

# **Pest, Disease & Wildlife in the Dragoons**

Guide 10 · Protection Reference

*Version 2026.05 · Revised 2026-05-16*

*IPM · Pests · Diseases · Wildlife · Exclusion*

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**RELATED GUIDES**

This guide is one of seventeen in the Dragoon Mountains Growing Guides Library: - **Guide 1 — Hydroponic Primer & Library Map** · the front door + master multi-crop calendar - **Guide 2 — Peppers in the Dragoons** · soil + hydroponic + variety-specific staking - **Guide 3 — Bato Bucket Hydroponic Systems** · system build, water treatment, operations - **Guide 4 — Hydroponic Nutrients** · Masterblend + DIY + pH + Indoor/LED - **Guide 5 — Grapes in the Dragoons** · Cochise County viticulture - **Guide 6 — Cool-Season Crops** · brassicas + alliums + greens + roots - **Guide 7 — Warm-Season Companions** · tomatoes, cucurbits, beans, corn, sweet potatoes - **Guide 8 — Herbs in the Dragoons** · annual + perennial · soil & hydroponic - **Guide 9 — Backyard Orchard in the Dragoons** · figs, pomegranates, jujubes, stone fruits - **Guide 10 — Pest, Disease & Wildlife** (this guide) · IPM + Cochise wildlife - **Guide 11 — Foundations: Soil & Seed** · seed starting, composting, soil-building - **Guide 12 — Harvest, Preservation & Storage** · canning, fermenting, drying, root cellaring - **Guide 13 — Water in Cochise County** · sourcing, testing, treatment, rainwater - **Guide 14 — Season Extension Structures** · cold frames, low tunnels, hoop houses, high tunnels - **Guide 15 — Native Food Crops of the Sonoran-Madrean Region** · the indigenous food complex of the Dragoons and the wider sky-island region - **Guide 16 — Companion Plantings & Polycultures** · the design layer — companion matrix, anti-companions, cover crops, 9 Dragoons-specific guild designs - **Guide 17 — Recipes & Kitchen Integration** · what to cook with what came out of the garden this morning · by-crop recipes + seasonal menus This guide is the canonical home for pest, disease, and wildlife content in the library. The crop guides each have short sections that point here for depth. Where this guide touches water chemistry, the bicarbonate protocol is in **Guide 3 §4**; the nutrient-deficiency versus disease distinction is in **Guide 4 Part 1**; calcium delivery for blossom-end rot is in **Guide 4 Part 1**; crop-specific protocols stay in the crop guides (the cucumber-beetle dusk-spray cycle is in **Guide 7 §5.5**, the squash-vine-borer foil collar is in **Guide 7 §6.4**, the codling-moth bag-and-trap routine is in **Guide 9 §10**).

## How to use this guide

This guide is built as a reference. Almost no one reads a pest manual cover-to-cover. The way to use it is to know what's in it, scan the table of contents when something shows up in the bed, and read the entry for that one problem.

The structure is in three parts:

1. **The framework (chapters 1-3).** What IPM means, what makes the Dragoons different from other gardens, how to scout, when to act, when to leave it alone.
2. **The pest catalog (chapters 4-11).** Insects sorted by feeding type (sucking, chewing, soil-dwelling, mites), then diseases by pathogen type (fungal, bacterial, viral), then the physiological disorders that look like disease but aren't.
3. **The vertebrate pressure (chapters 12-17).** Small mammals, large mammals, birds, the reptile allies, dogs as security, the fencing reference.
4. **The action references (chapters 18-20).** Beneficial insects and how to feed them, a spray decision tree, and a month-by-month scouting calendar.

### LOCAL TIP

The Dragoons have a smaller pest community than most of the United States but a more *unusual* one. The dry climate kills most fungal disease. Mild winters fail to knock back pest populations the way northern winters do. Low-elevation desert species — *javelina*, *packrat*, harlequin bug, glassy-winged sharpshooter — pressure the garden in ways the average national gardening book completely fails to address. Anything in this guide that says “the Dragoons signature pest” is something you will not find ranked the same way in a generic reference.

**If you're new here, read these four entries first.** Harlequin bug (§5.3) — the signature Dragoons brassica pest. Cucumber beetle (§5.4) — the signature cucurbit pest, vector for bacterial wilt. Peach leaf curl (§8.3) — the dormant copper spray in January is the single highest-return preventive action in the orchard year. Javelina (§13.2) — the single largest mammal threat, and the reason an orchard fence is not optional. Cover these four and you have prevented 60–70 % of typical Dragoons garden losses.

## 1 · The IPM mindset

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*Prevention · scouting · biological controls · targeted intervention*

Integrated Pest Management (IPM) is the working philosophy this guide is built around. The short version: the spray bottle is the last tool, not the first. Most pest problems in the Dragoons are solved before they happen — by site choice, variety choice, planting date, row cover, sanitation, irrigation discipline, and habitat for beneficial insects. When all of those fail, *then* you intervene, and you intervene precisely.

The four-step IPM logic:

1. **Prevention.** Right crop, right variety, right timing, right place. A *Frost* peach (genetically resistant to leaf curl) planted on a sheltered south-east aspect is a different pest profile than a generic peach planted in a frost pocket. Hydroponic Bato buckets on a fenced patio have a different pest community than the same crop in an open soil bed.
2. **Scouting.** Walk the bed regularly. Look at growing tips, leaf undersides, the base of stems, the soil surface. Knowing what's present *before* it explodes is what makes targeted intervention work.
3. **Biological controls.** Encourage beneficial insects (lacewings, parasitic wasps, syrphid flies, ladybugs) and the larger food web (snake, hawk, owl) that handle most of the pest pressure for free. Flowering insectary strips of cilantro, dill, yarrow, alyssum, and fennel are the single highest-return habitat intervention.
4. **Targeted intervention.** When prevention and biology fail, intervene with the most specific tool first. Hand-pick before you spray. Hose-blast before you spray soap. Spray *Bacillus thuringiensis* (Bt) before you reach for pyrethrin. Use pyrethrin (a contact-killing chrysanthemum extract that breaks down in UV — broad-spectrum, kills beneficials, last-resort) only when nothing milder will work, and never during bloom.

### 1.1 The “tolerable damage” mindset

The biggest single mental shift for new growers is accepting that **a healthy garden has pests in it**. A cabbage with three aphids on the outer leaf is not a problem. A cucumber vine with five flea-beetle pinholes per leaf is not a problem. A peach tree with two scab spots out of a hundred fruit is not a problem. The goal is not zero pests; the goal is a stable community where predator and prey hold each other in rough balance and the crop yields enough for the kitchen.

Reaching for the spray bottle at the first aphid does three things that work against you over time:

- Kills the beneficial insects that were about to handle the aphid for free.

- Selects for spray-resistant pest populations.
- Trains you to over-react, which costs time, money, and crop in the long run.

**Action thresholds, not zero thresholds.** Decide *before* you scout how much damage triggers intervention. A useful default for most crops: take action when the pest population reaches a density that's visibly slowing growth or damaging the harvested part of the plant. Below that, scout and wait. The threshold for a flea beetle on a mustard leaf you'll harvest in a week is much higher than the same beetle on an eggplant transplant whose true leaves haven't yet emerged.

## 1.2 What this guide is, and isn't

This is a reference for the home grower and the small market gardener working in the Dragoon Mountains region of Cochise County, Arizona — USDA zone 8a, about 4,700 ft elevation. It is not a commercial pesticide application manual; for licensed applicator material, the **University of Arizona Cooperative Extension** (Cochise County office) and the **Arizona Department of Agriculture** are the canonical references. It is also not a veterinary or wildlife-removal manual; for wildlife conflicts beyond exclusion (a sick coyote in the yard, a rattlesnake in the shed), contact **Arizona Game and Fish**.

The content is biased toward organic and low-input methods — not for ideological reasons, but because they have a better long-term outcome in a small garden ecosystem. Where a synthetic option is materially more effective (e.g., copper for peach leaf curl, *Bacillus thuringiensis* for caterpillars), it is named.

## 2 · The Dragoons pest & wildlife landscape

### What makes Cochise County unique

A Pacific-Northwest gardening book and a New-England gardening book are both wrong about the Dragoons in slightly different ways. The pest community here is shaped by four conditions you don't find together anywhere east of the Mississippi:

1. **Mild winters.** Coldest winter nights are typically 18–25 °F, with hard freezes lasting only 3–6 nights per year. This is not enough to kill the overwintering eggs and adults of most insect pests. *Harlequin bug, leafhopper, aphid, and tomato hornworm pupae* all overwinter successfully in the Dragoons, which means populations build year over year unless actively managed.
2. **Monsoon humidity.** From early July through mid-September, the Dragoons receive 6–10 inches of rain in 60 days. Daily humidity that was 8 % in June becomes 60 %+ in late July, and night dew sets on every leaf. This is the only window for fungal disease — *powdery mildew, Botrytis, downy mildew, late blight* — and it's compressed. Six weeks of risk, sandwiched between nine months of bone-dry air.
3. **Low-elevation desert species.** The Dragoons sit on the edge of the Sonoran and Chihuahuan deserts. Species adapted to those environments — *javelina, packrat, jackrabbit, harlequin bug, blister beetle, cactus longhorn beetle, kissing bug* — pressure the garden in a way the same crop in Connecticut never sees.
4. **Sky-island biodiversity.** The Dragoons are a “sky island” — an isolated mountain range surrounded by desert. Bird, snake, raptor, and small-mammal diversity is extraordinary. This works *for* you (gopher snake, kingsnake, red-tailed hawk, great horned owl all eat rodents) and *against* you (curve-billed thrasher, mockingbird, white-winged dove, scrub jay all eat fruit).

### 2.1 The Dragoons pest “fingerprint”

If you've gardened elsewhere, here's what's different.

| Conditions you're used to                 | What the Dragoons do instead                          |
|-------------------------------------------|-------------------------------------------------------|
| Winter kills overwintering pests          | Mild winter — most pests overwinter successfully      |
| Slugs are the dominant ground pest        | Slugs only matter for 6 weeks post-monsoon            |
| Squash bug is the worst cucurbit pest     | Cucumber beetle is worse — bacterial wilt vector      |
| Cabbage looper is the worst brassica pest | Harlequin bug is worse — not affected by Bt           |
| Deer are the worst mammal pressure        | Javelina match or exceed deer (and bypass low fences) |

| Conditions you're used to                    | What the Dragoons do instead                          |
|----------------------------------------------|-------------------------------------------------------|
| Mice and voles are the worst rodent pressure | Packrat (woodrat) is bigger and more destructive      |
| Powdery mildew runs all summer               | Powdery mildew has a 6-week monsoon window            |
| Damping-off is a year-round seedling risk    | Damping-off is mostly a hydroponic / indoor problem   |
| Late blight kills tomatoes in August         | Late blight is rare — too dry between rains           |
| Pierce's disease takes out vineyards         | Pierce's disease is essentially absent above 4,500 ft |
| Codling moth is a 2-generation pest          | Codling moth runs 3 generations in the long warm fall |

## 2.2 The “year-round” effect

In most American climates, January is a reset. Pest populations crash, gardeners regroup. In the Dragoons, January is a slightly slower version of October. Aphids are still on the overwintered kale. Harlequin bug adults are still under the mulch. Packrats are still in the woodpile. The implication: **pest management is a 12-month routine**, not a March-to-October push. Sanitation in the fall, dormant sprays in January, scouting in February — all of these matter more here than they do in colder country.

### LOCAL TIP

The single most useful pest-management habit in the Dragoons is the **dusk walk**. Most pest insects feed in low light. Hornworms, squash bugs, harlequins, cucumber beetles, and cutworms are all easier to spot at dusk than at noon. A flashlight, ten minutes a day in season, no spray, picking by hand — this beats most chemical interventions on plots under a quarter-acre.

## 3 · IPM principles in practice

*Scouting frequency · action thresholds · biological controls · “tolerable damage”*

This chapter is the operating manual for the framework in chapter 1. How often to scout, what to look for, what triggers action.

### 3.1 Scouting frequency

| Crop / context                    | Scouting frequency                       | What to look for                                                                                            |
|-----------------------------------|------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| Brassica transplants<br>(Aug–Oct) | Every 2 days                             | Cabbage white eggs<br>(yellow, on leaf underside);<br>harlequin bug adults; slug<br>damage                  |
| Cucurbits (Jul–Sep)               | Every 2 days                             | Cucumber beetle adults;<br>squash bug egg clusters<br>(copper-colored, on leaf<br>underside); wilt symptoms |
| Tomato (Jul–Sep)                  | Every 3 days                             | Hornworm frass on leaves<br>below feeding sites; psyllid<br>yellow-stippling on new<br>growth               |
| Peppers (May–Oct)                 | Weekly                                   | Aphid clusters on growing<br>tips; thrip silvery scarring<br>on leaves                                      |
| Grape (May–Sep)                   | Weekly + storm-trigger                   | Powdery mildew on shaded<br>canopy interior;<br>sharpshooter activity                                       |
| Orchard (year-round)              | Weekly in season, monthly<br>in dormancy | Codling moth egg traps;<br>trunk damage; gopher<br>mounds                                                   |
| Hydroponic reservoir              | Daily                                    | Water temperature; root<br>color (white = clean, brown<br>= Pythium); algae on walls                        |
| Soil beds (winter)                | Weekly                                   | Packrat sign; aphid<br>colonies on cool-season<br>crops; cutworm damage to<br>transplants                   |

The schedule above assumes the bed is in active production. During dormancy or transition, weekly is fine.

### 3.2 Action thresholds — when to intervene

The honest answer is: it depends on the crop and the pest. Some workable defaults:

| Pest                       | Action threshold                           | Reasoning                                         |
|----------------------------|--------------------------------------------|---------------------------------------------------|
| Aphids on growing tips     | Visible curl of new growth, or 30+ per tip | Below this, predators usually catch up            |
| Spider mites               | Visible stippling on >10 % of leaves       | Mites explode quickly past this point             |
| Cucumber beetle            | Any beetle, on any cucurbit                | Vector for bacterial wilt — one bite can transmit |
| Squash vine borer eggs     | Any egg, on any squash                     | Single bore = dead vine; prevention only          |
| Cabbage white caterpillars | 1+ caterpillar per plant                   | Multiplies fast; Bt at first sign                 |
| Harlequin bug              | Any adult, anywhere on brassicas           | Reproduces in days; act on first sighting         |
| Tomato hornworm            | 1+ on a plant                              | Will defoliate; hand-pick on sight                |
| Codling moth               | 5+ moths in pheromone trap per week        | Bag fruit or spray spinosad                       |
| Slugs                      | Multiple seedlings damaged overnight       | Iron-phosphate bait or beer trap                  |
| Cutworm                    | 1 transplant cut overnight                 | Cardboard collars on all remaining transplants    |
| Powdery mildew             | Any spotting on monsoon-window crops       | Already past prevention; spray immediately        |
| Peach leaf curl            | Any symptom in spring                      | Too late; spray dormant next winter               |

The threshold logic is different by pest: anything that vectors disease (cucumber beetle, leafhopper, psyllid) or that builds populations explosively (mites, aphids, harlequin) gets a low threshold. Anything that's mostly cosmetic (flea beetle on mature leaves) gets tolerated.

### 3.3 Biological controls — the food web

The Dragoons have an unusually rich beneficial-insect community when you stop spraying for it. The main categories:

- **Parasitic wasps** (*Cotesia*, *Trichogramma*, *Aphidius*) — tiny, mostly invisible, lay eggs in caterpillars and aphids. The mummified-aphid skins on a tomato plant are evidence of *Aphidius*. The grain-of-rice cocoons on a hornworm's back are

*Cotesia*. Both attracted by small flowering plants (cilantro, dill, fennel, yarrow, sweet alyssum).

- **Lacewings** (*Chrysoperla*) — green adult; larvae are voracious aphid and mite predators.
- **Ladybugs** (*Hippodamia convergens* native; *Harmonia axyridis* invasive) — adults and larvae both eat aphids. The native species overwinters in cliff crevices in the Dragoons; you don't need to buy them.
- **Syrphid flies** (hover flies) — adults look like small bees; larvae are aphid predators.
- **Predatory mites** — invisible to the naked eye, eat spider mites. Killed indiscriminately by sulphur and broad-spectrum sprays.
- **Assassin bugs, big-eyed bugs, minute pirate bugs** — generalist predators of small soft insects.
- **Spiders** — the most underrated predator. Every spider in the garden is on your side.

Beyond insects, the vertebrate predators matter:

- **Gopher snake, kingsnake** — rodent control, gopher control. See §15.
- **Red-tailed hawk, great horned owl, kestrel** — rodent and rabbit control.
- **Roadrunner** — eats lizards, large insects, even small snakes.
- **Bats** — moth control at night, including codling moth and corn earworm.

The implication: a garden surrounded by native habitat (cholla, mesquite, oak, prickly pear) has a larger predator pool to draw on than a garden surrounded by clean lawn. Leave some “messy” edges.

### 3.4 Hydroponic vs soil — different pest profiles

The two production systems have different pest communities. Knowing the difference saves a lot of misdiagnosis.

| Pest / problem                                                         | Soil bed            | Hydroponic                        |
|------------------------------------------------------------------------|---------------------|-----------------------------------|
| Cutworms                                                               | Yes — at transplant | No — irrelevant indoors / no soil |
| Grasshoppers                                                           | Yes (drought years) | Only outdoor Bato buckets         |
| Slugs                                                                  | Yes — post-monsoon  | Rare; sometimes on rockwool       |
| Aphids, thrips, mites                                                  | Yes                 | Yes — same control                |
| Cucumber beetle                                                        | Yes                 | Yes if outdoor; rare indoors      |
| Squash vine borer                                                      | Yes                 | Rare — no soil for pupation       |
| Soil-borne fungal disease<br>( <i>Fusarium</i> , <i>Verticillium</i> ) | Yes                 | No — system can be flushed        |

| Pest / problem            | Soil bed                 | Hydroponic                       |
|---------------------------|--------------------------|----------------------------------|
| Root-knot nematode        | Yes — old beds           | No — sterile media               |
| <i>Pythium</i> root rot   | Rare with good drainage  | <b>Yes — the #1 hydro threat</b> |
| Reservoir algae           | n/a                      | Yes — cover reservoir            |
| Fungus gnats              | Mostly with overwatering | Yes — rockwool transition        |
| Powdery mildew            | Yes — monsoon            | Yes — same biology               |
| Javelina, packrat, gopher | Yes                      | Only outdoor / unfenced          |

The single most important hydroponic-only pathogen is *Pythium* — see **Guide 2 §8** and **Guide 3** for the full reservoir-temperature protocol. The single most important soil-only pest is the cutworm at transplant.

## 4 · Sucking insects

*Aphids · thrips · whitefly · leafhoppers · psyllid · mealybug · scale*

Sucking insects insert a piercing-sucking mouthpart into plant tissue and feed on sap. Damage shows as stippling, distortion, sticky honeydew (and the sooty mold that grows on it), curled leaves, and stunting. Several species also vector viruses. As a group, sucking insects respond to: water sprays (mechanical knockdown), insecticidal soap, neem oil, and the predators (lacewings, ladybugs, syrphid flies, parasitic wasps) that handle them invisibly when not sprayed.

### 4.1 Aphids

There are roughly 5,000 aphid species globally; the Dragoons see about a dozen with any regularity. The four you'll meet:

| Species                                             | Color              | Main hosts                        | Notes                                |
|-----------------------------------------------------|--------------------|-----------------------------------|--------------------------------------|
| Green peach aphid<br>( <i>Myzus persicae</i> )      | Pale green         | Peppers, peaches, brassicas, many | Vectors >100 plant viruses           |
| Cabbage aphid<br>( <i>Brevicoryne brassicae</i> )   | Gray-green, waxy   | Brassicas only                    | Heavy waxy coat resists soap         |
| Cotton/melon aphid<br>( <i>Aphis gossypii</i> )     | Yellow-green       | Cucurbits                         | Vectors cucumber mosaic              |
| Woolly apple aphid<br>( <i>Eriosoma lanigerum</i> ) | White fuzz on bark | Apple roots, branches             | Hardest to control; serious in pomes |

**Identification.** Dense clusters of small (1–3 mm) soft-bodied insects on growing tips, leaf undersides, and flower buds. Sticky honeydew below the colony. Ants tending the colony (farming aphids for honeydew). Sooty mold growing on honeydew.

**Life cycle.** In the Dragoons mild winter, females can reproduce parthenogenetically (without mating, live birth) year-round on overwintered hosts (kale, garlic tops, peach buds). Populations explode in spring as new growth appears, crash in midsummer heat, rebound on fall brassicas. A single colony can double every 4–5 days.

#### Control sequence.

1. **Hose blast.** Water spray in the morning, focused on growing tips. Repeat every 3 days. Mechanically dislodges aphids, which mostly can't climb back up.
2. **Encourage predators.** Plant cilantro, dill, yarrow nearby and let them flower. Don't spray.

3. **Insecticidal soap.** Direct contact spray on visible colonies; reapply every 5–7 days. Effective on most species; less effective on the waxy cabbage aphid.
4. **Neem oil.** Smothers and disrupts molting. Spray at dusk to avoid pollinator and leaf-burn issues.
5. **Pyrethrin.** Last resort; kills beneficials. Spray at dusk on non-flowering plants only.

#### LOCAL TIP

The Dragoons aphid pattern is opposite the national one. In most of the U.S. aphid peak is May–June. Here it's **October through February** — the cool overwintered season — because fall brassicas and overwintering alliums give them continuous host material with no winter knock-back. Plan to scout cool-season crops hard for aphids, not summer crops.

## 4.2 Thrips

Thrips are tiny (1–2 mm) slender insects that rasp leaf surfaces and suck up the exuding sap. The two species that matter:

- **Onion thrips** (*Thrips tabaci*) — alliums primarily, also brassicas; silvery flecks on inner leaf curl.
- **Western flower thrips** (*Frankliniella occidentalis*) — peppers, tomatoes, flowers; vectors *tomato spotted wilt virus* (TSWV).

**Identification.** Silvery, papery scars on leaves and fruit. Tiny black “frass dots” along with the silvering. The insects themselves are hard to see; tap a flower over a white sheet and watch for cream-colored slivers running across.

**Scouting.** Yellow or blue sticky traps near flowering plants. Blue traps catch western flower thrips better than yellow.

#### Control sequence.

1. **Reflective mulch.** Aluminum-foil or silver-plastic mulch around plants disorients flying thrips. Most useful in commercial settings, marginally useful at home scale.
2. **Hose blast** mornings on heavily infested plants.
3. **Spinosad** — a soil-bacterium-derived insecticide effective on thrips. Spray at dusk; allows recovery time for pollinators before sunrise.
4. **Insecticidal soap** for hot infestations on non-flowering plants.

## 4.3 Whitefly

Tiny (1.5 mm) white moth-like insects that fly up in a cloud when a leaf is disturbed. The two species:

- **Greenhouse whitefly** (*Trialeurodes vaporariorum*) — common in indoor and protected production.
- **Silverleaf / sweetpotato whitefly** (*Bemisia tabaci*) — outdoor in warm regions; vectors several geminiviruses.

**Identification.** White cloud rising from leaf undersides when disturbed. Yellow stippling on upper leaf. Honeydew and sooty mold below colony.

**Control sequence.**

1. **Yellow sticky traps** at canopy height — catches adults; primarily for monitoring.
2. **Insecticidal soap** weekly until population breaks.
3. **Neem oil** — disrupts whitefly egg development. Most effective tool.
4. **Encourage predators** — *Encarsia formosa* (parasitic wasp) is the commercial biocontrol for whitefly; in the home garden, lacewings and predatory mites help.

#### 4.4 Leafhoppers and sharpshooters

Wedge-shaped jumping insects, 3–5 mm, that run sideways on stems and jump away when disturbed. They feed on plant sap and several species vector serious diseases.

- **Beet leafhopper** (*Circulifer tenellus*) — vectors *curly top virus* on tomatoes, beans, peppers, beets.
- **Glassy-winged sharpshooter** (*Homalodisca vitripennis*) — vectors *Pierce's disease* on grapes. Cold-limited; rare at Dragoons elevation (4,500+ ft) but present at lower Cochise sites.
- **Potato leafhopper** (*Empoasca fabae*) — causes “hopperburn” stippling and necrotic margins on beans, potatoes.

**Identification.** White or yellow stippling on leaves. Insects that jump or fly when leaves are touched. *Hopperburn* shows as V-shaped tip yellowing followed by necrosis.

**Control sequence.**

1. **Row cover** at transplant on susceptible crops in years with high leafhopper pressure.
2. **Reflective mulch** disorients them.
3. **Insecticidal soap** — only effective on direct contact; spray when leafhoppers are visible.
4. **Pyrethrin** if numbers are heavy and host crops are at risk. Dusk only.

The bigger management is at the variety / planting-date level: curly-top-tolerant tomato varieties exist, and early planting helps the crop establish before peak leafhopper flight (May–June).

## 4.5 Psyllid

Looks like a tiny cicada (2–3 mm). Adults jump or fly; nymphs are flattened scale-like discs that stay put on leaf undersides.

- **Tomato/potato psyllid** (*Bactericera cockerelli*) — vectors zebra chip in potato and “psyllid yellows” in tomato. Major Southwest pest in dry warm springs.

**Identification.** Yellowed cupping of new growth on tomato and potato (the “yellows” symptom). Tiny flat nymphs (like a flat scale insect) on leaf undersides. Sticky honeydew with a granular white “psyllid sugar” on leaves.

### Control sequence.

1. **Row cover** at transplant through May.
2. **Sulphur dust** — disrupts psyllid populations; useful pre-bloom.
3. **Insecticidal soap** — directly on nymphs.
4. **Tolerate.** Most years, the Dragoons see moderate psyllid pressure that doesn’t significantly affect yield.

## 4.6 Mealybugs and scale

Less common in outdoor Dragoons gardens but persistent on citrus, indoor figs, hibiscus, and overwintered hydroponic plants.

- **Mealybugs** — cottony white masses in leaf axils. Treat with rubbing alcohol on a cotton swab, or repeated insecticidal-soap sprays. Persistent — don’t expect a single application to fix it.
- **Scale insects** — bumpy crust on bark or stems, often along the underside of leaf midribs. *Soft scale* (sticky, exudes honeydew) and *armored scale* (no honeydew, harder shell). Dormant-season horticultural oil is the standard control. Encourage predatory ladybugs (the *Lindorus* / *Rhyzobius* species are key here).

## 4.7 Reference table — sucking insects at a glance

| Pest               | Season     | Crops                     | Severity          | First-line control |
|--------------------|------------|---------------------------|-------------------|--------------------|
| Green peach aphid  | Oct–Apr    | Peppers, brassicas, peach | Moderate          | Hose blast         |
| Cabbage aphid      | Nov–Feb    | Brassicas                 | High in late fall | Hose blast + soap  |
| Cotton aphid       | Jul–Sep    | Cucurbits                 | Moderate          | Predators, soap    |
| Woolly apple aphid | All season | Apple                     | Moderate          | Dormant oil        |

| Pest                  | Season               | Crops                            | Severity         | First-line control  |
|-----------------------|----------------------|----------------------------------|------------------|---------------------|
| Onion thrips          | Mar-May              | Alliums                          | Low              | Hose blast          |
| Western flower thrips | Apr-Sep              | Peppers, tomato, flowers         | Moderate         | Spinosad            |
| Whitefly              | Indoor / warm season | Indoor crops, tomato             | Moderate         | Soap + sticky traps |
| Beet leafhopper       | Apr-Jun              | Tomato, bean (vectors curly top) | Year-dependent   | Row cover           |
| Sharpshooter          | Apr-Sep              | Grape (vectors Pierce's)         | Low at elevation | Tolerate            |
| Tomato/potato psyllid | Apr-Jun              | Tomato, potato                   | Moderate         | Row cover, sulphur  |
| Mealybug              | Year-round indoors   | Citrus, indoor crops             | Low-moderate     | Alcohol swab, soap  |
| Scale                 | Year-round           | Citrus, stone fruit              | Low-moderate     | Dormant oil         |

## 5 · Chewing insects

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*Caterpillars · beetles · borers · grasshoppers*

Chewing insects remove plant tissue with mandibles. Damage shows as missing tissue (holes, notches, defoliation), frass (insect droppings), and sometimes stem severing or fruit boring. Many can be hand-picked, which is the highest-return single tool for this group on small plots. Where spraying is needed, *Bacillus thuringiensis* (Bt) — a soil bacterium toxic to caterpillars but harmless to bees, beneficials, mammals, and birds — is the canonical first reach for caterpillar pests. Bt does *not* affect beetles or true bugs.

### 5.1 Cabbage white & cabbage looper

The two most common brassica caterpillars in the Dragoons.

**Cabbage white butterfly** (*Pieris rapae*) — small white butterfly with one to two black spots per wing. Lays single yellow eggs (1 mm, bullet-shaped) on the underside of brassica leaves. Larvae are bright green and velvety, growing to about 30 mm.

**Cabbage looper** (*Trichoplusia ni*) — adult is a nondescript brown moth; larva is similar to the cabbage white green caterpillar but moves in a looping “inchworm” posture and is more nocturnal.

**Crops affected.** All brassicas (cabbage, broccoli, cauliflower, kale, brussels sprouts, kohlrabi, collards, mustards, arugula).

**Life cycle in the Dragoons.** Adults appear in mid-August as fall brassica transplants go in. Eggs hatch in 4–8 days; larvae feed 2–3 weeks before pupating. Two to three generations per fall. Cabbage white overwinters as pupa attached to fences, walls, and dry brush; cabbage looper overwinters in southern Arizona and migrates north each spring.

**Scouting.** Look for yellow eggs on leaf undersides, ragged holes in leaves (start at outer leaves, work toward heart), dark green frass pellets on lower leaves.

**Control sequence.**

1. **Floating row cover** at transplant through about 4 weeks. Cover edges with soil — butterflies will lay through any gap.
2. **Bt kurstaki** (*Bacillus thuringiensis* subsp. *kurstaki*) — spray weekly once cover comes off. Apply at dusk; Bt breaks down in UV within 24 hours.
3. **Hand picking** — for small plantings, 10 minutes a week per 50 sq ft is sufficient.
4. **Spinosad** for heavy populations; effective on both species.

## 5.2 Hornworms

Two related species — the **tomato hornworm** (*Manduca quinquemaculata*) and the **tobacco hornworm** (*Manduca sexta*) — feed on *Solanaceae* (tomato, pepper, eggplant, potato). The tobacco hornworm is more common in the Southwest. Both are large (up to 100 mm), green, with a curved spine (“horn”) on the rear.

**Identification.** Large green caterpillars on tomato or pepper foliage. Sudden defoliation of a single stem overnight. Pellet-sized green-black frass on lower leaves. The caterpillar itself is famously hard to see — its color matches the leaf exactly — but you can usually spot the frass first, then look up to find the larva.

**Life cycle.** Adult is a large gray-brown “hawk moth” that hovers like a hummingbird at evening flowers. Eggs are laid on leaf undersides. Larvae feed 3–4 weeks, then drop and pupate in soil. In the Dragoons, peak hornworm pressure is mid-July through early September during the monsoon.

### Control sequence.

1. **Daily dusk scouting** during monsoon — flashlight, walk the bed, look for frass, then look up. Hand-pick into a jar.
2. **Bt kurstaki** spray on heavy infestations.
3. **Leave parasitized larvae alone.** A hornworm with grain-of-rice-sized white cocoons on its back has been parasitized by *Cotesia congregata* — a parasitic wasp. Don’t kill it; let the wasps emerge to attack other hornworms.
4. **Trichogramma wasps** — commercial release for serious infestations; targets eggs before they hatch.

## 5.3 Harlequin bug — THE Dragoons brassica pest

The signature local brassica pest, and one of the few that’s *worse* in the Dragoons than in most of the country. *Murgantia histrionica* — bright orange and black shield-shaped true bug, 8–12 mm. Adults overwinter in plant debris and emerge in late summer to attack fall brassicas.

**Harlequin bug is THE Dragoons brassica pest.** It is not affected by Bt. It is hard to kill once established. It is the single biggest reason fall brassica plantings fail in Cochise County. Plan exclusion (row cover + sanitation) into the brassica calendar — *before* the bug appears, not after.

**Identification.** Vivid orange-and-black shield-shaped bugs on brassica foliage. Yellow-and-white stippling on leaves (sap drained from feeding sites). Eggs laid in tidy double rows of barrel-shaped, black-and-white-striped eggs on leaf undersides. Nymphs are wingless miniature versions of adults.

**Crops affected.** All brassicas, with mustards, kale, and turnip especially favored. Will also feed on tomato, bean, and corn in late season when brassicas are limited.

**Life cycle.** Three or four generations per year in southern Arizona. Adults overwinter under rocks, in leaf litter, in dead brassica stalks. Emergence in late August lines up exactly with fall brassica transplant. A pair can produce 100+ eggs.

**Scouting.** Daily inspection from August 15 onward. Look for adults sunning on top of leaves in cool morning. Look for egg rows on leaf undersides. Look for stippled feeding damage.

### **Control sequence.**

1. **Sanitation in spring.** The single highest-return action is fall and spring removal of all brassica debris, mustard volunteers, and weedy brassica relatives within 100 ft of the bed. Every overwintering adult you don't have in March means dozens of nymphs you don't deal with in September.
2. **Floating row cover** from transplant date through October.
3. **Trap crops.** A row of mustard or radish left to flower nearby pulls harlequins off the cabbage. Vacuum the trap crop in the morning when adults are sluggish.
4. **Hand picking morning and evening.** Hold a jar of soapy water under the plant and tap — adults drop straight in.
5. **Crush egg rows** on leaf undersides as you find them. The double-rowed barrels are unmistakable.
6. **Neem or pyrethrin** as last resort. Both kill beneficials. Dusk only, never during bloom.

## **5.4 Cucumber beetle — the cucurbit vector**

The Dragoons signature cucurbit pest, and the most important warm-season pest in the whole guide because of its disease-vector role. See **Guide 7 §5.5** for the full protocol; what follows is the reference summary.

Two species both present:

- **Striped cucumber beetle** (*Acalymma vittatum*) — yellow with three black stripes.
- **Spotted cucumber beetle** (*Diabrotica undecimpunctata*) — yellow with twelve black spots.

**Cucumber beetle = bacterial wilt vector.** The beetle by itself eats a small amount of foliage and flowers — annoying but not crop-threatening. The reason it's the signature cucurbit pest is that it vectors *Erwinia tracheiphila* — bacterial wilt — which has no cure. One bite from an infected beetle can kill a mature cucumber vine in 7-14 days. This is why the threshold is "any beetle,

anywhere on a cucurbit” rather than the usual population threshold.

**Identification.** Small (5–7 mm) yellow beetles with stripes or spots on cucumber, squash, melon, or zucchini foliage and flowers. Wilting of individual stems, then whole plant, despite adequate moisture — usually the bacterial-wilt signal.

**Life cycle.** Adults overwinter in leaf litter at the edge of fields, emerge in late June, peak after the first big monsoon rain in early July. Two to three generations per year. The first generation is the dangerous one for bacterial wilt — the beetles emerge carrying the bacterium from last year’s overwintering sites.

**Control sequence.** (See **Guide 7 §5.5** for full protocol.)

1. **Row cover** from transplant through first flowering. Remove for pollination; this is the trade-off.
2. **Trap crops.** A row of *Blue Hubbard* squash at the bed edge draws beetles off the real crop.
3. **Pyrethrin spray at dusk** within 48 hours of the first big monsoon rain (the surge trigger).
4. **Yellow sticky traps** for monitoring.
5. **Cull wilt-symptomatic plants within 48 hours.** Trash, don’t compost — the bacterium overwinters in beetle gut.

## 5.5 Squash vine borer

A clearwing moth (*Melittia cucurbitae*) whose larva bores into squash stems and kills the plant from inside. The biggest single-plant killer in the Dragoons cucurbit patch. See **Guide 7 §6.4** for the full protocol.

**Identification.** Sudden wilt of an entire squash or zucchini plant despite full moisture. Frass (sawdust-like) at the base of the main stem. Slicing the stem lengthwise reveals a fat cream-colored caterpillar tunneling inside.

**Life cycle.** Single adult emergence in mid-to-late July in the Dragoons. Adult resembles a wasp (orange and black, day-flying). Lays eggs at base of squash stems. Larvae hatch and immediately bore in; the damage is done before it’s visible.

**Control sequence.**

1. **Aluminum foil collar** wrapped around the base of every squash and zucchini stem from May through August. Physically blocks egg-lay. Single highest-return intervention.
2. **Second sowing** in late July as insurance — even if the first planting collapses, the second will produce in September after borer flight ends.
3. **Stem injection** of Bt with a syringe at the first sign of frass — sometimes saves a

plant.

4. **Sanitation.** Remove and burn (or trash) all squash debris in fall.

## 5.6 Corn earworm

The single most reliable pest of sweet corn in the Dragoons. *Helicoverpa zea* — the larva of a brown night-flying moth. Same species attacks tomato (tomato fruitworm), cotton (cotton bollworm), and bean (bean podworm).

**Identification.** Cream to brown caterpillars (up to 35 mm) inside the ear tips, eating kernels. Frass at the silks. The ear tip is the only part affected — kernels below the feeding zone are usually fine.

**Life cycle.** Adult moth lays single eggs on fresh corn silks. Larva crawls down the silk into the ear tip. Three or four generations per year in southern Arizona; peak August.

### Control sequence.

1. **Plant early** — April 15 if soil temperature allows. The first corn flush gets the lightest pressure.
2. **Resistant varieties** with tight husks (*Country Gentleman*, *Silver Queen*) — bird and bug resistance both.
3. **Mineral oil drop** — a few drops of mineral oil mixed with Bt onto fresh silks, 6 days after silking. Suffocates and kills early larvae.
4. **Tolerate the tip damage.** A 1-inch tip with a worm can be cut off; the rest of the ear is perfect.

## 5.7 Codling moth — the apple pest

*Cydia pomonella*. The dominant pest of apple and pear in the Dragoons. See **Guide 9 §10** for the full orchard protocol.

**Identification.** Wormy fruit — small caterpillars eating into the fruit, usually entering through the calyx (blossom) end. Frass at the entry hole. Apples drop prematurely.

**Life cycle.** Three generations per year in the long Dragoons apple season — late April, late June, and late August. Adult is a small gray moth with bronze wing-tips; flies at dusk.

### Control sequence.

1. **Pheromone traps** for monitoring. Threshold: 5+ moths per trap per week triggers spray.
2. **Bag fruit individually** in paper or footed nylons at thumbnail size. Labor-intensive but effective for backyard trees with under 100 fruit.

3. **Spinosad spray** at first egg-hatch (about 250 degree-days after first trap catch).
4. **Sanitation.** Pick up dropped fruit weekly through summer.
5. **Codling moth granulosus virus** (CYD-X) — commercial biocontrol effective for serious infestations.

### 5.8 Flea beetle

Tiny (2 mm) shiny black beetles that jump when disturbed, leaving pinholes in leaves. *Phyllotreta* and *Epitrix* species. Multiple species attack different crops.

**Identification.** Pinholes on leaves; tiny black beetles that jump away when leaves are touched. Worst on young seedlings; mature plants outgrow the damage.

**Crops affected.** Eggplant primarily; mustards, arugula, and young brassicas secondary; tomato and sweet potato occasionally.

#### Control sequence.

1. **Row cover** at transplant through about 4 weeks of growth.
2. **Tolerate** on established plants — cosmetic damage only.
3. **Nasturtiums** as trap crop — flea beetles prefer them.
4. **Pyrethrin** for severe seedling damage; dusk only.

### 5.9 Blister beetle

Long (15–25 mm) slender beetles, often striped or black, that appear in swarms after monsoon rains. *Epicauta* species. Eat tomato, potato, pepper, and amaranth foliage. Notable because they contain *cantharidin* — a chemical that blisters human skin on contact.

**Identification.** Sudden swarm of long beetles on tomato or pepper plants, often defoliating an entire plant in hours. Black, gray, or striped pattern.

#### Control sequence.

1. **Hand-pick wearing gloves.** Cantharidin causes blisters; do not touch beetles directly.
2. **Knock into a bucket of soapy water** with a stick.
3. **Row cover** on susceptible crops during monsoon for the worst years.
4. **Tolerate** if the swarm is brief — they often move through in 1–3 days.

### 5.10 Grasshoppers

In drought years, a serious pest of nearly everything. Three or four species in the Dragoons; *Melanoplus* species dominant.

**Identification.** Rapid defoliation, no specific pattern. Visible grasshoppers, especially in late afternoon.

**Control sequence.**

1. **Row cover** during heavy years.
2. **Nosema locustae bait** — protozoan biocontrol that infects grasshoppers; slow-acting and works only on nymphs. Apply early in season.
3. **Kaolin clay spray** — coats foliage with a film that grasshoppers won't feed on. Hard to keep on through monsoon rain.
4. **Chickens or guinea fowl** if you keep them — significant control.

**5.11 Reference table — chewing insects**

| Pest              | Season                 | Crops                  | Severity                | First-line control          |
|-------------------|------------------------|------------------------|-------------------------|-----------------------------|
| Cabbage white     | Aug-Oct, Mar-May       | Brassicas              | Moderate                | Row cover + Bt              |
| Cabbage looper    | Sep-Nov                | Brassicas              | Moderate                | Bt                          |
| Harlequin bug     | Sep-Nov                | Brassicas              | <b>High — signature</b> | Sanitation + row cover      |
| Tomato hornworm   | Jul-Sep                | Solanaceae             | High                    | Dusk hand-pick              |
| Cucumber beetle   | Jul-Sep                | Cucurbits              | <b>High — signature</b> | Exclusion + dusk spray      |
| Squash vine borer | Jul (1 flight)         | Squash, zucchini       | High                    | Foil collar                 |
| Corn earworm      | Aug                    | Sweet corn             | High                    | Early planting, mineral oil |
| Codling moth      | May-Aug                | Apple, pear            | High                    | Bagging, spinosad           |
| Flea beetle       | May, also Mar-May      | Eggplant, mustards     | Low-moderate            | Row cover                   |
| Blister beetle    | Jul-Sep (post-monsoon) | Tomato, pepper, potato | Year-dependent          | Hand-pick (gloves)          |
| Grasshopper       | Aug-Sep (drought)      | All                    | Year-dependent          | Nosema, row cover           |

## 6 · Soil pests

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*Wireworm · cutworm · root-knot nematode · root maggot · grubs*

Soil-dwelling pests are the ones you can't scout for directly — you see the damage above ground and infer what's eating roots below. Most soil pest management is preventive: cover crops, rotation, solarization, and exclusion at transplant.

### 6.1 Cutworm

Gray-brown caterpillars (15–40 mm) that curl into a “C” when disturbed. *Agrotis* and *Peridroma* species. Hide in soil during day, emerge at night, sever transplant stems at ground level.

**Identification.** Seedlings or transplants cleanly cut off at soil level, lying intact on the ground in the morning. Sometimes the caterpillar is curled in the soil within 2 inches of the damaged plant.

**Crops affected.** Brassica transplants, tomato transplants, lettuce, anything at the small-transplant stage in August–October. Spring transplants in March–April.

**Life cycle.** Multiple species; some overwinter as larvae in soil, others as adult moths. Peak damage at transplant time in late summer.

**Control sequence.**

1. **Cardboard collars.** Toilet-paper-tube cylinder cut to 3 inches, pushed 1 inch into soil at every transplant. Single highest-return intervention. Cardboard biodegrades after harvest.
2. **Diatomaceous earth** ring around each transplant.
3. **Bt** drench at transplant — modest effect.
4. **Hand-pick at dusk** — they emerge at low light.

### 6.2 Wireworm

Hard, shiny, slender orange-yellow larvae (15–30 mm) of click beetles (*Agriotes*, *Limonius*). Bore into root crops, seed potatoes, and tubers.

**Identification.** Slender brown tunnels in carrots, potatoes, sweet potatoes, and root crops generally. Wireworms themselves are found in soil during cultivation.

**Crops affected.** Root crops primarily; corn and bean seedlings if heavy.

**Life cycle.** Adults are click beetles. Larvae live 2–4 years in soil before pupating. Worse in beds recently converted from sod or pasture (where larvae lived in grass roots).

**Control sequence.**

1. **Avoid planting root crops in newly converted beds** for 2 years after sod removal.
2. **Trap with potato chunks** buried 4 inches deep — dig up weekly and destroy wireworms.
3. **Beneficial nematodes** (*Steinernema feltiae*) applied as drench in spring.
4. **Heavy rotation** — never the same root crop in the same bed two years running.

### 6.3 Root-knot nematode

Microscopic worms (*Meloidogyne* species) that infect roots and cause galls, stunting, and progressive decline. Persistent in beds once established.

**Identification.** Stunted above-ground growth despite adequate water and nutrients. Roots show small to large galls (bumpy lumpy swellings) when dug. Worse on carrots, beets, tomatoes, peppers, melons.

**Crops affected.** Carrots and root crops show galls most dramatically; tomatoes, melons, and peppers are also susceptible. Brassicas, alliums, and corn are tolerant.

**Life cycle.** Persistent in soil. One generation per 30–60 days during warm weather. Females lay 500+ eggs in gelatinous matrix attached to root.

#### Control sequence.

1. **Rotation is everything.** Never grow susceptible crops in the same bed two years running.
2. **Cover-crop with Nemagold marigolds** (*Tagetes patula*) — 60-day cover crop produces alpha-terthienyl in roots, which suppresses nematode populations.
3. **Solarization.** Clear plastic over moist soil for 6 weeks in midsummer. Works in the Dragoons sun; soil temps under plastic reach 140 °F.
4. **Soil amendments with crab/shrimp shell meal** — chitin amendments encourage chitinase-producing soil microbes that attack nematode eggs.
5. **Plant resistant varieties.** Tomato varieties marked “VFN” or “N” have nematode resistance.

### 6.4 Root maggot

*Delia* species — the larvae of small flies that lay eggs at the soil line on brassica and onion stems. Larvae tunnel into roots and bulbs.

- **Cabbage maggot** (*Delia radicum*) — brassica roots and stem base.
- **Onion maggot** (*Delia antiqua*) — onion and garlic bulbs.

**Identification.** Wilting brassica transplant without obvious above-ground cause; pull up and find white tunneling larvae at the root crown. Onions with brown rotted-out bulb interiors and tunneling.

**Control sequence.**

1. **Row cover at transplant** prevents adult egg-lay. Single most effective intervention.
2. **Wood-ash or diatomaceous earth ring** around plant stems.
3. **Beneficial nematodes** (*Steinernema feltiae*) as soil drench.
4. **Delay planting** if a maggot outbreak is known in the area.

**6.5 White grubs**

Larvae of June beetles, May beetles, and chafers. Large (15–30 mm), white, C-curved grubs in soil. Eat roots of grasses, sometimes seedlings.

**Identification.** White C-shaped grubs found during cultivation. Usually a problem only in beds recently converted from lawn or in beds heavily amended with raw organic matter.

**Control sequence.**

1. **Beneficial nematodes** (*Heterorhabditis bacteriophora*) — soil drench in warm soil.
2. **Milky spore disease** — bacterial control, slow to establish but persistent.
3. **Cultivation.** Tilling exposes grubs to predator birds.

**6.6 Reference — soil pests**

| Pest               | Damage                        | Crops                 | Control sequence                              |
|--------------------|-------------------------------|-----------------------|-----------------------------------------------|
| Cutworm            | Severed transplants overnight | Brassicas, tomato     | Cardboard collars                             |
| Wireworm           | Tunneled roots                | Carrots, potatoes     | Rotation, traps                               |
| Root-knot nematode | Galled roots, stunting        | Tomato, carrot, melon | Marigold cover, rotation, resistant varieties |
| Cabbage maggot     | Tunneled brassica roots       | Brassicas             | Row cover at transplant                       |
| Onion maggot       | Rotted onion bulbs            | Alliums               | Row cover at transplant                       |
| White grubs        | Root feeding                  | Lawn, seedlings       | Beneficial nematodes                          |

## 7 · Mites & non-insect pests

*Spider mites · eriophyid mites · springtails*

Mites are not insects — they're arachnids, with eight legs as adults (six as larvae). Most are too small to see clearly without a hand lens. They reproduce explosively in dry hot weather and resist many conventional insecticides.

### 7.1 Spider mites

Two-spotted spider mite (*Tetranychus urticae*) is the dominant species. Adults are about 0.4 mm with two dark spots on the back. They feed on undersides of leaves and produce fine webbing.

**Crops affected.** Almost everything — peppers, tomatoes, eggplant, beans, melons, hops, citrus, almost all hydroponic crops. Severe in dry heat (June pre-monsoon especially).

**Identification.** Tiny stippled white-yellow flecking on leaves (each fleck is a feeding site). Fine webbing on leaf undersides and growing tips in heavy infestations. The mites themselves require a hand lens — look like moving specks of dust on the underside of a leaf, often near the midrib.

**Life cycle.** Egg to adult in 5–7 days in hot dry weather. A single female lays 100+ eggs. Populations can double daily under perfect conditions (95 °F, low humidity). Overwinter as adult females in plant debris.

#### Control sequence.

1. **Raise humidity.** Mist plants in morning; mites hate humid microclimates. This is the highest-return single intervention in dry pre-monsoon June.
2. **Hose blast** every 3 days on the undersides of leaves.
3. **Predatory mites** (*Phytoseiulus persimilis*, *Neoseiulus californicus*) — commercial release; effective in greenhouse and indoor production.
4. **Insecticidal soap** weekly — contact only, needs direct hit on mites.
5. **Neem oil** at dusk — effective and gentler than other options.
6. **Sulphur dust** — effective on mites *and* powdery mildew simultaneously. Do not apply above 85 °F (burns foliage).
7. **Avoid broad-spectrum sprays.** Pyrethrin kills predatory mites and worsens the problem.

#### WARNING

**Broad-spectrum sprays make spider mites worse.** Pyrethrin, carbaryl, and many other “kill-everything” sprays wipe out the predatory mite community before they wipe out the spider mites. The result is a population explosion

within 2–3 weeks. If spider mites are a problem, the *first* thing to remove from rotation is the broad-spectrum insecticide.

## 7.2 Eriophyid mites

Microscopic (0.2 mm) mites that cause specific deformations rather than general stippling. Genus-specific:

- **Tomato russet mite** (*Aculops lycopersici*) — causes bronzing of lower tomato stems and leaves; severe in hot dry conditions.
- **Grape erineum mite** (*Colomerus vitis*) — causes raised galls (erineum patches) on grape leaves; cosmetic.
- **Apple rust mite** (*Aculus schlechtendali*) — causes russetting of apple skin; minor.

**Identification.** Specific symptom by host — bronzed tomato stems, raised galls on grape, rusty apple skin. The mites themselves are not visible without strong magnification.

### Control sequence.

1. **Sulphur dust** — effective. Same temperature caution as for spider mites.
2. **Tolerate cosmetic damage** — erineum mites on grape, rust mites on apple — these rarely affect crop yield.
3. **Sanitation.** Prune out heavily infested wood in dormancy.

## 7.3 Springtails

Tiny (1–3 mm) jumping arthropods that thrive in moist soil and decomposing organic matter. Not true insects, not true pests in most cases. Sometimes a nuisance in hydroponic rockwool and seedling trays.

**Control.** Reduce moisture; springtails self-correct when conditions dry. No spray needed.

## 8 · Fungal diseases

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*Powdery mildew · peach leaf curl · early blight · late blight · downy mildew · Fusarium · Verticillium · gray mold · Septoria · Pythium*

Fungal diseases in the Dragoons are seasonal — the dry air kills most fungi for nine months of the year, but the six-week monsoon window is a concentrated risk. The dominant principle for fungal disease is **prevention before symptoms appear**. Once you see disease, the season's outcome is mostly fixed; you can slow it but rarely stop it. Two times to act: dormant winter sprays before bud break (for peach leaf curl, brown rot), and preventive sprays in late June before the first monsoon rain (for powdery mildew, downy mildew, *Botrytis*).

### 8.1 Powdery mildew

The most common fungal disease in the Dragoons. Multiple causal species — *Podosphaera xanthii* on cucurbits, *Erysiphe* species on others, *Uncinula necator* on grape.

**Identification.** White powdery coating on upper leaf surfaces, sometimes shoots and stems. Affected leaves yellow and drop. Heavily affected fruit (cucumbers, melons) can develop sunburn from leaf loss.

**Crops affected.** Squash, zucchini, cucumber, melon, grape, peppers (mild), peas, beans (late). Almost everything is susceptible to some species.

**Life cycle.** Spores germinate at 60–80 °F under humid conditions but unlike most fungi do not require leaf wetness — they thrive in monsoon humidity even without rain. Peak July through September.

#### Control sequence.

1. **Prevention via spacing and airflow.** Trellis cucurbits vertically. Prune lower leaves off tomatoes. Open the canopy on grape vines before July 1.
2. **Resistant varieties.** Many cucurbit varieties have powdery-mildew resistance (PMR) in their names. Use them.
3. **Potassium bicarbonate spray** (*Kaligreen*, *MilStop*) every 14 days from late June. Best preventive.
4. **Milk spray** — 1 part milk to 9 parts water, applied weekly. Genuine effect, well-documented in trials. Cheap.
5. **Sulphur** — every 14 days from June. Do not apply above 95 °F. Effective on grape especially.
6. **Neem oil** at dusk — moderate effect.

**LOCAL TIP**

The Dragoons powdery mildew onset is highly predictable. Look at three signals: (1) the first night dew on your beds — usually within a week of the first significant monsoon rain, (2) overnight humidity above 60 % three nights in a row, (3) afternoon thunder developing on consecutive days. When all three line up, you have about 7 days before mildew shows. Spray before, not after.

**8.2 Downy mildew**

Different organism (oomycete, *Peronospora* and *Pseudoperonospora* species) than powdery mildew but similar appearance. Less common in the Dragoons because it needs continuous leaf wetness — which the dry-day-wet-night monsoon pattern doesn't always provide.

**Identification.** Yellow angular patches on upper leaf, with a downy gray-purple fuzz on the underside (visible early morning when dew is fresh). Worse on cucurbits, brassicas, alliums.

**Control sequence.** Same as powdery mildew, with copper-based sprays added for severe cases. Less common in the Dragoons than in humid climates.

**8.3 Peach leaf curl**

The single most important stone-fruit disease in the Dragoons. Caused by *Taphrina deformans*. Infects buds during winter and emerges with the new spring leaves.

**Two dormant copper sprays, January and February.** This is the single most important stone-fruit task in the Dragoon orchard calendar. Skip it and the peach crop is at risk. Do it religiously and peach leaf curl essentially never appears. Once symptoms appear in spring, control for that season is impossible.

**Identification.** Red puckered, thickened, curled leaves on peach or nectarine in early spring (March–April). Severe defoliation. Following year, weakened tree with reduced bloom.

**Life cycle.** Spores overwinter in bud scales. Spring rain triggers germination as buds swell. Once inside developing leaves, the fungus is untouchable.

**Control sequence.**

1. **Mid-January copper spray** at full label rate. Cover every twig and bud.
2. **Mid-February copper spray** — repeat, especially if a wet spring is forecast.
3. **Plant resistant variety** — *Frost* peach is genetically resistant; *Indian Free* mod-

erately resistant.

4. **Sanitation.** Rake and dispose of fallen leaves in autumn; do not compost on site.

See **Guide 9 §5** for the full stone-fruit protocol.

### 8.4 Early blight

Caused by *Alternaria solani*. Most common on tomato; also on potato and eggplant.

**Identification.** Concentric brown ring spots on lower leaves first; spots have a “bulls-eye” appearance. Yellowing and drop of affected leaves. Progresses up the plant.

**Life cycle.** Overwinters on debris and in soil. Spreads by water splash. Peak during monsoon. Worse on stressed, low-nutrient plants.

**Control sequence.**

1. **Mulch heavily** to reduce soil splash onto lower leaves.
2. **Prune off lowest 12 inches of foliage** on tomatoes.
3. **Drip irrigation, not overhead.**
4. **Crop rotation** — no tomatoes in the same bed for 3 years.
5. **Copper or chlorothalonil spray** weekly during monsoon if disease appears early in the season.
6. **Resistant varieties** (*Iron Lady*, *Mountain Magic*).

### 8.5 Late blight

Caused by *Phytophthora infestans*. Devastating in humid climates; rare in the Dragoons because the dry mid-day breaks the disease cycle.

**Identification.** Olive-green or brown water-soaked lesions on leaves and stems. White fuzzy growth on undersides in humid weather. Fruit develops greasy brown lesions. Rapid death.

**Control.** If late blight appears (rare): remove and destroy all infected plant material; copper or chlorothalonil spray as preventive. Plant in well-spaced sunny beds with airflow.

### 8.6 Fusarium and Verticillium wilts

Two distinct soilborne fungi (*Fusarium oxysporum* and *Verticillium dahliae*) with similar symptoms. Both invade roots and plug vascular tissue.

**Identification.** One-sided yellowing of lower leaves on tomato (*Fusarium* often), bilateral on eggplant (*Verticillium* often). Wilting progresses upward despite adequate water. Brown discoloration in stem vascular tissue when split.

**Life cycle.** Persist 6+ years in soil. Spread by infected transplants, contaminated tools.

**Control sequence.**

1. **Resistant varieties.** “VF” (Verticillium + Fusarium resistant) or “VFN” (with nematode resistance) on tomato seed packets. Many modern hybrids.
2. **Long rotation** — at least 4 years before susceptible crops return to an infected bed.
3. **Solarization** of severely infested beds.
4. **No cure for infected plants** — remove and trash.

**8.7 Gray mold (Botrytis)**

*Botrytis cinerea*. The “noble rot” of wine grapes and the common cause of post-bloom decline on many fruits.

**Identification.** Fuzzy gray mold on flowers, fruit, leaves. Worst on dense canopy fruit zones. Tomato fruit develops “ghost spot” rings; grape clusters get bunch rot.

**Crops affected.** Strawberry, grape, tomato, peppers, beans (post-bloom), figs.

**Life cycle.** Spores overwinter on debris. Cool wet conditions favor development — paradoxically less of an issue in hot midsummer than in cool monsoon mornings.

**Control sequence.**

1. **Airflow.** Open canopies, space plants, prune dense foliage.
2. **Mulch** to keep splash off lower leaves.
3. **Sanitation.** Remove dead flowers and damaged fruit before they sporulate.
4. **Copper or chlorothalonil** preventive on grapes during monsoon bunch development.

**8.8 Septoria leaf spot**

*Septoria lycopersici* on tomato primarily. Small dark spots with light centers on lower leaves, progressing upward.

**Control.** Same as early blight — mulch, prune lower foliage, drip irrigation, rotation.

**8.9 Pythium root rot**

The dominant hydroponic-system pathogen. *Pythium* species are oomycetes that attack roots in warm reservoirs (above 72 °F).

**Identification.** Brown slimy roots in net pots; sour smell from reservoir; wilting despite full reservoir.

**Control sequence.** See **Guide 2 §8** and **Guide 3** for full protocol.

1. **Drop reservoir temperature below 72 °F.** Bury, insulate, shade.
2. **Flush system, replace media** if roots are brown.

3. **Hydrogen peroxide** at 3 ml/gal of 3% — dissolves bio-film, oxygenates root zone.

### 8.10 Other fungal issues

| Disease                            | Pathogen                               | Crops                 | Key control                                       |
|------------------------------------|----------------------------------------|-----------------------|---------------------------------------------------|
| Apple scab                         | <i>Venturia inaequalis</i>             | Apple                 | Resistant varieties, sanitation; rare in Dragoons |
| Brown rot                          | <i>Monilinia</i> spp.                  | Stone fruit           | Copper at bloom; thin for airflow                 |
| Fire-blight<br>(bacterial; see §9) | <i>Erwinia amylovora</i>               | Apple, pear           | Prune 12" below damage                            |
| Anthracnose                        | <i>Colletotrichum</i> spp.             | Tomato, pepper, beans | Sanitation, crop rotation                         |
| Damping-off                        | <i>Pythium</i> ,<br><i>Rhizoctonia</i> | Seedlings             | Sterile seed-starting medium, airflow             |

## 9 · Bacterial diseases

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*Bacterial wilt · Pierce's disease · fireblight · bacterial speck/spot · soft rot*

Bacterial diseases are less common than fungal in the Dragoons but harder to control. Most have no chemical cure — the management is prevention (resistant varieties, vector control, sanitation) and removal of infected material.

### 9.1 Bacterial wilt of cucurbits

*Erwinia tracheiphila*. The reason cucumber beetle is the Dragoons signature cucurbit pest.

**Identification.** Sudden wilt of a cucumber, melon, or squash vine despite adequate moisture. Cut a stem and a sticky stream of bacterial ooze pulls between the cut faces when separated. Death within 7–14 days of first symptoms.

**Crops affected.** Cucumber and melon especially; squash and zucchini less commonly.

**Life cycle.** Overwinters in cucumber beetle gut. Transmitted when beetle feeds on a healthy plant.

**Control.** No cure once infected. Management is vector control — see **§5.4** for cucumber beetle protocol, and **Guide 7 §5.5** for the full cucurbit protocol.

### 9.2 Pierce's disease

*Xylella fastidiosa*. Bacterial disease of grapes and many other plants, vectored by xylem-feeding leafhoppers (sharpshooters).

**Identification.** Marginal leaf scorch on grape (yellow to brown drying from the leaf edge inward, with a green-yellow border). Progressive vine decline over 2–5 years.

**Status in the Dragoons.** Pierce's disease is essentially absent above 4,500 ft elevation. The bacterium does not survive Dragoons winter cold; vector populations are limited. The threat lies at lower-elevation Cochise sites. See **Guide 5 §1** for the elevation-rule logic.

**Control.** Site selection is everything — plant grapes above 4,500 ft. At lower elevations, vector control with kaolin clay and insecticidal soap helps, but the disease is functionally untreatable once established.

### 9.3 Fireblight

*Erwinia amylovora*. The dominant bacterial disease of apple and pear in the Dragoons. Moderate pressure here — drier than Pacific Northwest pear country but a real concern in monsoon years.

**Identification.** “Shepherd's crook” — blackened bent tips on branches; shoot tips

look scorched. Cankers (dark sunken bark patches) on larger branches. Bacterial ooze in warm wet weather.

**Crops affected.** Apple, pear, and quince. Asian pears are much more resistant than European pears.

**Life cycle.** Bacteria overwinter in cankers; spread by rain and insects during bloom. Worst in warm wet springs.

**Control sequence.**

1. **Resistant varieties.** *Liberty, Pristine, Enterprise* apples; *Shinseiki, Hosui, Magness* pears.
2. **Prune in dry weather.** Cut 12 inches below visible damage; sterilize pruners between every cut (10 % bleach or 70 % alcohol).
3. **Avoid heavy nitrogen** — succulent growth is more susceptible.
4. **Copper or streptomycin spray at bloom** in severe-pressure years.

See **Guide 9 §7** for the full pome-fruit protocol.

## 9.4 Bacterial speck and spot

*Pseudomonas syringae* (speck) and *Xanthomonas* species (spot). Cool wet spring weather diseases on tomato and peppers.

**Identification.** Small black spots with yellow halos on leaves and fruit. Fruit spots are small, dark, often scabby.

**Control.**

1. **Disease-free seed** — these bacteria spread on seed.
2. **Drip irrigation, not overhead.**
3. **Copper spray** weekly during cool wet spring.
4. **Crop rotation.**

## 9.5 Soft rot

*Erwinia carotovora* and related species. Causes wet, foul-smelling rot of stored or wounded vegetables — onions, potatoes, cabbage heads, carrots, sweet peppers.

**Control.** Prevention is everything: handle gently at harvest, cure properly, store dry. Once started, the rot spreads through the storage container.

## 10 · Viral diseases

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*Tomato/tobacco mosaic · curly top · TSWV · cucumber mosaic*

Viral diseases have no cure. Management is vector control (the insect that carries the virus), resistant varieties, and removal of infected plants. All of them are common enough in the Dragoons that the home grower will encounter at least one in a typical season.

### 10.1 Tomato/tobacco mosaic virus (TMV/ToMV)

Mosaic-pattern yellowing on leaves; distorted growth. Vectored mechanically (on hands, tools, clothing — anyone who smokes tobacco can transfer ToMV from cigarette to plant). Persistent in soil.

#### Control.

1. **Resistant varieties** — most modern hybrid tomatoes carry the *Tm-1* or *Tm-2* resistance gene.
2. **Wash hands before handling tomatoes.** Especially after smoking.
3. **Remove infected plants** within 48 hours. Trash, don't compost.
4. **Sterilize tools** with 10 % bleach between plants when pruning.

### 10.2 Curly top virus (BCTV)

Beet curly top virus. Vectored by the beet leafhopper. Year-dependent severity in the Dragoons — devastating in some years, absent in others.

**Identification.** Stunted, upward-cupped leaves with yellowed veins. Plants stop growing and produce no fruit. Affects tomato, bean, beet, spinach, pepper.

#### Control.

1. **Row cover** at transplant in known bad years.
2. **Resistant varieties** — fewer than for TMV, but some exist (*Roza* tomato is curly-top tolerant).
3. **Remove infected plants** — they're not coming back.
4. **Plant earlier** — establish the crop before the May-June peak of leafhopper migration.

### 10.3 Tomato spotted wilt virus (TSWV)

Vectored by western flower thrips. Causes a wide range of symptoms — bronzing of leaves, ringspots on fruit, stunting.

#### Control.

1. **Resistant varieties.** Most quality tomato hybrids now include "SW" (TSWV) re-

sistance.

2. **Thrips control** — reflective mulch, hose blast, spinosad.
3. **Remove infected plants** within 48 hours.

#### 10.4 Cucumber mosaic virus (CMV)

Vectored by aphids. Wide host range — cucurbits, peppers, tomatoes, ornamentals.

**Identification.** Yellow mosaic pattern on leaves; distorted fruit (cucumber fruit becomes warty and bitter). Stunted growth.

#### Control.

1. **Aphid control** — see §4.1.
2. **Resistant varieties** in cucumber (*Marketmore 76*, *Diva*).
3. **Remove infected plants.**

#### 10.5 Reference — viral diseases

| Virus           | Vector                | Hosts                    | Severity       | Control                             |
|-----------------|-----------------------|--------------------------|----------------|-------------------------------------|
| TMV/ToMV        | Mechanical            | Tomato, pepper, eggplant | Moderate       | Resistant varieties, hygiene        |
| Curly top       | Beet leafhopper       | Tomato, bean, beet       | Year-dependent | Row cover, resistant varieties      |
| TSWV            | Western flower thrips | Tomato, pepper, lettuce  | Moderate       | Resistant varieties, thrips control |
| Cucumber mosaic | Aphids                | Cucurbits, peppers       | Moderate       | Resistant varieties, aphid control  |

## 11 · Physiological disorders

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*Blossom-end rot · hollow stem · tipburn · buttoning · sunscald · splitting*

Physiological disorders look like disease but aren't caused by pathogens. They're caused by environmental stress, nutrient imbalance, or cultivar limitations. The Dragoons climate produces a particular set of them — wide diurnal swings, intense sun, dry air, alkaline soil, monsoon rain shock — and several are major causes of crop loss that get misdiagnosed as disease.

### 11.1 Blossom-end rot (BER)

Dark sunken spot on the blossom end of tomato, pepper, eggplant, squash, watermelon. Cause: calcium not reaching the developing fruit — almost always a *delivery* problem (irregular watering, root damage, pH imbalance) rather than a *supply* problem (true calcium deficiency in soil or nutrient solution).

**Soil control.** Consistent watering. Mulch to even out soil moisture. Soil pH 6.0–7.0 (alkaline Cochise water is usually fine for calcium availability). Avoid excessive nitrogen, which dilutes calcium uptake.

**Hydroponic control.** See **Guide 4 Part 1**. Maintain pH 5.8–6.2, EC below 3.0, and mix calcium nitrate last in nutrient prep. Almost always a dosing or pH problem, not a Ca deficit.

### 11.2 Tipburn

Brown necrotic margins on inner leaves of lettuce, cabbage, brussels sprouts, and other heading crops. Caused by calcium failure during rapid growth, often combined with heat stress. Same root mechanism as BER — calcium is the most water-mobility-dependent macronutrient.

**Control.** Even watering. Avoid heat stress (shade cloth in late spring); choose tipburn-resistant varieties (modern lettuce hybrids commonly are).

### 11.3 Hollow stem

Hollow cavities in the main stem and floret stems of broccoli and cauliflower. Caused by boron deficiency, often combined with very rapid growth (high nitrogen + plenty of water + warm soil).

**Control.** Soil test for boron. Side-dress with boron only if test shows deficit — boron toxicity is easy to cause. Slow growth slightly with moderate nitrogen.

### 11.4 Buttoning

Premature, tiny head formation on brassicas — broccoli or cauliflower that produces a marble-sized head and gives up. Caused by cold stress on young transplants (more

than 10 days below 50 °F before establishment).

**Control.** Don't transplant brassicas before the soil is consistently above 60 °F. Don't expose seedlings to early frost.

### 11.5 Sunscald

White or tan papery patches on the sun-facing side of peppers, tomatoes, apples, melons, even tree trunks. Caused by direct intense sun on tissue not previously shaded.

**Control.**

1. **Don't strip foliage** above ripening fruit; leave shade on the south and west sides.
2. **30 % shade cloth** during the worst June heat.
3. **Orient rows north-south** for even sun exposure.
4. **White latex trunk paint** on young fruit trees (50/50 with water).

### 11.6 Fruit splitting / cracking

Sudden splitting of ripe or near-ripe tomatoes, melons, grapes, pomegranates, figs after a heavy monsoon rain. The fruit took up water faster than the skin could expand.

**Control.**

1. **Pick fruit at "color break"** before a forecast heavy rain.
2. **Mulch heavily** to even out soil moisture.
3. **Drip irrigation** rather than long deep weekly soaks (the latter pattern primes splitting when rain hits).
4. **Crack-resistant varieties** (*Juliet*, *Mountain Pride*, *Sungold* among tomatoes; *Suri Sahel*, *Wonderful* among pomegranates).

### 11.7 Other physiological problems

| Disorder            | Crops                        | Cause                       | Control                                     |
|---------------------|------------------------------|-----------------------------|---------------------------------------------|
| Catfacing           | Tomato                       | Cold during flower set      | Plant after consistent 55 °F+ nights        |
| Bolt-before-set     | Brassicas, lettuce, cilantro | Heat stress / day length    | Plant in proper season; bolt-slow varieties |
| Cat-eye / zippering | Tomato                       | Cold during set             | Wait for warmer nights                      |
| Sun-scorched fruit  | Peppers, tomato              | Direct sun, dehydration     | Leave shading foliage                       |
| Tomato leaf roll    | Tomato                       | Heat stress, often harmless | Mulch, irrigation                           |

| Disorder     | Crops  | Cause              | Control       |
|--------------|--------|--------------------|---------------|
| Hollow heart | Potato | Inconsistent water | Even watering |

**Most “disease” problems in the Dragoons are actually physiological.**

The wide diurnal swings, intense sun, dry air, and monsoon rain shock cause more visible damage than any pathogen except powdery mildew and peach leaf curl. Before reaching for a fungicide or assuming a virus, check water consistency, pH, soil temperature, and recent weather. Most often the answer is “mulch better and water more evenly.”

## 12 · Small mammals

*Packrat · gopher · ground squirrel · jackrabbit · cottontail*

The Dragoons have a richer small-mammal community than most American gardening regions. The four below are the ones that pressure gardens with any regularity.

### 12.1 Packrat (woodrat)

*Neotoma albigula* (white-throated woodrat) is the species you'll meet most often. The packrat is the iconic Cochise County mammal — a stocky brown rodent the size of a small squirrel, with a furry (not naked) tail. Builds large stick-and-debris nests (middens) in cholla, prickly pear, woodpiles, and outbuildings.

**Identification.** Stick middens 2–4 ft across, often with bones, glass, foil, and shiny objects woven in. Chewed irrigation lines. Squash and melon fruit gnawed with tooth marks larger than a mouse but smaller than a rabbit. Tomato fruit half-eaten.

**Damage in the garden.** Chews drip lines (they're attracted to water flow). Eats squash, melon, tomato fruit. Strips bark from young trees in winter for moisture. Nests in outbuildings, sheds, vehicles.

#### Control.

1. **Habitat reduction.** Move woodpiles, junk piles, dead cholla, and brush away from the garden. The packrat lives where its midden goes — eliminate midden sites near the garden.
2. **Snap traps** baited with peanut butter, set near runs and at midden entrances. The largest snap trap (rat-sized, not mouse-sized) is what you want.
3. **Live traps** if you prefer relocation — but they'll come back from anywhere under a mile, so relocation needs to be far.
4. **Don't poison.** Secondary poisoning kills the snakes, hawks, and owls that handle packrats for free.
5. **Cholla and prickly pear within 50 ft of the garden** are prime midden habitat — clear them or accept the trade-off.

#### LOCAL TIP

The packrat is opportunistic about water sources. The single fastest way to attract them to your garden is to leave a slow drip on a hose bib overnight, or to have a leaking irrigation valve. Walk the lines weekly during the dry season and fix any drip you didn't intend.

## 12.2 Gopher

Pocket gopher (*Thomomys bottae*) — solitary, tunnel-dwelling rodent. Active year-round in the Dragoons. Lives underground, rarely seen above; identified by characteristic fan-shaped soil mounds.

**Damage.** Eats roots of trees, perennials, root crops. Can kill a young fruit tree in a single season — symptoms are sudden wilt and decline with no above-ground cause, then the trunk wobbles when pushed because the roots are gone.

### Control sequence.

1. **Wire baskets at planting.** Quarter-inch galvanized hardware cloth shaped into a 24-inch cube around the root ball when planting any tree or perennial. Standard practice in the Dragoons; absence is a major preventable loss.
2. **Active trapping.** Macabee or Cinch traps set in fresh mounds when gophers are detected. Two traps in each tunnel, facing opposite directions.
3. **Snake habitat.** A bull/gopher snake population in the yard is the longest-term control. See §15.
4. **Don't bait with strychnine or anticoagulant grain bait** in orchard soil — secondary poisoning of hawks, owls, and dogs is a serious risk.

## 12.3 Ground squirrels

Round-tailed ground squirrel (*Spermophilus tereticaudus*) and rock squirrel (*Spermophilus variegatus*) — both present in the Dragoons. Burrowing diurnal rodents; rock squirrels especially are bold and persistent.

**Damage.** Eat fruit, nuts, melons, sweet corn, sometimes tomatoes. Strip seeds from sunflowers. Tunnel into garden beds. Rock squirrels can climb fruit trees.

### Control.

1. **Trapping** with snap traps or live traps; rebait daily.
2. **Hardware cloth burial** at fence line — 12 inches below grade prevents tunnel entry.
3. **Owl boxes.** Encourage great horned owl on the property; one owl can eat 1,000+ rodents per year.

## 12.4 Jackrabbit and cottontail

Two species, different management:

- **Black-tailed jackrabbit** (*Lepus californicus*) — large (5–8 lb), long ears, leaps 6+ ft. Cuts through young trees and strips bark in winter. Can clear a 4-ft fence.
- **Desert cottontail** (*Sylvilagus audubonii*) — smaller (2–3 lb). Eats lettuce, peas, beans, brassica seedlings, low fruit.

**Damage.** Bark stripping on young trees in winter (jackrabbit). Seedling and low-leaf grazing (both). Sharp 45-degree pruner-cuts on stems are the classic rabbit signature.

**Control.**

1. **Welded-wire fence**, 5 ft minimum for jackrabbits, 4 ft for cottontails. Bury 6 inches deep or pin tight to ground.
2. **Hardware-cloth tree tubes** around young trunks, lower 24 inches, in winter.
3. **Owl, hawk, coyote** populations all eat rabbits — leave habitat for predators.

## 13 · Large mammals

*Javelina · deer · mule deer*

### 13.1 Javelina — the Cochise large-mammal threat

*Pecari tajacu* — collared peccary. The Dragoons signature large mammal, and the single most important wildlife threat to fruits, melons, and unfenced gardens.

**Plant the fence before the trees.** A herd that learns where the figs, pomegranates, or melons are will return every year for the rest of those plants' lives. The unfenced backyard orchard in the Dragoons is a javelina restaurant. Exclusion before they discover the food is dramatically easier than removal after.

**Identification.** Pig-like, 30–60 lb adults, gray-black with a pale collar. Travel in herds of 6–15. Mostly nocturnal but visible at dusk and dawn. Strong musky scent at scent posts and bedding areas.

**Damage.** Eats melons, figs, pomegranates, sweet potatoes, prickly pear fruit, almost anything ripe. Pushes over small trees to reach fruit. Strips bark from young fruit trees for moisture. Roots up bulbs and root crops. Tears apart compost piles.

**Favorite targets.** Figs (especially ripe), pomegranates (Wonderful especially), melons of all kinds, sweet potatoes when harvested, peaches that drop to the ground.

#### Exclusion — what works:

1. **5-ft welded-wire fence** as a minimum perimeter. T-post every 6 ft, fence buried or pinned at ground level. Javelina dig under more often than they climb.
2. **6-ft fence with one electrified strand** at 12 inches above ground — the height of a javelina nose. A 0.5-joule charger and a single hot wire is dramatically more effective than 4 ft of unmanaged wire alone.
3. **Trunk wraps.** Corrugated drain pipe (slit lengthwise, wrapped around the lower 24 inches of trunk) on every young fruit tree, refreshed annually.
4. **Sanitation.** Don't leave dropped fruit on the ground. Don't compost fruit waste at the orchard edge. Don't leave fallen fig clusters under the tree overnight.
5. **Motion-activated sprinklers** have very short-lived effect; javelina habituate within 1–2 weeks.

**What doesn't work.** Smelly deterrents (mothballs, ammonia, urine sprays) — short-lived. Most “natural” repellents — javelina habituate fast. Low fences (under 4 ft) — they walk through or under. Dogs alone — a single dog rarely deters a herd; see §16.

**WARNING**

**Do not approach a herd.** Javelina are not aggressive but will defend young or trapped animals. They have sharp tusks and run fast. If a herd is in your yard, make noise from a distance and let them leave on their own. Call **Arizona Game and Fish** for persistent problems; do not shoot — javelina are a regulated game species and require a permit.

**13.2 Deer**

White-tailed deer (*Odocoileus virginianus*) at higher Dragoon elevations; mule deer (*Odocoileus hemionus*) at lower. Both browse hard on most garden plants.

**Damage.** Strips foliage from fruit trees, peppers, beans, tomatoes. Stripped bark in winter. Worse in drought years when wild forage is poor.

**Control.**

1. **8-ft fence is the only reliable exclusion.** Lower fences (6 ft) work some places but mule deer can clear 6 ft.
2. **Two-fence system** — two 5-ft fences set 4 ft apart can work where 8-ft is prohibited; deer won't jump into the narrow space.
3. **Tree tubes** for individual orchard trees in fenced gardens.
4. **Motion-activated sprinklers** — short-term effect (4-8 weeks before habituation).
5. **Liquid Fence and similar repellents** — moderate effect, must be reapplied after rain.

## 14 · Birds

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*Netting · sparrow attacks · dove pressure · the harvest-first strategy*

Bird pressure in the Dragoons is real but selective. Most birds are not pests; some flocking species hit specific crops hard at specific times.

### 14.1 The species that matter

- **Curve-billed thrasher** (*Toxostoma curvirostre*) — eats figs, peaches, apricots, tomatoes. Year-round resident.
- **Northern mockingbird** (*Mimus polyglottos*) — same target list as thrasher. Year-round.
- **House finch** (*Haemorhous mexicanus*) — strips young plantings of leaves, eats berries. Year-round.
- **House sparrow** (*Passer domesticus*) — attacks newly seeded beds, strips seedlings. Worst in spring.
- **White-winged dove** (*Zenaida asiatica*) — eats grain, sunflower, sweet corn. Summer migrant.
- **Mourning dove** (*Zenaida macroura*) — same as white-wing.
- **Scrub jay, gray-breasted jay** — opportunistic; eat almonds, sometimes fruit.
- **Cedar waxwing** (*Bombycilla cedrorum*) — flocks descend on stone-fruit trees just before harvest.

### 14.2 Defenses

1. **Bird netting** — 3/4 inch mesh, draped over fruiting trees or vines just before veraison (first color change). The single most effective tool. Drape, don't tent — drape allows physical contact at canopy edges, where birds learn quickly there's no food. Tent-style structures with airspace let birds get inside and trap them (mortality + crop loss).
2. **Drape, then leave.** Once netted, don't lift for partial harvests; lift only on harvest morning. Partial coverage teaches the birds where to enter.
3. **Harvest-first strategy on figs.** Visit the tree daily during ripening. Pick fruit at just-ripe before birds find it. A tree visited daily often loses very little; a tree left alone for three days can lose 30 % in one bad weekend.
4. **Closed-eye fig varieties** (*Celeste*) resist bird entry compared to open-eye varieties (*Mission, Brown Turkey*).
5. **Reflective tape, fake owls, mylar balloons** — minor effect, birds habituate within 1-2 weeks.
6. **Avoid bird mortality.** Use small-mesh netting (1/4 to 3/4 inch). Larger mesh tangles wings. Inspect netting daily during use — birds occasionally still get caught and need release.

### 14.3 Sparrow and dove pressure on bare beds

Newly seeded beds — beets, carrots, lettuce — get attacked by sparrows and doves at germination. Common in spring.

#### Control.

1. **Floating row cover** until plants are 3 inches tall.
2. **Bird tape or scare balloons** for short-term protection (effective for 1-2 weeks before habituation).
3. **Pre-germination indoors.** Pre-sprout seeds and transplant — bypasses the seedling-vulnerability window.

### 14.4 Sweet corn — the dove and crow problem

Sweet corn at silking attracts white-winged doves and Chihuahuan ravens.

#### Control.

1. **Plant in a block, not a row** — denser plantings reduce per-plant access.
2. **Bird tape on tassels.**
3. **Tight-husked varieties** (*Country Gentleman*, *Silver Queen*) resist bird entry to the ear.

#### WARNING

**Bird netting can kill.** Snakes, lizards, and birds themselves all get tangled in poorly maintained or oversized-mesh netting. Use small-mesh netting (1/4 to 3/4 inch). Inspect netting daily. Remove and store netting immediately after harvest — don't leave it up year-round. The wildlife mortality from chronic netting is real and avoidable.

## 15 · Reptiles as garden allies

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*Gopher snake · kingsnake · whipsnake · why to leave them alone*

The Dragoons are home to a remarkable reptile diversity, and most of it is on your side. The non-venomous snakes in particular are the longest-running rodent and gopher control in the garden. Learning to identify them and leaving them alone is one of the highest-return habits a Cochise County gardener can build.

### 15.1 The gopher snake — your most useful reptile

**Sonoran gopher snake** (*Pituophis catenifer affinis*) — also called bull snake. Tan to yellow with dark brown blotches, 3–6 ft long, sometimes longer. Active diurnal and crepuscular.

**Why you want one in the yard.** Eats pocket gophers (the name is literal), packrats, ground squirrels, mice, young rabbits. A single resident gopher snake handles more rodents in a summer than any trap, poison, or terrier ever could. Permanent residents are common in Cochise County yards with adequate shelter.

**How to recognize.** Long, slender. Yellow-tan with squared brown blotches running the length of the back. Pointed head, **round pupils**, no rattle. When threatened, may flatten its head, vibrate its tail in dry leaves to mimic a rattlesnake, and hiss — completely harmless, designed to scare predators away.

**The rattlesnake confusion.** Gopher snakes often *mimic* rattlesnake threat display. Look for: (1) **head shape** — gopher snake has a long pointed head, rattlesnake has a triangular wide head, (2) **tail** — gopher snake has a tapered pointed tail, rattlesnake has the characteristic segmented rattle, (3) **pupils** — gopher snakes have round pupils, rattlesnakes have vertical slit pupils. From a safe distance the tail tells you the most.

**How to encourage.** Leave brush piles, woodpile edges, and rock features at the property edge. Provide shelter — a sheet of plywood on the ground in a quiet corner is a popular bull-snake refuge. Don't kill any non-venomous snake in the yard. Don't use rodenticides that secondary-poison snakes through their prey.

### 15.2 Kingsnake

**Sonoran mountain kingsnake** (*Lampropeltis pyromelana*) and **California kingsnake** (*Lampropeltis californiae*) — both present in the Dragoons. Kingsnakes eat rodents and **other snakes including rattlesnakes**. The mountain kingsnake is the brilliant red-black-and-white-banded snake you'll occasionally see in the Dragoons.

**Why you want one.** Kingsnakes are immune to rattlesnake venom and actively hunt them. A resident kingsnake reduces rattlesnake encounter risk around the house.

**How to recognize.** California kingsnake is banded black and white (sometimes black and yellow). Sonoran mountain kingsnake has red-black-white bands — the order matters: “**red touch black, friend of Jack; red touch yellow, kill a fellow**” distinguishes the harmless mountain kingsnake from the venomous coral snake (which has red touching yellow — but the western coral snake is rare in the Dragoons region).

### 15.3 Other harmless snakes you might see

- **Coachwhip** (*Coluber flagellum*) — fast diurnal, slender, pink-red or tan; eats lizards and small mammals.
- **Western patch-nosed snake** (*Salvadora hexalepis*) — small, fast; eats lizards.
- **Glossy snake** (*Arizona elegans*) — nocturnal, eats rodents.
- **Lyresnake, night snake** (*Hypsiglena*) — small, rear-fanged, mildly venomous but no threat to humans.

### 15.4 The one snake to identify and respect

**Western diamondback rattlesnake** (*Crotalus atrox*) — present throughout Cochise County. Triangular head, segmented rattle, vertical pupils. Most active April–October. Will rattle as a warning if approached.

#### The encounter protocol.

1. **Stop and back away slowly.** Give the snake at least 6 ft of space.
2. **Don’t kill it.** Even rattlesnakes serve their ecological role, and killing one tends to bring others (the territory remains, the prey base remains).
3. **Call a relocater.** In the Sierra Vista / Tombstone / Bisbee area, several local relocaters will move a snake for free; in remoter parts of Cochise County, contact **Arizona Game and Fish** for advice.
4. **Train pets.** Rattlesnake-aversion training for dogs is widely available in Cochise County and dramatically reduces the bite risk.

#### LOCAL TIP

**The most important reptile fact for a Dragoons gardener:** the snake in the woodpile is almost certainly a gopher snake, not a rattlesnake. Learn the tail difference — pointed tip versus segmented rattle — and you’ll recognize the right snake at 10 ft. A resident gopher snake is the cheapest, longest-lasting rodent control system available, and the kingsnake (rare but present) adds rattlesnake control on top of that.

### 15.5 Lizards as allies

- **Desert spiny lizard, side-blotched lizard, whiptail** — all eat insects (grasshoppers, beetles, occasionally hornworm larvae). Encourage by leaving sunny rocks

and rock-pile habitat.

- **Greater earless lizard** — fast, common, harmless.
- **Gila monster** (*Heloderma suspectum*) — venomous but slow and not aggressive. Protected by state law. Leave alone if seen.

## 16 · Dogs as garden security

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*Breed considerations · training · produce safety*

A dog on the property is the single most effective wildlife deterrent for some pressure types. Not all dogs and not all situations, but the right dog handles javelina, deer, jackrabbit, and packrat presence by simple deterrence.

### 16.1 What a dog can do

- **Javelina deterrence.** A dog actively patrolling — barking, occasionally chasing to the fence — keeps most javelina herds out of the immediate yard. A herd will sometimes test, but rarely settles.
- **Deer deterrence.** Less reliable; deer pressure depends heavily on local population density. A dog helps but doesn't replace fencing.
- **Rabbit and ground squirrel deterrence.** Most dogs catch or chase rabbits and squirrels; over weeks, the rabbit population learns to feed elsewhere.
- **Packrat deterrence.** Some dogs are hunters; others ignore packrats. Terriers and small hunters are best at this.

### 16.2 What a dog can't do

- Doesn't replace fencing for an orchard or vineyard. The dog isn't watching 24 hours; the fence is.
- Doesn't help with birds. Most dogs don't engage with birds reliably.
- Doesn't help with insect pests, obviously.
- Doesn't help much with snakes — and an untrained dog *into* a rattlesnake is a serious veterinary emergency.

### 16.3 Breeds suited to the Dragoons

The right dog depends on the workload, the size of the property, and the climate (the Dragoons reach 100 °F in June and 18 °F in January).

- **Heat-tolerant working breeds** — Australian shepherd (with regular shade), Anatolian shepherd, Karelian bear dog. These are perimeter and livestock-guardian breeds.
- **Heat-tolerant smaller hunters** — Jack Russell terrier (packrat / rodent), rat terrier, fox terrier. Smaller, more nimble, good in dense plantings.
- **Avoid heavy-coated breeds** without serious shade and water. A Newfoundland is miserable in June Dragoons.

### 16.4 Training for produce safety

A garden-trained dog learns to:

1. **Not dig in beds.** Train with “off” command and consistent correction at the first

attempt. A dog that learns to dig in a tomato bed in week one will dig forever.

2. **Not eat tomatoes, melons, peppers off the vine.** Many dogs naturally avoid them; some develop a habit. Correct early.
3. **Patrol the fence line.** Walk the perimeter together early — the dog learns the boundary as its territory.
4. **Rattlesnake aversion.** Worth the one-day class for any Dragoons dog. Local trainers offer this annually around Sierra Vista and Tucson.

#### **WARNING**

**Some garden plants are toxic to dogs.** Tomatoes (foliage, green fruit), onion family (all parts), grapes and raisins, rhubarb leaves, some mushrooms. Most dogs avoid them naturally but supervise new dogs in the garden initially. Keep onion and garlic harvests off the ground where the dog can reach.

## 17 · Fencing & exclusion

*What works for each animal · cost · siting · sub-grade burial*

Fencing is the single largest infrastructure investment in pest management. A well-sited 8-ft deer fence around a half-acre orchard costs \$2,500–4,000 in materials and 30–60 hours of work; the same orchard fence-free averages 50 %+ wildlife losses per year, indefinitely. The math favors fencing almost always.

### 17.1 Animal-by-animal exclusion requirements

| Animal            | Minimum fence                                                     | Notes                            |
|-------------------|-------------------------------------------------------------------|----------------------------------|
| Cottontail rabbit | 3-ft welded wire, pinned to ground                                | 1-inch or smaller mesh at bottom |
| Jackrabbit        | 5-ft welded wire                                                  | 1-inch mesh; bury or pin         |
| Ground squirrel   | 4-ft + 12-inch buried apron                                       | Hardware cloth on burial portion |
| Pocket gopher     | Hardware-cloth basket at planting                                 | Per tree / perennial             |
| Packrat           | Hardware cloth at fence skirt                                     | Move woodpile / cholla habitat   |
| Javelina          | 5-ft welded wire minimum; 6-ft + electric strand at 12" preferred | Bury or pin tight to ground      |
| Deer              | 8-ft fence                                                        | Or 2× 5-ft fences set 4 ft apart |
| Birds             | Bird netting over fruiting tree/vine                              | Drape, not tent; 3/4-inch mesh   |

### 17.2 Material specifications

**Welded wire** (galvanized, 14 or 16 gauge) is the workhorse fencing material. 2x4-inch mesh for most uses; 1-inch mesh at the bottom 18 inches if rabbits or squirrels are in play. Roll widths typically 4 ft, 5 ft, or 6 ft.

**Hardware cloth** (1/4 or 1/2 inch galvanized mesh) for buried portions, tree baskets, gopher exclusion. More expensive but indispensable where it matters.

**T-posts** every 6 ft for typical garden fence; every 8 ft for heavier orchard fence with bigger gauge wire. Drive posts 18 inches into ground.

**Electric strand** — 14-gauge poly wire, 0.5 to 2 joule charger, single strand at 12 inches off ground for javelina. Don't use barbed wire — wildlife mortality is high and the deterrent value isn't better than smooth wire.

### 17.3 Siting considerations

1. **Map the runs.** Animals travel on predictable paths — wash bottoms, ridge tops, fence lines, dirt road edges. Site your fence to **block the run**, not at random.
2. **Gate placement.** Put gates where they're not on the run. A gate on the deer trail is a deer trail with a gate.
3. **Don't fence in a hawk corridor.** Open shooting lanes for raptors are good for rodent control. A bowed-top deer fence with overhead wire is the worst case.
4. **Tree-line edges.** Many predators (and some pests) move along treelines. Keep at least a 4 ft mowed strip between woods and garden.
5. **Drainage.** Don't site fence on a wash centerline. Build gabion or rip-rap if you must cross a wash.

### 17.4 Sub-grade burial

For animals that dig under (javelina, ground squirrel, gopher, rabbit):

- **Apron method.** Bury 12 inches of hardware cloth at 90-degree angle outward from the fence base. When animal tries to dig, hits the apron and turns back.
- **Skirt method.** Pin fence wire tight to ground with landscape staples every 12 inches. Less expensive, less reliable than apron.
- **Trench method.** Bury 12-18 inches of fence vertically below grade. Most expensive but most secure.

### 17.5 Cost ranges (2026 dollars)

| Fence type                                              | Linear-foot cost (materials) | Labor (DIY hours / 100 ft) |
|---------------------------------------------------------|------------------------------|----------------------------|
| 4-ft welded wire, T-posts                               | \$4-6                        | 4-6                        |
| 5-ft welded wire, T-posts                               | \$5-7                        | 5-7                        |
| 6-ft welded wire, T-posts                               | \$7-10                       | 6-8                        |
| 8-ft deer fence, posts                                  | \$12-18                      | 8-12                       |
| Hardware cloth (3 ft tall, buried apron)                | +\$5-8                       | +3-5                       |
| Single electric strand                                  | +\$1-2                       | +2 (plus charger \$80-200) |
| Tree-individual basket (1/2" hardware cloth, 4 ft tall) | \$25-40/tree                 | 1 hr/tree                  |

For a typical 100 ft × 100 ft (400 ft perimeter) garden:

- Cottontail-only 3-ft fence: ~\$1,600 in materials.
- Jackrabbit + javelina 5-ft + electric: ~\$2,800 in materials.
- Deer-rated 8-ft fence: ~\$5,500 in materials.

- Tree baskets for 20 fruit trees: ~\$600.

**LOCAL TIP**

**The Cochise County fencing pattern that works:** a 5-ft welded wire perimeter with a single electric strand at 12 inches (javelina + most rabbits + some deer), individual hardware-cloth tree baskets on every fruit tree (gopher + bark-stripping rabbit), and 3/4-inch bird netting on tree canopies during fruiting only. This sits at roughly half the cost of an 8-ft deer fence and handles 90 % of typical Dragoons wildlife pressure. The exception is heavy deer pressure on the western Dragoons foothills, where the 8-ft fence is genuinely necessary.

## 18 · Beneficial insects & how to attract them

*Parasitic wasps · lacewings · ladybugs · syrphid flies · insectary strips*

The beneficial insect community is the long-term solution to most pest pressure. A garden that has them needs less spraying. A garden that doesn't, never quite gets ahead. This chapter is about how to invite them in and keep them around.

### 18.1 The major beneficials

| Beneficial                                                                      | Targets                    | What it looks like                                     | How to attract                                |
|---------------------------------------------------------------------------------|----------------------------|--------------------------------------------------------|-----------------------------------------------|
| Lacewing<br>( <i>Chrysoperla</i> )                                              | Aphids, mites, thrips      | Green delicate adults; brown alligator-shaped larvae   | Cilantro, dill, fennel flowers; don't spray   |
| Ladybug<br>( <i>Hippodamia</i> ,<br><i>Harmonia</i> )                           | Aphids, mealybugs          | Red/orange round adults; black/orange alligator larvae | Pollen flowers, overwintering shelter         |
| Syrphid fly<br>( <i>Toxomerus</i> ,<br><i>Eupeodes</i> )                        | Aphids                     | Hovering bee-mimic adults; gray-green larvae           | Sweet alyssum, yarrow, dill                   |
| Parasitic wasp<br>( <i>Cotesia</i> , <i>Aphidius</i> ,<br><i>Trichogramma</i> ) | Caterpillars, aphids, eggs | Tiny (1–5 mm) wasps; rarely seen                       | Small-flower forage (cilantro, dill, alyssum) |
| Predatory mite<br>( <i>Phytoseiulus</i> ,<br><i>Neoseiulus</i> )                | Spider mites               | Microscopic                                            | Avoid sulphur/broad-spectrum sprays           |
| Ground beetle                                                                   | Cutworms, slugs            | Glossy black running beetles                           | Mulch, stone piles                            |
| Spider                                                                          | Generalist                 | Various                                                | Leave webs in non-traffic areas               |
| Tachinid fly                                                                    | Caterpillars               | Bristly gray flies                                     | Same forage as parasitic wasps                |
| Assassin bug                                                                    | Generalist                 | Long-legged predator bugs                              | Mixed habitat                                 |
| Minute pirate bug                                                               | Thrips, mites, aphids      | Tiny (2 mm) black-white bug                            | Small flowers                                 |

### 18.2 Insectary strips — the canonical Dragoons mix

A 12 to 24-inch-wide flowering strip adjacent to the main beds is the single best beneficial-insect habitat. The Dragoons-appropriate mix:

| Plant                                         | Role                                 | Season           |
|-----------------------------------------------|--------------------------------------|------------------|
| Cilantro / coriander                          | Parasitic wasp forage when in flower | Spring + fall    |
| Dill                                          | Parasitic wasp + syrphid forage      | Spring-summer    |
| Fennel                                        | Long-season parasitic wasp forage    | Late spring-fall |
| Yarrow ( <i>Achillea</i> )                    | Lacewing + parasitic wasp forage     | Summer           |
| Sweet alyssum ( <i>Lobularia</i> )            | Syrphid fly forage (massive)         | Cool seasons     |
| Buckwheat                                     | Generalist forage                    | Summer           |
| Borage                                        | Bee forage + parasitic wasp          | Summer           |
| Bachelor's button ( <i>Centaurea</i> )        | Pollinator + lacewing                | Spring           |
| Native sunflower ( <i>Helianthus annuus</i> ) | Generalist                           | Summer-fall      |
| Black-eyed Susan ( <i>Rudbeckia</i> )         | Generalist                           | Summer-fall      |

The principle: **let things flower**. Cilantro that bolts is *good*. Dill gone to seed is *good*. A row of bolted brassicas in spring is some of the highest-quality parasitic-wasp forage available in the Dragoons. Don't pull the bolt before the wasps find it.

#### LOCAL TIP

The Dragoon native oaks (*Quercus emoryi* — Emory oak — and *Quercus arizonica* — Arizona white oak) are exceptional parasitic-wasp habitat. The complex bark, lichen cover, and seasonal small-insect populations support large wasp colonies. If you have native oaks on the property, leave them — they're doing more pest control than any spray you could buy.

### 18.3 The “never spray during bloom” rule

**Never spray pollinator forage in bloom.** Bees, native bees, and the beneficial-insect community are all most exposed when plants are flowering. Even “soft” sprays — soap, neem, spinosad — can harm them. The hard rule: if it's flowering and pollinators are visiting, don't spray. If you must intervene during bloom, hand-pick or water-blast only.

This is especially important for:

- **Brassicas in flower** (bolted, or seed crops). Spring brassica bloom is critical native-bee forage in the Dragoons.
- **Cucurbits in flower.** Squash bees (*Peponapis pruinosa*) are specialists that emerge with the first squash bloom.
- **Beans in flower.** Heavy bumble bee forage.

- **Stone fruit in bloom.** Peach bloom is one of the earliest spring forage events.
- **Native plants in bloom near the garden.** Mesquite, oak, manzanita, agave — all in the wild beneficial-insect supply chain.

### 18.4 Buying versus attracting

Most commercial beneficial-insect releases (ladybug packets, lacewing eggs, predatory mites) have **mixed track records** in open gardens — the insects often disperse within hours. They work in greenhouses and indoor production where the insects are confined.

For outdoor gardens, the better long-term return is on **habitat** rather than direct release. The native beneficial-insect community is already in the Dragoons — if you stop spraying and start flowering, they show up on their own.

The exceptions worth purchasing:

- **Predatory mites** for greenhouse / hydroponic systems with spider mite problems.
- **Trichogramma wasp cards** for moderate-scale corn earworm or codling moth pressure (timed release).
- **Beneficial nematodes** for soil-grub and root maggot problems (genuine effect when properly applied).

### 18.5 What kills beneficials

| Practice / spray                 | Beneficials harmed                                             |
|----------------------------------|----------------------------------------------------------------|
| Pyrethrin                        | Bees, wasps, lacewings, ladybugs, syrphids — almost everything |
| Carbaryl (Sevin)                 | Same                                                           |
| Imidacloprid (neonicotinoids)    | Bees, wasps especially                                         |
| Broad-spectrum insecticidal soap | Soft-bodied beneficials (lacewing larvae, syrphid larvae)      |
| Sulphur                          | Predatory mites                                                |
| Diatomaceous earth               | Ground beetles, some lacewing larvae                           |
| Heavy mowing                     | Ground habitat (ground beetles, spiders)                       |
| Bare-soil weed control           | Generalist predator habitat                                    |

Most of these *can* be used selectively without major harm — the rule is targeted, dusk-timed, not during bloom, not on flowering forage.

## 19 · Spray decision tree

*When to spray · what to spray · what NOT to spray · dusk timing*

This chapter is the synthesis of the rest of the guide. Most garden problems do not need a spray. When they do, the choice of spray matters. The framework below works from the gentlest, most targeted tool outward.

### 19.1 The decision sequence

When a pest or disease is detected, walk this sequence from the top. Stop at the first step that resolves the problem. Most garden issues never get past step 2.

1. **Is the population above the action threshold?** If not — wait and scout. Most damage is cosmetic and the predators are coming.
2. **Is there a cultural fix?** Mulch, prune, adjust watering, exclude with row cover, rotate next year. This solves more problems than any spray.
3. **Mechanical fix?** Hand-pick, hose-blast, sticky trap, pheromone trap. Effective for low-to-moderate populations.
4. **Targeted biological?** *Bt* for caterpillars; spinosad for thrips; beneficial nematodes for soil grubs. Species-specific, low impact on the rest of the ecosystem.
5. **Targeted soft chemical?** Insecticidal soap, horticultural oil, sulphur, copper, sodium bicarbonate. Short residual; spray at dusk.
6. **Broad-spectrum (last resort).** Pyrethrin, only at dusk, only on non-flowering plants. Acknowledge the collateral damage.

### 19.2 The spray inventory — what each one does

| Spray             | Class      | Target                                   | Mode of action                     | Pollinator safety            | Notes                                        |
|-------------------|------------|------------------------------------------|------------------------------------|------------------------------|----------------------------------------------|
| Insecticidal soap | Soap       | Soft-bodied insects (aphid, mite, thrip) | Disrupts cell membranes on contact | Moderate; spray dusk         | Must contact insect to work                  |
| Horticultural oil | Oil        | Scale, eggs, some mites                  | Smothers                           | Moderate                     | Don't apply >85 °F                           |
| Neem oil          | Botanical  | Soft-bodied + growth disruption          | Disrupts molting, antifeedant      | Moderate (some brands worse) | Some neem brands contain phytotoxic carriers |
| Bt kurstaki       | Biological | Caterpillars only                        | Gut toxin specific to Lepidoptera  | High (safe for bees)         | UV-degrades; spray dusk                      |

| Spray                       | Class      | Target                                       | Mode of action            | Pollinator safety                         | Notes                         |
|-----------------------------|------------|----------------------------------------------|---------------------------|-------------------------------------------|-------------------------------|
| Bt israelensis              | Biological | Mosquito/fungus gnat larvae                  | Gut toxin                 | High                                      | For aquatic / soil use        |
| Spinosad                    | Biological | Caterpillar, thrip, leafhopper, some beetles | Soil-bacterium derivative | Moderate; spray dusk                      | Bees safe once dried          |
| Pyrethrin                   | Botanical  | Broad-spectrum insects                       | Sodium-channel disruption | <b>Low — kills bees on contact</b>        | Last resort; dusk only        |
| Sulphur                     | Mineral    | Mites, powdery mildew                        | Multiple                  | Low for predatory mites; bee-safe         | Don't apply >85 °F            |
| Copper (Bordeaux, fixed Cu) | Mineral    | Bacterial + fungal                           | Multiple                  | Bee-safe but <b>toxic to aquatic life</b> | Dormant-spray peach leaf curl |
| Potassium bicarbonate       | Mineral    | Powdery mildew                               | Surface pH disruption     | Safe                                      | Preventive                    |
| Diatomaceous earth          | Mineral    | Slugs, soft-bodied insects                   | Mechanical abrasion       | Low (kills beneficials too)               | Reapply after rain            |
| Kaolin clay                 | Mineral    | Grasshopper, codling moth, sunburn           | Coating                   | Safe                                      | Hard to keep on through rain  |
| Iron phosphate (Sluggo)     | Mineral    | Slugs                                        | Stomach poison            | Safe (pets, wildlife)                     | Wet-bait every 10 days        |
| Nosema locustae             | Biological | Grasshopper nymphs                           | Pathogen                  | Safe                                      | Slow-acting                   |
| Beneficial nematodes        | Biological | Soil grubs, root maggots, fleas              | Parasitism                | Safe                                      | Warm moist soil               |

### 19.3 The hard rules

#### WARNING

##### Three things never to do:

1. **Never spray during bloom.** Not pyrethrin, not neem, not even spinosad. If a plant is flowering and pollinators are visiting, don't spray it.
2. **Never apply copper near waterways.** Copper is acutely toxic to fish, frogs, and aquatic invertebrates. Spray dormant orchards far from streams or pond runoff. Don't rinse copper sprayer into a drain that feeds surface water.
3. **Never use broad-spectrum sprays during a pest outbreak you don't understand.** Pyrethrin makes spider mites worse by killing predatory mites. Carbaryl makes aphids worse by killing aphid predators. Diagnosis before treatment, always.

### 19.4 Dusk timing — the safety rule

Most beneficial insects (especially bees) stop foraging at sunset. Most pest insects feed at dusk and night. Most sprays that aren't bee-safe become dramatically less harmful applied after sunset.

The protocol: spray within 30 minutes of sunset. Allow overnight drying. By morning, most contact-acting sprays (pyrethrin, neem, spinosad) have degraded enough to be relatively safe for pollinators returning.

Sprays that should NOT be applied at midday:

- Pyrethrin (pollinator kill)
- Neem (pollinator harm + leaf burn at high temperature)
- Spinosad (pollinator harm before drying)
- Sulphur (foliage burn above 85 °F)
- Horticultural oil (foliage burn above 85 °F)
- Copper (foliage burn at high temperature on some crops)

Sprays that *can* be applied any time:

- Insecticidal soap (best on dry mornings)
- Hose-blast water spray (best mornings)
- Iron phosphate slug bait (apply when ground is moist)

## 19.5 Neem brands — a caveat

### WARNING

**Not all “neem” is the same.** Cold-pressed pure neem oil with no carrier solvents is what the books mean by “neem oil.” Cheaper neem products are often clarified neem (hydrophobic extract of neem oil — actually a different chemical profile, less active) or solvent-cut neem in a phytotoxic carrier. Read the label. Pure cold-pressed neem with an emulsifier (and water dilution per label) is what works without burning crops or harming pollinators excessively.

## 19.6 The “what to keep in the shed” inventory

For a typical Cochise County backyard garden, the practical spray inventory is small:

1. **Bt kurstaki** (Dipel, Thuricide) — caterpillar control. Replace yearly; loses potency.
2. **Insecticidal soap** (M-Pede, Safer’s, homemade 1 tbsp Castile soap per quart water).
3. **Neem oil** (pure cold-pressed) — emergency aphid/mite/whitefly control.
4. **Spinosad** (Monterey Garden Insect Spray) — thrip, codling moth, leafhopper.
5. **Sulphur dust or wettable sulphur** — powdery mildew + spider mites.
6. **Liquid copper** (Bonide) — dormant peach leaf curl, fireblight.
7. **Potassium bicarbonate** (Kaligreen, MilStop) — powdery mildew.
8. **Iron phosphate slug bait** (Sluggo).
9. **Kaolin clay** (Surround) — grasshopper, codling moth, sunburn.
10. **Diatomaceous earth** — cutworm, slug, some beetle.

This handful covers nearly every pest and disease in this guide. Replace anything biological (Bt, spinosad, nematodes) annually.

## 20 · Annual scouting calendar

*Month-by-month · what to watch for · when controls are needed*

The Dragoons pest year runs a different rhythm than most American climates — mild winters keep populations alive year-round, the dry pre-monsoon period favors mites, the monsoon brings fungal disease and cucurbit pests, the long fall extends most pest seasons by 4–6 weeks. The calendar below summarizes the 12-month rhythm for the home grower.

### 20.1 The year in pests

| Month    | Primary scouting targets                                                                                                       | Active controls                                                                 |
|----------|--------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| January  | Aphids on overwintered brassicas; packrat sign                                                                                 | <b>Dormant copper spray on peach (mid-month);</b> dormant oil on apple/pear     |
| February | Aphids continue; codling-moth trap setup                                                                                       | <b>Second dormant copper on peach;</b> first compost amendments                 |
| March    | Onion thrips on overwintered alliums; flea beetle on greens; cabbage white emerging                                            | Row cover on spring brassicas; trap setup                                       |
| April    | Cabbage white peak (spring); leafhopper migration begins; spider mites on indoor/protected crops; codling moth flight 1 starts | Bt on brassicas; spinosad if needed; humidity-raise on indoor mites             |
| May      | Cucumber beetle adults emerge; squash vine borer wraps applied; flea beetle on eggplant; spider mites peak (pre-monsoon dry)   | Foil collars on squash; row cover on cucurbits; hose-blast for mites            |
| June     | Spider mites peak; codling-moth flight 1 egg-laying; pre-monsoon heat stress (BER, blossom drop)                               | Mite intervention; codling-moth spinosad; mulch and watering discipline for BER |

| Month     | Primary scouting targets                                                                                                                   | Active controls                                                                                                        |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| July      | <b>Monsoon onset</b> — cucumber beetle surge; powdery mildew prevention; tomato hornworm appears; squash vine borer flight                 | Pyrethrin dusk on cucurbits at first rain; potassium bicarbonate on cucurbits; Bt on hornworm; aluminum foil on squash |
| August    | Hornworm peak; squash bug peak; cabbage white returning for fall; harlequin bug emerging; powdery mildew everywhere; codling moth flight 2 | Daily dusk scouting (hornworm, harlequin); row cover on fall brassica transplants; bird netting on grapes (veraison)   |
| September | Harlequin bug peak; cabbage white continues; fall aphid buildup begins; grape harvest (bird pressure)                                      | Trap crops for harlequin; bird netting; final monsoon mildew control                                                   |
| October   | Cabbage looper peak; aphids ramping up on cool-season crops; cutworm at fall transplants; <b>garlic and brassica beds going in</b>         | Cardboard collars on all transplants; Bt on caterpillars; sanitation on summer bed turnover                            |
| November  | Aphids on overwintered brassicas; final cleanup; packrat activity                                                                          | Sanitation; mulching; remove summer-crop debris                                                                        |
| December  | Aphids continue; codling moth pupating; planning dormant sprays                                                                            | Order pheromone traps for next season; prune fruit trees; plan rotations                                               |

## 20.2 The four “must-do” dates

### The four highest-return actions of the Dragoons pest year:

1. **Mid-January and mid-February — dormant copper on peach trees.** Prevents peach leaf curl. Single most important orchard action.
2. **Late May — aluminum foil at base of every squash stem.** Prevents squash vine borer. Single most important cucurbit action.
3. **First big monsoon rain in July — pyrethrin dusk on cucumber/melon/squash within 48 hours.** Controls the cucumber beetle surge that vectors bacterial wilt.

4. **Late August — row cover on every fall brassica transplant.** Excludes cabbage white, harlequin bug, and cutworm at the most vulnerable stage. Do these four and you handle 60–70 % of typical Dragoons pest losses.

### 20.3 The dormant-season checklist

Winter (December–February) is when most of the next year’s pest pressure is decided. The dormant-season checklist:

1. **Sanitation.** Remove all summer-crop debris. Burn or trash anything that was infected (don’t compost). Rake fruit-tree leaves and dispose.
2. **Dormant copper sprays.** Mid-January and mid-February on peach/nectarine. Single dormant copper on apple/pear if fireblight was an issue.
3. **Dormant horticultural oil** on apple, pear, and stone fruit. Smothers overwintering scale, mites, and some aphid eggs.
4. **Pruning.** Cut out fireblight cankers (sterilize between cuts), peach tree borer damage, fruit mummies, broken or crossing limbs.
5. **Pheromone trap order.** Codling moth, peach tree borer, corn earworm traps for the coming season.
6. **Compost and mulch.** Build the beds while they’re empty.
7. **Tool sterilization.** Clean and oil pruners; replace blades; sterilize loppers.
8. **Plan rotations.** No same-family crop in the same bed two years running.
9. **Fence inspection.** Walk the perimeter. Repair sags, gaps, gate latches. Look for signs of pressure (digging at fence base, browse damage just inside).
10. **Soil tests.** Order soil tests from a state lab; plan amendments.

### 20.4 The monsoon-onset trigger

The single most important “trigger event” in the Dragoons pest year is the first big monsoon storm — typically late June to mid-July. Within 48–72 hours of that storm:

- Cucumber beetle populations triple. Bacterial wilt risk peaks.
- Squash vine borer flight intensifies.
- Powdery mildew spores germinate.
- Hornworm moths begin egg-laying.
- Slug populations explode.
- Spider mite populations crash (humidity-killed) — moves them off the priority list.

Knowing this lets you concentrate action: in the week after the first monsoon storm, plan to scout cucurbits daily, spray potassium bicarbonate preventively on mildew-prone crops, apply pyrethrin dusk to cucurbits if cucumber beetles appear, and scout solanaceae for first hornworm frass.

**LOCAL TIP**

**Track the monsoon onset for your specific site.** The “first big storm” varies by 2–4 weeks across the Dragoons foothills. The west side (Tombstone, Sierra Vista) usually breaks earlier than the east side (Sunizona, Pearce). Keep a multi-year notebook of monsoon onset dates and your associated pest events — within 3 years you’ll have a personal calendar that’s more accurate than any regional bulletin.

## Appendix A · Quick-reference table by problem

When you find damage and don't know what caused it, this table works backward from symptom to likely cause.

| Symptom                                       | Likely cause                     | Section      |
|-----------------------------------------------|----------------------------------|--------------|
| Seedlings cut at soil level overnight         | Cutworm                          | \$6.1        |
| Wilted vine despite wet soil (cucurbits)      | Bacterial wilt (cucumber beetle) | \$9.1        |
| Wilted plant, gummy frass at base (squash)    | Squash vine borer                | \$5.5        |
| Stippled silvery flecks on leaves             | Thrips or leafhopper             | \$4.2, \$4.4 |
| White powdery coating on leaves               | Powdery mildew                   | \$8.1        |
| Bronzed stems on tomato                       | Tomato russet mite               | \$7.2        |
| Holes in brassica leaves                      | Cabbage white / looper           | \$5.1        |
| Bright orange-and-black bugs on brassica      | Harlequin bug                    | \$5.3        |
| Pinholes in eggplant or mustard               | Flea beetle                      | \$5.8        |
| Large green caterpillar on tomato             | Hornworm                         | \$5.2        |
| Wormy fruit, entry hole at calyx              | Codling moth                     | \$5.7        |
| Curled puckered red leaves on peach           | Peach leaf curl                  | \$8.3        |
| Black "shepherd's-crook" tips on apple/pear   | Fireblight                       | \$9.3        |
| Cupped distorted leaves on tomato             | Curly top virus                  | \$10.2       |
| Mosaic yellow pattern on cucurbit             | Cucumber mosaic                  | \$10.4       |
| Dark sunken spot on tomato bottom             | Blossom-end rot                  | \$11.1       |
| Brown necrotic margin on lettuce inner leaves | Tipburn                          | \$11.2       |
| Hollow stem in broccoli                       | Boron deficiency                 | \$11.3       |
| Tiny broccoli head ("buttoning")              | Cold stress on young transplant  | \$11.4       |

| Symptom                                      | Likely cause            | Section      |
|----------------------------------------------|-------------------------|--------------|
| Cracking tomato fruit after rain             | Splitting               | §11.6        |
| Sunken white papery patch on fruit           | Sunscald                | §11.5        |
| Stick midden in cholla or shed               | Packrat                 | §12.1        |
| Fan-shaped soil mounds                       | Pocket gopher           | §12.2        |
| Stripped bark on young tree (winter)         | Jackrabbit or packrat   | §12.4, §12.1 |
| Pushed-over fruit tree, strong musk          | Javelina                | §13.1        |
| Stripped foliage above 4 ft                  | Deer                    | §13.2        |
| Pecked or hollowed fruit at canopy edge      | Birds                   | §14          |
| Galled bumpy roots at harvest                | Root-knot nematode      | §6.3         |
| Tunneled root crops                          | Wireworm                | §6.2         |
| Sudden wilt despite healthy top (young tree) | Gopher                  | §12.2        |
| Concentric ring spots on lower tomato leaves | Early blight            | §8.4         |
| Brown slimy hydroponic roots                 | <i>Pythium</i> root rot | §8.9         |

## Appendix B · Further reading and resources

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**University of Arizona Cooperative Extension — Cochise County office.** The canonical source for region-specific pest, disease, and crop alerts. Bulletins, master gardener program, soil and plant diagnostic services.

**Arizona Department of Agriculture.** Pesticide regulation, licensed-applicator information, regulated-species permits (javelina, deer).

**Arizona Game and Fish.** Wildlife relocation, conflict-resolution advice, hunting and permit information.

### Books worth owning:

- *Garden Insects of North America* — Whitney Cranshaw. The standard pest identification reference.
- *The Holistic Orchard* — Michael Phillips. The deepest practical orchard IPM reference.
- *The Family Garden Journal* — Native Seeds/SEARCH (Tucson). Sonoran Desert-region grower's calendar.
- *Insects of the Texas Lost Pines* — Stephen Welton Taber. Despite the title, broadly applicable to Southwest insect identification.
- *A Field Guide to Western Reptiles and Amphibians* — Robert Stebbins. Snake and lizard identification.

### Online resources:

- **University of Arizona College of Agriculture publications** — [cals.arizona.edu](http://cals.arizona.edu) — extensive Arizona-specific bulletins.
- **Native Seeds/SEARCH** — [nativeseeds.org](http://nativeseeds.org) — heritage Southwest varieties, many of them disease/pest-resistant.
- **Bugguide.net** — the standard insect identification community resource.
- **iNaturalist.org** — submit photos for community ID of unfamiliar pests, plants, and wildlife.

### Local relationships worth building:

- **The Cochise County Cooperative Extension office** in Sierra Vista. Free soil tests, pest ID, master gardener volunteer pool.
- **Local Cooperative Extension master gardener clinics** — generally Tuesday mornings during growing season.
- **A licensed pest-control applicator** for the occasional commercial-grade need (large-scale fungal infection, regulated-species removal).
- **A snake relocater** — multiple individuals in the Sierra Vista, Tombstone, and Bisbee areas will move rattlesnakes for free.

## Closing notes

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The Dragoons garden is unusual among American gardens. The pest community is smaller than most regions, but the species are different enough that a generic gardening book gets it wrong in costly ways. The single biggest mental shift for a newcomer is moving from a “spray-when-you-see-it” reflex to a prevention-first, scout-often, intervene-precisely IPM rhythm.

Five habits cover most of what matters:

1. **The dusk walk.** Ten minutes a day in season. No tool but a flashlight and a jar.
2. **The four “must-do” dates.** Dormant copper in January and February. Foil collars in May. Pyrethrin within 48 hours of the first monsoon storm. Row cover on fall brassicas in August.
3. **The native habitat.** Don’t tidy the property to lawn-and-bed neatness. Native oak, prickly pear, mesquite, and brush all support the predator community that handles most pest pressure for free.
4. **The fence.** Plant it before the trees. A javelina-rated, jackrabbit-rated 5-ft fence with a single electric strand is the canonical Cochise County perimeter.
5. **The notebook.** Year-over-year tracking of pest events on your specific site is more accurate than any regional bulletin. Three years of notes, and you have a personal calendar.

The Dragoons garden rewards attention. Most of the work is paying attention before the work is needed.

— Guide 10, *Dragoon Mountains Growing Guides*