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SEMINAR SERIES

Avocado IPM

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Avocado, Blueberry, Citrus, Wine Grapes

Avocado IPM

I. What is Integrated Pest Management?

II. Disease Management and Role in IPM

III. Major Pests and IPM Strategies

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Avocado IPM

What is Integrated Pest Management?

"IPM is an ecosystem-based strategy that focuses on long- term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant cultivars. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organisms. Controls are selected and applied to minimize risk to human health, beneficial and nontarget organisms, and the environment" (IPM in Practice, UCANR Publication 3418)

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What is Integrated Pest Management?

Avocados have a history of biological control: "The natural enemies of avocado pests also seem to be more effective in keeping pest populations down to sub-economic proportions..." (Ebeling 1959)

Border inspections prevented introduction of new pests: "Several very serious pests of avocado occur in Mexico that have not yet become established in California or Florida." (Ebeling 1959)

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Avocado IPM

What is Integrated Pest Management?

Resident biological controls in avocado orchards:

Mite controls: Green lacewing, brown lacewing, dusty-wings, lady-beetles, Stethorus beetle, Rove beetles, larvae of cecidomyid flies, predatory mites, predatory thrips.

Scale controls: Twice-stabbed lady beetle, Lindorus beetle, parasitic mites, whirly-gig mites, parasitic wasps

Worm controls: Spiders, Apanteles wasp, Meteorus wasp, Trichogramma platneri, Tachinid wasp, Granulosis virus.

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Avocado IPM

Factors that can affect the balance of IPM in avocados:

1. Newly introduced pests (Stenoma moth, seed weevils, Ambrosia beetle, etc.) will require eradication treatments.

2. Potential resistance to current pesticides (Repeated use of abamectin showing more tolerance by avocado thrips and persea mite)

3. Increased use of pyrethroids (Resistance potential and upset or resurgence of pests under biological control)

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Avocado IPM

Factors that can affect the balance of IPM (Continued)

4. Cold winter temperatures can kill beneficials (or sterilize their eggs) and cause resurgence of pests (Looper, Amorbia).

5. Dust (from wind and traffic) and pesticide drift can cause upsets along borders (Avocado brown mite, latania scale).

6. New varieties (Gwen more susceptible to persea mite while Lamb hass less is susceptible).

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Disease Management

Prevent completion of "Disease Triangle" (Host, Pathogen, Environment)

1. Host: Maintain optimum nutrition levels, irrigate when needed, use resistant rootstocks, maintain soil pH around 6.5.

2. Pathogen: Keep inoculum low. Apply woody mulch, apply gypsum, apply registered phosphoric acid, copper boxes for boots, no entry during wet conditions, fences (deer, coyote, etc.)

3. Environment: Reduce conditions that favor disease, plant on mounds (drainage), leach salts, don't overwater

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Disease Management

Why healthy trees are important:

Better able to withstand attacks by persea mite, etc.
Survive adverse weather conditions better (frost & heat)
Reduce the potential for drop of newly set fruit and mature crop
Trees adequately fertilized can withstand effects of diseases
Stressed or diseased trees can attract pests

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Disease Management

Major Avocado Diseases:

1. Avocado Root Rot (Phytophthora cinnamomi)
2. Crown Rot (Phytophthora citricola)
3. Avocado Branch Canker (Botrysphaeria, Dothiorella, etc.)

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Avocado IPM

Avocado Root Rot (New trees)

1. Select most resistant rootstock suitable for existing conditions
2. Plant trees on mounds for better drainage in heavy, clay type soils
3. Apply woody mulch
4. Apply gypsum at tree base (20 lbs per tree) or through irrigation
5. Apply registered phosphites foliar or through irrigation at least two to three times per year
6. Irrigate to the needs of the tree

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FEEDER ROOTS WITH AVOCADO ROOT ROT

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MOUNDED AND MULCHED

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Avocado Root Rot (Older Trees)

1. Inject phosphites into scaffolds if root rot severe (sparse foliage and lack of feeder roots). Consider replanting if trees are too far gone (and new trees are available).
2. Apply gypsum topically or through irrigation
3. Apply woody mulch
4. Stump trees to stimulate leaf flush
5. Irrigate to the needs of the tree
6. Once newly expanded leaf flush and feeder roots appear then apply registered phosphites foliar and/or irrigation two to three times per year.

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AVOCADO ROOT ROT

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RECENT INJECTION SITE

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OLD INJECTION SITE

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PLUGGED INJECTION SITES

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Crown Rot

1. Keep soil and leaves away from bud union/graft
2. Don’t allow irrigation to hit trunks
3. Prevent wounding trunk when suckering, pruning, weed wacking.
4. Apply register phosphites to lesions to slow spread of disease

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STUMPED TREES AND WOOD PILES

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CROWN ROT

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COVERED BUD UNION WITH CROWN ROT

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Avocado Branch Canker

1. Delay pruning if wet conditions (fog, rain, high humidity) anticipated. Cuts are susceptible to infection for 10 to 14 days.

2. If branches damaged by sunburn, prune off branches before onset of fall rains

3. Prevent wounding of trees (picking ladders, forklifts, etc.)

4. Apply material to protect pruning wounds

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AVOCADO BRANCH CANKER

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The Two Major Pests of Avocado and IPM Strategies

1. Avocado thrips

2. Persea mite

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AVOCADO THRIPS (Scirtothrips perseae Nakahara)

When found in Ventura County (June 1996 by PCA Charlie Gribble), species was new to science and country of origin unknown (Mexico City to Guatamala City).

By 1997 avocado thrips had spread north and south of Ventura with significant damage to fruit in San Diego County. Only material registered for control was sabadilla (Veratran D) a botanical stomach poison.

Life cycle at 77 degrees F (Hoddle): Females lay 20 eggs, hatch in 11 days, population can double in 10 days. Prefers cooler temperatures. Immature fruit most preferred by thrips for egg laying.

From efficacy trials in 1998 (Morse, Hoddle, Hand, Nyberg, Urena, Roberts, Peirce), California Avocado Commission (Steve Peirce) submits Section 18 emergency exemption request for Agri-Mek 0.15 EC to control avocado thrips.

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AVOCADO THRIPS (Hoddle)

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Chemical Control of Avocado Thrips (Conventional)(UC IPM)

Abamectin (Agri-Mek SC, etc.): Translaminar, need to add oil, slow to kill thrips but long lasting (4 to 6 weeks), low gpa by air (50), bee hazard

Spinetoram (Delegate WG): Translaminar, need to add oil, bee hazard.

Fenpropathrin (Danitol): Contact material, oil not needed, highest resistance potential (one application every three years), bee hazard, label confusion (PHI is one day but workers need personal protective equipment for seven days)

Spirotetramat (Movento): Systemic, need to add oil, slow to kill thrips, expensive relative to other materials, bee hazard

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AVOCADO THRIPS SCAR

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Chemical Control of Avocado Thrips (Organic)(UC IPM)

Veratran D: Stomach poison, acidify water (pH 5), sugar or molasses (feeding attractant), better efficacy with higher gpa (75 to 80), add no additional materials (nutrition, etc.), organic, better efficacy with heat, 4 days to two weeks control (up to 5 or 6 treatments per season sometimes).

Spinosad (Entrust SC): Translaminar, need to add oil, organic, bee hazard

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AVOCADO THRIPS SCAR (LATE SEASON)(Hoddle)

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Cultural, Environmental, and Bio-Control for Avo Thrips

Heat: Temperature increase from 77 to 86 degrees F decreases egg hatch 61 percent (Hoddle). Translation: Inland areas (Temecula, Fillmore, Moorpark) have less thrips pressure and new fruit sizes up beyond susceptible stage quicker.

Mulch: Avocado thrips pupate in the ground and rate of adult emergence is less due to greater biological activity (fungi and beneficial predators) in mulched orchards (Hoddle).

Cover crops: Flowers with nectaries (Alyssum, vetch, etc.) attract lacewings, hover flies

Beneficial predators: Franklinothrips sp. (predatory thrips), Euseius hibisci (predatory mite), Orius (minute pirate bug), Chrysoperla rufralabris, C. carnea (lacewings)

Beneficial parasitoid: Ceranisus menes (native wasp)

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AVOCADO THRIPS SCAR (FALL)

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PERSEA MITE (Oligonychus perseae)(Tuttle, Baker, Abbatiello)

First discovered in San Diego County in 1990 (Hand), Ventura in 1993, Santa Barbara in 1994, San Luis Obispo in 1996.

Native to Mexico, damages avocados in arid regions, but not a major pest in Michoacan avocado growing area.

Adult female mites live an average of 27 days, lay 46 eggs at 77 degrees F

Most susceptible varieties: Hass and Gwen.

Least susceptible varieties: Fuerte and Lamb Hass

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PERSEA MITE (CONT)

Mites damage leaves by removing chlorophyll during feeding and causes leaf drop

Leaf drop can start with mite feeding injury to 15% of leaf surface

Tree vigor important: Adequate nutrition, water, existing crop load, etc.

Easier Persea mite counting technique (Machlitt) for pest control advisers

Frequent monitoring, time of year (shorter daylength, cooler temperatures)

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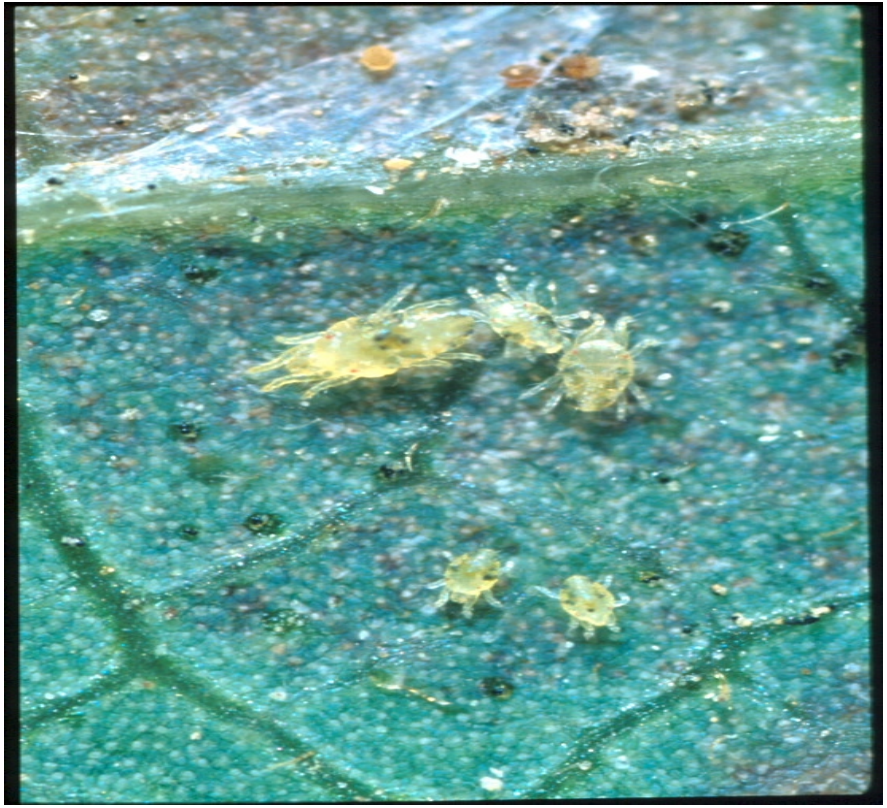
PERSEA MITE



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Early Chemical Control of Persea mite (UC IPM)

Sulfur: Disrupts biological control, difficult to use with high temperatures

Omite: Disrupts biological control, registration dropped, lasted 6 weeks

Narrow Range Oil:

- **Ground (6 to 8 gallons per acre at 100 gpa, low volume)**
- **Helicopter (15 to 18 gallons per acre at 100 gpa)**
- **Contact killing of predators**

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Current Chemical Control of Persea mite (UC IPM)

Abamectin (Agri-Mek SC): Translaminar, need to add oil, one application every two to three years, do not tank mix with nutrients, bee hazard

Spirodiclofen (Envidor): Contact material, oil may reduce efficacy

Etoxazole (Zeal): Mostly contact material, ovicide

Fenpyroximate (Miteus): Contact material

Narrow Range Oils: Contact material, low volume or hand

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PERSEA MITE NESTS

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Cultural, Environmental, and Bio-Control of Persea mite

Heat: Mite levels reduced (egg collapse) with high temps (90 - 100 degrees F)

Nitrogen management: Increase nitrogen to replace dropped leaves

Reduce additional tree stress: Pick mature crop, control avocado root rot, proper irrigation management, optimum nutrition

Release predatory mites (at 50% leaf presence) along borders: N. californicus

Release green lacewings

Preserve resident beneficial predators: Six spotted thrips, Stethorus picipes (beetle), Ceciodomyidae (fly larva), Euseius hibisci (predatory mite), brown lacewing

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Avocado IPM

Occaisional Pests and IPM Strategies

1. Omnivorous Looper
2. Amorbia cuneana
3. Greenhouse thrips
4. Avocado brown mite
5. False Chinch Bug
6. Earwigs
7. Brown Garden Snail
8. Torpedo Bug
9. Latania scale
10. Polyphagus Shot Hole Borer (PSHB)
11. Spiders

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OMNIVOROUS LOOPER (Sabulodes aegrotata)

Sporadic pest

Female lays 200 to 300 eggs

Five generations per year

Monitor for adult flights with pheromone traps

Field inspect following major moth flights to confirm egg laying and hatch

No established economic threshold

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LOOPER LARVAE NEST

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PREDICTING LOOPER OUTBREAKS

Grove history: Previous looper outbreaks, malathion use

High nitrogen levels (lots of new leaves to feed on)

Unpruned, dense canopy, shaded out (worms like shade)

Cold winter (T. platneri, etc. killed or laying sterile eggs)

Cool, overcast spring, summer (worms feed longer during daylight)

Wet winter and spring (good leaf flush)

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LOOPER LEAF FEEDING

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LOOPER CHEMICAL CONTROL THEN

Bacillus thuringensis (Dipel, etc.): Stomach poison

Kryocide: Stomach poison

Methomyl (Lannate): Contact poison, disruptive

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LOOPER FRUIT FEEDING

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LOOPER CONTROL NOW

Trichogramma plateri: Release 200 K per acre minimum with peak moth flights (Approx. 100 + for three weeks, 300 in one week). Release as T. platneri eggs hatching to reduce ant predation.

Granulosis virus (naturally occurring with high looper numbers)

Bacillus thuringensis (Dipel, etc.): Stomach poison, apply with newly hatched worms

Spinetoram (Delegate WG): Translaminar, need oil, bee hazard

Fenpropathrin (Danitol): Limit use to once every three years

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LOOPER ADULT MALE MOTH IN TRAP

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LOOPER BUCKET TRAP PHEROMONE

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TRICHOGRAMMA PLATNERI ADULT ON LOOPER EGG

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AVOCADO LEAFROLLER (Amorbia cuneana)

Female moth lays 400 to 500 eggs in lifetime

Four to five overlapping generations per year

Feeding injury to leaves, fruit touching leaves, and fruit in clusters

Damage is greater with heavy crop

Monitor adult flights with pheromone trap

Field inspect following major moth flights to confirm egg laying and hatch

No established economic threshold

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AMORBIA LARVA (CLARK)

PREDICTING AMORBIA OUTBREAKS

High numbers of mature fruit

Many clustered fruit or fruit in heavy leaf canopy

Cold winter (T. platneri, etc. killed or laying sterile eggs)

Grove history of Amorbia problems, previous malathion use

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AMORBIA CONTROL THEN AND NOW

Then: B.t., Kryocide, Lannate

Now: T. platneri, B.t., Spinetoram, Fenpropathrin

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GREENHOUSE THRIPS (Heliothrips Haemorrhoidalis)(Bouche)

Greenhouse thrips (GHT) feeding causes cosmetic surface scarring of fruit. The longer the fruit is held, the more damage caused by GHT. Heavy crop years in coastal areas had heavier fruit damage.

In 1987, GHT was the key pest of avocados (Goodall, SB County)

Historically, treatments of malathion were used for control. Repeated malathion applications caused upsets of avocado brown mite, six-spotted mite, omnivorous looper, avocado leaf roller, and latania scale.

Early season harvesting of fruit (August or earlier) limited scarring to mature crop and removed the majority of GHT to reduce movement to new fruit set.

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GREENHOUSE THRIPS (Davidson)

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Greenhouse Thrips (Cont.)

Packing House Fruit Scar Sizes: Dime (1 to 1.5% of fruit surface), Quarter (3% of fruit surface)(10 to 20 thrips feeding for one week)

A wasp (Thripobius semiluteus) introduced in 1986 from Australia (Beattie, McMurtry), raised first at UC Riverside then commercially (FAR) achieved 33% (non-released area) up to 80% (released area) in trials

Some fruit scar can occur before Thripobius parasite can control pest. Worked better in San Diego area than in northern areas (most likely helped by earlier fruit harvest)

Currently controlled with abamectin (Agri-Mek SC, etc.) applications for avocado thrips

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GREENHOUSE THRIPS & THRIPOBIUS PUPAE (Hoddle)

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AVOCADO BROWN MITE (Oligonychus punicae)

Avocado brown mite (ABM) feeds on upper leaf surfaces initially along leaf veins. Mite feeding removes chlorophyll from leaves, reducing photosynthesis. Severe infestations may have defoliation. Defoliation can occur at 300 ABM per leaf.

With normal conditions, ABM is under good biological control from the spider mite destroyer (Stethorus picipes), green lacewings (Chrysoperla sp., predatory mites, etc. Populations of ABM start to decrease at 40 Stethorus beetle per 200 ABM.

Cultural control includes controlling dust (watering roads) which improves predator activity.

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AVOCADO BROWN MITE (Hoddle, UC IPM)

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AVOCADO BROWN MITE

Chemical controls include narrow-range oil, etoxazole (Zeal), abamectin (Agri-Mek SC)?

Outbreaks associated with warm temperatures, malathion applications, and build up of dust or ash from fires (Thomas fire, December, 2017, Ventura & Santa Paula, personal observation)

“It is important to use discretion when it comes to any use of insecticides” (Dr. Jim McMurtry, Biological Control Division, University of California (Riverside)

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AVOCADO BROWN MITE LEAF INJURY (Hoddle, UC IPM)

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FALSE CHINCH BUG (NYSIUS RAPHANUS)

When vegetation dries up, is cut, or weeds are treated, false chinch bug migrates in large numbers to any green plants and sucks sap from shoots and stems

Usually a problem in new plantings along borders near native vegetation. Healthy mature trees can withstand feeding

Chemical control with malathion historically

Monitor borders when vegetation along edges starts to dry up. Likes spurge

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FALSE CHINCH BUG

Motiles

Branch feeding

Leaf feeding

Dead leaves

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FALSE CHINCH BUG
SEPTEMBER 2018

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EUROPEAN EARWIG (Forficula auricularia)

Problem in new avocado plantings. Usually feed on leaves at night. Feeding can be confused with other leaf feeders (snails vs fuller rose beetle vs June beetle). Hide in tree wraps during the day. Removing the wraps is best control. Baits registered in avocados: Spinosad (Seduce) is OMRI approved.

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BROWN GARDEN SNAIL (Helix aspersa)

Problem in young trees. Feed at night, early morning, with irrigation. Hide in tree wraps, tree skirts, weeds during the day.

Removing tree wraps, controlling weeds, and maintaining tree skirts off the ground is best control. Copper bands work, labor intensive. Baits available: Iron phosphate (Sluggo), sodium ferric EDTA (Ferrox Agriculture)

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TORPEDO BUG (Siphanta acuta)

Plant-hopper native to Australia

Feed on fruit stems, exude honeydew which turns to black sooty mold on stem end of fruit. One report of fruit with sooty mold downgraded 10% (Carpinteria)

More sooty mold in dry years (no rain to wash off sooty mold)

Hosts: Avocado, citrus, coffee, eucalyptus, oleander

Biocontrol: Steel Blue Lady Beetle, minute wasp (Hawaii)

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TORPEDO BUG

Adult

Egg mass

Nymph

Sooty mold

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LATANIA SCALE
(Hemiberlesia lataniae)

Through the 1930's Latania scale was the principle scale pest in avocados. About one-third of groves were affected and fruit was washed and brushed to remove scales. Some acreage was sprayed or fumigated.

Under good biological control except where dust or pesticide drift is an issue. Major beneficials: Twice-stabbed beetle (Chilocorus stigma), Lindorus beetle (Lindorus lophanthae)

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LATANIA SCALE PREDATOR:

TWICE-STABBED BEETLE

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POLYPHAGUS SHOT HOLE BORER (Euwallacea sp.)

Related species is Kuroshiro Shot Hole Borer (KSHB) mostly in San Diego County

Beetle vectors Fusarium dieback. PSHB burrow into branches (do not eat wood), carry fungus in mouthparts to place in galleries for immature beetles to feed on. Galleries disrupt flow of water and nutrients and can cause weakened limbs to break. Many plant species affected (box elder, castor bean, willow)

Control: Cut infested branch off, chip into one inch diameter pieces, and cover

Beetles found in heritage avocado planting at Huntington Gardens in San Marino in August 2012. Trees look healthy, good leaf flush and color, no sign of disease.

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PSHB

Dead branch

Shotgun holes

Sugar volcanos

Entry hole

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SPIDERS
(ORB WEAVERS)

PICKING CONCERNS (WORKERS WON'T PICK UNLESS SPIDERS TREATED)

BROAD SPECTRUM MATERIALS APPLIED TO KILL SPIDERS. POTENTIAL TO UPSET BIOLOGICAL CONTROL.

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Tips to Improve Avocado IPM

Use selective materials to preserve predators and parasitoids

High mortality of Franklinothrips with spinosad, abamectin. Lacewing mortality ok with spinosad and abamectin

Limit broad spectrum materials (pyrethroids, etc.). Rotate chemistries to slow resistance and prevent resurgence of target pests (thrips and persea mite) and secondary pest outbreaks (looper, mealybug, six-spotted mite).

Cold winters: Re-establish beneficial populations (Trichogramma platneri)

Dust control along roads, borders (avocado brown mite and persea mite)

Monitor frequently (pest and beneficials) to better time treatment if needed

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