM

Making informed decisions on sprays by using monitoring traps gives you the best information for minimizing risk

• If traps reveal CM pressure is low, and many beneficial insects are on traps, would this be effective?

Some considerations,

- → <u>Never spray before petal drop</u>
- \rightarrow Apply when temperatures are below 75
- ➔Good coverage mist



Codling Moth IPM

Summer – Fall Cultural Controls

- Trunk Banding
- Cardboard bands around truck (1 or 2), starting 1 ft above ground
- Corrugations should be vertical, large enough for pupae
- Monitor cardboard and dispose of every 2 weeks
- Remove fallen fruit, dispose of (find a friend with goats)
- Sanitation of fruit (fruit thinning)







Biologicals

- Codling moths are edible! Do your part!
- Invertebrates: earwigs, carabids, spiders, ants and harvestmen are all predators
- Parasitoid wasps also play a large role in regulating populations
- Woodpeckers (especially Northern Flickers)
- Promoting birds (kestrels, bluebirds)
- Bats (CM are active dusk-midnight!)
- Like most systems, biodiversity is key



Wolf spiders are voracious predators of freeliving fifth-instar codling moth larvae but took as long as 24 hours to consume a cocooned larva.



Carabid beetles (Pterostichus melanaria) attacked both free-living and and cocooned larvae in lab tests where they were enclosed with the larvae, but showed much less interest in them in an orchard setting.



Earwigs cat free-living codling moth larvae but not cocooned larvae, and the larvae are in that vulnerable stage only for a very short time during their lifecycle.



Codling moth larvae can put up a good fight when attacked by a daddy longlegs (Opiliones). In one lab test, the larva killed its attacker. Even when they prevail, daddy longlegs take a long time to eat the larvae and they will not eat cocooned larvae.



Biologicals – companion planting

- Wasps are great employees!
- *Trichogramma* spp*, ichneumonid, and braconid wasps
- Consider companion planting species known to attract wasps – smaller flowered herbaceous plants
- Continuous bloomers!
- Yarrow, carrot family (Umbelliferae), asters, legumes, and mustards (Brassicaceae), milkweeds, buckwheat, cinquefoil
- Comfrey planted on S-SW side of tree taproot & nutrient availability







Codling Moth IPM Summary

If you have a handful of backyard trees and low worm issues – then sit back relax and enjoy your apples!

For larger orchards or to maximize production,

- Neem Oil Applications
- Surround Applications
- Use monitoring traps
- Cardboard Banding
- Insecticide treatment decision?
- Sanitation
- Promotion of biodiversity

Sign up for free traps!



Apple Maggot (Rhagoletis pomonella)

- Hosts: apple, hawthorn, crabapple, pear
- Several fruit fly species with various hosts
- Infestation results in complete loss of the fruit
- Have you ever seen one?









Apple Maggot Life Cycle

- Some important differences with codling moth
- Only 1 generation per year!
- Continuous emergence from soil through entire growing season!





Apple Maggot Life Cycle

Adult flies coming in to oviposit eggs into apples is a vulnerable time

Maggots in fallen fruit also vulnerable





Apple Maggot IPM

Most vulnerable periods in the life cycle of apple maggot is

- \rightarrow at the adult stage when coming in oviposit (trap),
- ➔and at the maggot-pupae transition (sanitize and promote biodiversity)

Spraying insecticides not considered effective; adult flies are simply not in host plant long enough













RESTICIDE FREE



Real apple and wire

Sticky Cards

Mie gard

Commercial

WALLSON

Trapping Apple Maggots

- Set it up at fruit set (after petal drop), earlier is better!
- Yellow and/or red
- Provide a nice clear area around trap, check for branches that can sway in
- Trap card could be cardboard, posterboard, wood, or commercial traps for long term, clingwrap on outside each year for easy disposal
- Set it up on the downwind side (typically east side)
- How many traps?
- ➔ If you only have a few trees, why not put a bunch? Try 3 or 4 per tree!



Trapping Apple Maggots

- 'Tanglefoot' a natural sticky substance
- Do it at the tree, don't try to transport!
- Apply tanglefoot to trap best as a thin layer on all sides at a temp > 90F
- Bring vegetable oil and a paper towel
- Very effective when infestations are bad, you may need to replace surface within season



Kaolinite Spray



- Also effective against apple maggot
- AND GRASSHOPPERS!







Physical Barriers

Backyard trees, may be worth bagging a few couple of dozen fruits

Make sure to inspect before bagging, looking for entry holes or 'pin-pricks'





Apple Maggot Cultural Controls -Sanitation

- Regularly sanitizing the area below the tree of fallen fruit removes source of pupae who will emerge next year
- Heavily infested fruit is likely to prematurely fall from tree
- Humans shouldn't eat fallen fruit for a number of reasons
- Make friends with a pig, goat, sheep, chicken, cow, or horse!



Pear/Cherry Slugs – Pear/Cherry Sawfly



- Small species of sawflies (hymenoptera), larvae are ¼ in. long, skeletonize leaves
- Pupae overwinters in soil, adults emerge, lay eggs into leaf, larvae emerge and fed on leaf through 5 instars
- 2 generations per year (2nd generation is more destructive)
- 2nd generation adults emerge in July, during a shorter period of time



Pear/Cherry Slugs – Pear/Cherry Sawfly

- 2nd generation larvae can be more destructive, and are the pupae that will emerge next year
- Generally not a major* concern, can be treated with basic insecticides, insecticidal soap or even strong jets of water
- Prevent oviposition with Kaolinite!
- Wood ash on leaves, and below dripline
- Diatomaceous earth below dripline, sprinkled on soil





Pear sawfly has two generations a year. It overwinters as a pupa in the ground. Timings are based on observations in Oregon.



Western Flower Thrips

- Very small insect (Thripidae)
- Native to SW North America, now elsewhere in fruit growing regions
- Nymphs hatch and feed on young fruits
- Their feeding at young stage of fruit leaves scars as fruit matures and enlarges, causing deformities



1/16 inch





Western Flower Thrips

- Most damage is going to be on stone fruits
- Monitor by shaking flowers into a jar, look for nymphs
- Not usually a concern for management in Northern NM
- Lacewings and lady beetles eat these!







Flatheaded Appletree Borer

- Buprestidae beetle, larvae bores extensively into apple trees (3/8 in bores)
- Especially damaging to younger trees, or post-grafting
- Risk of secondary infection
- Monitor trees for frass coming from holes
- Options available: cultural controls, biological predation



Peach twig Borer (Anarsia lineatella)

- Moth species, overwinters as 1st instar larvae in 1-3 year old wood limb crotches
- Emerges in spring (around bloom) and moves to twigs attack newly emerged leaves, blossoms and shoots
- Larvae mine inside causing terminal buds to dieback (problem for young trees)
- After fruitset can attack fruits, larvae enter fruit at stem and feed just under skin



Peach twig Borer (Anarsia lineatella)

- Look for overwintering larvae in late fall (chimney stack of frass)
- Look for 'flagging' of shoots in spring/summer
- Pheromone traps are available to monitor and plan chemical treatments
- Dormant oil effective
- Kaolinite Effective
- Spinosad or BT effective
- Encourage beneficial insects





Greater Peach Tree Borer



Moth species

- Larvae hatches and bores into cambium
- Tends to attack near graft union/base of tree
- Damage into root zone
- Dormant oil spray
- Sanitation keep base of tree clean
- Paint trunks 1:1 ratio of white latex:water
- Control is most critical on young trees



Greater peachtree borer damage (note borer in bark). Photo by J. R. Baker, NC State University





Plum Curculio & Other Weevils

Dyslobus sp

Controls: Kaolin application Neem oil application Remove by hand Sanitize





Wooly Apple Aphids

- In roots during winter (can create root galls), and foliage in summer
- Insecticidal soap and horticultural mineral oil
- Non-organic controls broadspectrum insecticides





Other Pest Reports – Mystery insect?





Fruit Insect Pest IPM Summary

- Horticultural oil sprays are effective at both prevention, and smothering overwintering eggs or larvae
- Kaolinite applications effective for prevention of variety of species
- Orchard sanitation and cleaning 'drops' effective on variety of species
- Sticky traps for apple maggot & other fruit flies
- Pheromone lures, monitoring, and decision points for detrimental moth species – Spinosad applications


Microbial Diseases of Fruit Trees

Sometimes referred to as 'summer diseases' – symptoms appear in Summer, but prevention begins in Winter/Spring!

- Bacteria
- Blight (Fire Blight) in blossoms, twigs, trunk, etc.
- Bacterial Spot
- Bacterial Canker Disease
- Fungi
- Apple Scab
- Apple Rust
- Powdery Mildew
- Molds
- Phytophthora rot





Fire Blight (Erwinia amylovora) - bacterium

- Look for 'burned leaves' appearance, crook-necked leaf stem
- Ask for help, doesn't hurt to ask!
- Monitoring and removal are key early prevention
- Sanitize between cuts (and trees)*
- Prune back 18" from infected cankers don't 'short-cut'
- Bordeaux Mixture (Copper Sulfide, Lime, water) can be used on cankers and gummosis areas to limit infections in fall/winter (up to bud break)
- Remove suckers/water sprouts and also prune modestly DON'T ENCOURAGE VIGOROUS SHOOT GROWTH





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Bacterial Spot

- 'Shot-hole' appearance
- Mostly affecting stone-fruit
- Extended hot/dry periods slow growth

Management

- Good pruning for air circulation
- Copper can be applied as triage – dilute to avoid leaf damage (especially on peaches)
- Variety selection





Fruit Cankers

Cankers will appear sunken, swollen, or cracked

- Bacterial cankers (sweet cherries)
- 'Gummosis'
- Cold-injured trees more susceptible

Cytospora Canker (peaches)

- Fungal,
- Copper in dormant season
- Pruning

Pruning in height of summer = OK Hot/Dry conditions limit spread





Apple/Pear Scab

- Fungal disease, overwinters in fallen diseased leaves
- Spores fly from affected leaves to developing leaves, flowers, fruit, etc.
- Leaves must be wet to allow for infection by fungal spore
- Crabapples are susceptible, may be sources of infection

Management

- Orchard Sanitation
- Prune for open shape with good air circulation





Powdery Mildew (Podosphaera leucotricha) -Fungi

- Active when humidity >70%
- Look for earliest signs on underside of leaves, can progress to twigs, flowers and fruit

Management

- Pruning to promote plenty of sunshine and air movement
- Avoid spraying foliage while irrigating
- Fungicidal sprays in home orchards usually not warranted





Cedar-Apple Rust

- Most common 'rust' disease of apples
- Fungi requires Junipers & Apples to complete cycle

Management

- Avoid Apple/Juniper plantings.....
- Some variety resistance in apples
- Prune out galls in Junipers if seen
- Chemical fungicides not recommended





Phytophthora Rot

- A fungi-like pathogen, sometimes called 'water molds'
- Infections occur when soil around base of tree remains wet for extended periods – or tree is planted too deeply
- Avoid prolonged standing water around base of tree
- Avoid wetting trunk when possible
- No fungicides are recommended





Other issues?





Questions from the Registration

- Fertilization most important for young trees (get a good size), less so for older trees (do a soil or leaf analysis test!)
- Watering Deep, penetrating watering, focused beneath dripline, allow to dry between waterings
- Varieties for your area see NMSU Extension publication on variety recommendations – it's all about knowing your *chilling hours*



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Questions?

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