

Peppers in the Dragoons

Guide 2 · Warm-Season Track

Soil & Hydroponic Production

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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** (this guide) · 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** · IPM + Cochise wildlife exclusion - **Guide 11 — Foundations: Soil & Seed** · soil-building, composting, seed-starting, propagation - **Guide 12 — Harvest, Preservation & Storage** · canning, fermenting, drying, cellaring - **Guide 13 — Water in Cochise County** · sourcing, testing, treatment, rainwater, conservation - **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

1 · Why the Dragoons for Peppers

Native Chiltepin · climate heritage · your natural advantages

The Dragoon Mountains are not just suitable for pepper growing — they are ancestral pepper territory. The Chiltepin (*Capsicum annuum* var. *glabriusculum*), the wild ancestor of nearly all cultivated chiles, grows natively in Cochise County and the surrounding sky island ranges. The Apache people harvested and used it for centuries. You are growing peppers in their homeland.

Climate advantages for pepper growing

Factor	Dragoon Conditions	Why Peppers Love It
Summer temperatures	85–95°F daytime	Ideal fruiting range. Hot enough to set fruit reliably without blossom drop from extreme heat.
Night temperatures	55–70°F — cool nights	Peppers set fruit best when nights drop below 75°F. Dragoon nights are perfect.
Monsoon humidity	50–70% July–Sept	Boosts fruit sizing and prevents blossom drop from dry air stress.
Monsoon rainfall	8–12" in 6 weeks	Reduces irrigation need by 40–60% during peak fruiting season.
Diurnal temperature swing	30–40°F daily	Concentrates capsaicin and flavour compounds. Dragoon chiles are hotter and more flavourful.
Fall season	Sept–Nov — warm days, cool nights	Extended ripening window. Peppers continue producing long after summer crops are done.
UV intensity	15–20% higher at elevation	Accelerates ripening and colour development. Intense sun deepens flavour.
Frost timing	First frost Oct–Nov at mid elevation	Long growing season — 180+ frost-free days at 4,500–5,000 ft.

The Chiltepin connection

The wild Chiltepin grows along rocky canyon washes and under mesquite trees throughout Cochise County, including the Dragoon and Chiricahua mountain ranges. These small, intensely hot berries (50,000–100,000 SHU — Scoville heat units, the standard chili-heat scale) disperse via birds and have survived here for thousands of years with zero irrigation and no amendments. They prove this land was made for peppers.

LOCAL TIP

Wild Chiltepin plants can be found growing naturally along canyon washes in the Dragoons. Collect seeds from ripe berries in fall — these are perfectly adapted to your exact conditions and make excellent parent stock for your garden. They are also genuinely rare and delicious.

2 · Pepper Species & Variety Reference

Scoville ratings · days to maturity · Dragoon suitability

Peppers belong to five main domesticated species. Understanding which species each variety belongs to helps predict its temperature preferences, growing habit, and how well it will perform at Dragoon elevation. This chapter is the variety encyclopaedia for the whole library — both the soil track in §5 and the hydroponic track in §6 reference it.

Species overview

Species & Key Facts	Dragoon Suitability
<i>C. annuum</i> · Jalapeño, poblano, cayenne, serrano, bell, Hatch, Anaheim, Chiltepin · hot summers, warm nights	●●●●● Excellent — widest variety selection, most productive species here.
<i>C. chinense</i> · Habanero, Scotch bonnet, ghost pepper · very hot — needs high heat	●●●● Good — lower Dragoon elevations best; may need shade cloth above 5,500 ft.
<i>C. pubescens</i> · Rocoto, Manzano · cool highlands — prefers 45-65°F nights	●●●●● Ideal — the Dragoons' cool nights are exactly what Rocoto needs.
<i>C. frutescens</i> · Tabasco, Malagueta · hot, humid	●●● Moderate — monsoon season works well; dry season challenging.
<i>C. baccatum</i> · Aji Amarillo, Lemon Drop · warm, moderate	●●●● Good — Andean origin tolerates elevation and temperature swings.

Complete variety reference

Variety · Profile	Dragoon Notes
Bell Pepper · <i>C. annuum</i> · 0 SHU · Sweet · 70-80d · 18-24"	Excellent — fall crop. Heat above 90°F causes blossom drop; plant for fall harvest.
Poblano / Ancho · <i>C. annuum</i> · 1,000-2,000 SHU · Mild · 65-80d · 24-30"	● Excellent. Thick walls love the Dragoon fall. Green = poblano; dried red = ancho.
Anaheim / Hatch · <i>C. annuum</i> · 500-2,500 SHU · Mild · 75-80d · 24-30"	● Excellent. New Mexico Hatch varieties thrive at similar elevations. Roast by the bushel.
Hungarian Wax · <i>C. annuum</i> · 1,000-15,000 SHU · Mild-Med · 70d · 18-24"	Good. Early ripening — useful for spring harvest before monsoon.
Jalapeño · <i>C. annuum</i> · 2,500-8,000 SHU · Medium · 70-75d · 24-30"	● Excellent. Native to Mexico — loves the Dragoon climate. Hotter when stressed. Very productive.

Variety · Profile	Dragoon Notes
Serrano · <i>C. annuum</i> · 10,000–25,000 SHU · Hot · 75–90d · 18–24"	● Excellent. More heat-tolerant than jalapeño. Prolific producer. Great for fresh salsa.
Chipotle (smoked jalapeño) · <i>C. annuum</i> · 2,500–8,000 SHU · Medium · 70–75d · 24–30"	Harvest jalapeños when red for traditional chipotle smoking over mesquite — perfect local wood.
Cayenne · <i>C. annuum</i> · 30,000–50,000 SHU · Hot · 70–75d · 18–24"	● Excellent. Heat-tolerant, prolific, easy to dry at Dragoon elevation. Thin walls dry perfectly in the fall sun.
Chiltepin (native) · <i>C. annuum</i> · 50,000–100,000 SHU · Very Hot · 90–120d · 36–48"	●● Native to Cochise County — zero adaptation needed. Perennial if protected from frost. Grows wild in canyon washes. The most important local variety.
Thai / Bird's Eye · <i>C. annuum</i> · 50,000–100,000 SHU · Very Hot · 75–90d · 18–24"	Good. Compact plant, prolific, heat-tolerant. Excellent container variety.
Habanero · <i>C. chinense</i> · 100,000–350,000 SHU · Extreme · 85–100d · 24–36"	Good at lower elevations (< 5,000 ft). Needs long, hot season. Start 10–12 weeks early. Monsoon humidity improves fruit set.
Ghost / Bhut Jolokia · <i>C. chinense</i> · 800,000–1,000,000+ SHU · Extreme · 100–120d · 36–48"	Challenging — needs very long season. Start January indoors. Best below 4,800 ft elevation. Monsoon season critical for fruit set.
Scotch Bonnet · <i>C. chinense</i> · 100,000–350,000 SHU · Extreme · 90–100d · 24–36"	Moderate — similar to habanero. Fruity flavour worth the effort.
Rocoto (Red/Yellow) · <i>C. pubescens</i> · 30,000–100,000 SHU · Very Hot · 90–120d · 36–60"	●● Ideal — the Dragoons' cool nights are perfect for Rocoto. Perennial to 15+ years if protected from frost. See dedicated §3.
Manzano (Apple Chile) · <i>C. pubescens</i> · 12,000–30,000 SHU · Hot · 120+d · 36–60"	●● Ideal — same as Rocoto. Yellow/orange apple-shaped fruit. Black seeds. Beautiful purple flowers.
Aji Amarillo · <i>C. baccatum</i> · 30,000–50,000 SHU · Hot · 90–100d · 36–48"	Good. Andean origin — elevation tolerant. Fruity, unique flavour. Excellent food pepper. Needs staking.
Lemon Drop · <i>C. baccatum</i> · 15,000–30,000 SHU · Hot · 90–100d · 24–36"	Good. Citrusy, bright flavour. Heat and drought tolerant. Excellent for salsas and hot sauce.

3 · The Rocoto Special Section

Capsicum pubescens · high-elevation adaptation · growing secrets

The Rocoto (*Capsicum pubescens*) is the rarest, most elevation-adapted, and most misunderstood pepper species in cultivation. Native to the Andes at 6,000–14,000 ft elevation, it is the only pepper species that thrives in cool conditions — and it is perfectly suited to the Dragoon Mountains. While most chiles struggle with cool Dragoon nights, the Rocoto absolutely requires them to set fruit.

This chapter covers the species biology and the universal Rocoto protocol. The soil-specific tweaks live in §5; the hydroponic-specific tweaks (reservoir temperature, in-system trellising) live in §6; the multi-string trellising spec lives in §7.

Why Rocoto is perfect for the Dragoons

Rocoto Requirement	Dragoon Condition	Match?
Cool nights 45–65°F for fruit set	55–68°F night temps most of the year	●● Perfect
Partial shade tolerance in hot weather	Mountain aspect provides afternoon shade on east-facing slopes	●● Perfect
Well-drained, deep soil	Sandy loam over caliche — break through hardpan at planting	Good
pH 6.0–7.0	Dragoon soils pH 7.5–8.5 — needs sulfur amendment	■ Needs work
Moderate humidity during fruit set	Monsoon July–Sept provides 50–70% humidity	●● Perfect
Protection from frost (perennial)	Frost arrives Oct–Nov — needs protection or harvest by then	Manageable
Long growing season 90–120+ days	180+ frost-free days at mid elevation	Sufficient

Rocoto growing protocol for the Dragoons

1. **Start very early — January indoors.** Rocotos need 10–14 weeks before transplant. Germination is slow (14–28 days). Use a bottom heat mat at 75–80°F.
2. **Partial shade siting.** Plant on the east side of a structure or taller plants. Morning sun is fine — afternoon shade prevents blossom drop in summer heat.
3. **Amend soil heavily** (soil track). Rocoto needs pH 6.0–6.5. Apply sulfur in fall before planting. Add 4" compost. They are heavy feeders compared to other chiles. For the hydroponic equivalent, see §6.

4. **Consistent moisture.** Never let Rocotos dry out — this immediately causes blossom drop. Daily drip irrigation during dry periods. Mulch heavily.
5. **Patience at flowering.** Rocotos bloom prolifically but will drop flowers if nights exceed 75°F. The Dragoon monsoon season (cool nights returning) triggers the best fruit set.
6. **Frost protection = perennial.** At the first frost threat in October, cover with frost cloth or bring container plants indoors. Protected Rocotos can live 15+ years and grow 10 ft tall — becoming a permanent garden feature.

LOCAL TIP

Black seeds: Rocoto is the only domesticated pepper species with black seeds — a reliable identifier. It also has distinctly hairy leaves and stems, and beautiful purple-violet six-pointed star flowers. If your “rocoto” has white flowers and white/tan seeds, it is mislabelled — check your seed source.

4 · Choose Your Track — Soil or Hydroponic

Decision matrix · who wins in the Dragoons

The next two chapters split. Most Dragoon growers will eventually run both — peppers are tolerant of either method, and each has practical advantages here. Pick the track that fits your site, water, and patience before reading on.

At a glance

The hydroponic column below references EC (*electrical conductivity*, in mS/cm or millisiemens per centimeter — a proxy for dissolved nutrient concentration in the reservoir) and *Pythium* (a warm-water root-rot pathogen that becomes the dominant disease pressure in any reservoir running above 72°F). Both are covered in detail in §6.

Factor	Soil Track (\$5)	Hydroponic Track (\$6)
Up-front cost	Low — compost, sulfur, drip	Moderate — Bato buckets, pumps, reservoir
Daily attention	Low — drip on timer	Moderate — daily pH/EC check
Water use	Higher — evaporation, runoff	60-80% lower — recirculating
Local soil limits (caliche, pH 8)	Major obstacle — needs raised beds & sulfur	Bypassed entirely
Well-water hardness	Tolerated by soil buffering	Must be pre-treated (see Guide 3)
Yield ceiling (per plant)	Moderate	High — 1.5-2× soil under good management
Capsaicin / flavour	Excellent — Dragoon diurnal swing	Excellent — same swing applies
Perennial Rocoto	In-ground or 5-gal container	In-bucket overwintering — see §10
Best for	Chiltepin, jalapeño, serrano, Hatch	Rocoto, habanero, poblano, ghost
Pest pressure	Full outdoor spectrum (cutworms, javelina, grasshoppers)	Reduced; <i>Pythium</i> replaces them as top threat
Power required	None (gravity drip OK)	Pump — solar (RAINPOINT) or AC
Failure mode	Drought stress, BER, blossom drop	Reservoir > 72°F → <i>Pythium</i> root rot

Variety-by-variety recommendation

Variety	Best Track	Reason
Chiltepin	Soil ●	Native — wants Dragoon soil and zero coddling. Self-seeds.
Jalapeño / Serrano / Cayenne	Either	Soil is cheapest; hydro DWC gives the highest yield.
Poblano / Anaheim / Hatch	Either	Dutch / Bato bucket outperforms soil if water is limited.
Bell & sweet	Hydroponic	Heat-sensitive; reservoir cooling steadies fruit set.
Habanero / Scotch Bonnet / Ghost	Hydroponic ●	Long season; warm root zone in Dutch bucket extends growth.
Rocoto / Manzano	Hydroponic ●	Year-round in-bucket overwintering protects the perennial investment.
Aji Amarillo / Lemon Drop	Either	Both happy; staking is needed regardless.

You do not have to choose once. A common Dragoon setup is **Chiltepin and jalapeño in a raised bed, plus a 4-bucket Bato row for Rocoto, habanero, poblano, and one bell**. Same nutrient programme covers the buckets; the bed runs on drip and compost.

RELATED GUIDES

The Bato Bucket build, water-treatment protocol, and daily operations live in **Guide 3 — Bato Bucket Hydroponic Systems**. Read that guide before committing to the hydroponic track in §6.

5 · Soil Track

Site, soil, seeds, water, nutrition, calendar — for in-ground and container peppers

This chapter is the complete soil-growing recipe for the Dragoons. It assumes a raised-bed or amended-bed approach on typical Cochise County ground — sandy loam over caliche, pH 7.5–8.5, low organic matter. The fixes are all standard; what is Dragoon-specific is the timing and the materials.

5.1 Site selection & soil preparation

Peppers are sun-loving, warmth-requiring plants that reward good soil preparation generously. In the Dragoons, the main soil challenges are high alkalinity (pH 7.5–8.5) and low organic matter. Both are solvable with targeted amendments before planting.

Soil requirements

Parameter	Target	Typical Dragoon Reading	Fix
pH	6.0 – 7.0	7.5 – 8.5	Elemental sulfur 1–2 lb per 100 sq ft. Acidify irrigation water to pH 6.5.
Organic matter	3 – 5%	< 1%	3–4" compost worked into top 10". Repeat every season.
Drainage	Water infiltrates freely	Can waterlog over caliche	Raised beds 12–18" deep. Break caliche layer before planting.
Texture	Sandy loam — well-draining	Variable — often adequate	Add perlite or coarse sand to heavy clay areas. 20–30% by volume.
Nitrogen	Moderate pre-plant	Often low	Aged compost + alfalfa meal pre-plant. Avoid high-N during fruiting.
Calcium	Adequate — critical for BER prevention	High (abundant from caliche)	Usually sufficient. Issues arise from pH lockout or uneven watering, not deficiency.

Pre-plant bed preparation

- **Soil test first** — know your pH before adding anything. UA Cooperative Extension (520-458-8278) can advise on local testing.
- **Apply elemental sulfur** — 1-2 lb per 100 sq ft if pH > 7.5. Work in 4-6 weeks before planting for best effect.
- **Add 3-4" compost** — work into top 8-10" of soil. Local alfalfa hay compost from Willcox feed stores is excellent.
- **Check caliche depth** — drive a rebar rod. If hardpan is shallower than 18", build raised beds or auger through before planting.
- **Raised beds** — the easiest solution for most Dragoon sites. 12-18" deep beds with a 50% native soil / 50% compost mix. Complete drainage control, optimal pH, no caliche limitation.

Companion planting

Plant with:	Why
Basil	Repels aphids and thrips. Improves pepper flavour when grown nearby. Perfect Dragoon monsoon companion.
Carrots	Deep roots break up soil below pepper root zone. Don't compete for same nutrients.
Oregano	Native-adapted, drought-tolerant. Repels pests and attracts beneficial insects. Perennial in the Dragoons.
Marigolds	Strong repellent for nematodes and many insects. Plant around perimeter of pepper bed.
Onion / Garlic	Repel aphids and spider mites. Plant between pepper rows.

Avoid planting with:	Why
Tomatoes, potatoes, eggplant	Same <i>Solanaceae</i> family (tomato/pepper/eggplant/potato — they share root diseases and many pests). Rotate every 2-3 years.
Fennel	Allelopathic — inhibits pepper root development.
Brassicas (cabbage, broccoli)	Compete for same nutrients and may harbour aphids that spread to peppers.

5.2 Starting seeds & transplanting

Peppers need a head start indoors — they are slow-growing and require warm soil for germination. At Dragoon elevations, the last frost occurs April-May, so seeds started in February give you the longest possible growing season.

Seed starting timeline by variety

Variety Group	Start Indoors	Transplant Outdoors	Reason
Rocoto / Manzano (<i>C. pubescens</i>)	January	Late April – May	Slow germinators, very long season (120+ days)
Habanero, Ghost (<i>C. chinense</i>)	Late January – Feb	Late April – May	Longest season of common varieties (85-100 days)
Jalapeno, Serrano, Cayenne (<i>C. annuum</i>)	Mid February	Late April – early May	Standard 8-10 week head start
Poblano, Anaheim, Hatch, Bell	Mid February	Late April – early May	8-10 week head start
Chiltepin (native)	February – March	May	Scarify seeds first (light sandpaper) — tough seed coat
Aji, Lemon Drop (<i>C. baccatum</i>)	February	Late April – May	8-10 week head start

Germination requirements

Factor	Target	Notes
Soil temperature	80-85°F (27-29°C)	The most critical factor. Use a heat mat under seed trays. Without heat, germination is slow and erratic.
Rocoto soil temp	75-80°F (24-27°C)	Rocoto prefers slightly cooler germination than other species.
Sowing depth	1/4" (6 mm)	Cover lightly. Firm seed-to-soil contact essential.

Factor	Target	Notes
Germination time	7-21 days (<i>C. annuum</i>); 14-28 days (<i>C. pubescens</i>)	Rocoto and habanero are the slowest. Do not give up early.
Moisture	Consistently moist — not wet	Cover tray with clear dome until germination. Check daily.
Light (after sprout)	16 hrs under LED grow light	Place seedlings 2-3" below a T5 or quantum board LED immediately after sprouting.

Hardening off & transplanting

- Begin hardening off 10-14 days before transplant date — set plants outside in a sheltered spot for 1 hour on day 1, increasing by 1-2 hours daily.
- Never transplant when soil temperature is below 60°F — check with a soil thermometer, not the calendar.
- Transplant on a cloudy day or in late afternoon — reduces transplant shock from high-altitude UV.
- Space most varieties 18-24" apart — Rocotos and large *C. chinense* need 30-36".
- Water in immediately with a dilute fish emulsion solution — 1 tbsp per gallon. This helps roots establish quickly.
- No nitrogen fertiliser for 2-3 weeks after transplant — let roots establish before pushing growth.

5.3 Irrigation & water management

Consistent moisture is more important for peppers than total water volume. Irregular watering — the classic Dragoon challenge with monsoon boom-and-bust cycles — causes blossom drop, blossom end rot, and split fruits. Drip irrigation plus thick mulch solves most of this automatically.

Irrigation by growth stage

Stage	Water Need	Frequency	Notes
Transplant establishment (Weeks 1-3)	Moderate — consistent	Daily light watering	Keep root zone moist. Don't overwater — no roots yet to absorb excess.
Vegetative growth (Weeks 3-8)	Moderate	Every 2 days	Increase as canopy grows. Drip at 0.5-1 GPH per plant.
Pre-flowering (Weeks 6-10)	Moderate — increase	Daily in dry heat	Consistent moisture critical as buds form. Drought stress now causes flower abortion.
Flowering (critical stage)	Consistent — never stress	Daily minimum	Blossom drop is triggered by both drought AND flooding. Keep even moisture.
Monsoon season (July-Sept)	Reduce drip	Monitor rainfall — reduce or pause drip	2" of rain = skip 3-5 days of drip. Mulch prevents oversaturation.
Fruiting (peak production)	Moderate-High	Daily or every 2 days	Large fruit load demands consistent water. Blossom end rot from irregular moisture.
Late harvest / wind-down	Reduce	Every 3 days	Slight water stress at this stage increases capsaicin concentration — hotter peppers.

Blossom drop prevention

Blossom drop is the most common frustration for Dragoon pepper growers. Understanding the triggers makes it preventable:

- **Temperature.** Flowers drop when daytime temps exceed 90°F or nights drop below 55°F. The Dragons rarely hit both extremes — but June pre-monsoon is the highest-risk window.
- **Water stress.** Even one day without water during flowering can drop an entire flush of blossoms. Install drip before plants flower.
- **Overfertilising with nitrogen.** High-N pushes leaf growth instead of fruiting. Switch to low-N fertiliser at first flower bud.
- **Thrips.** These tiny insects damage flowers directly. Yellow sticky traps near flowering plants catch them early.
- **Monsoon salvation.** Many dropped buds are replaced within 2–3 weeks once monsoon rains bring cooler nights — the Dragoon monsoon often restores a previously struggling pepper plant.

5.4 Nutrition & fertilisation

Pepper nutrition changes significantly through the growing season. High nitrogen early builds plant structure; lower nitrogen with higher phosphorus and potassium at flowering and fruiting drives production. Calcium is the critical micromanagement nutrient — deficiency causes blossom end rot regardless of how well everything else is managed.

Seasonal nutrition programme

Stage	NPK Focus	Application	Local / Organic Source
Pre-plant soil prep	Balanced	3–4" compost + 5 lb alfalfa meal per 100 sq ft	Local alfalfa (Willcox), bat guano, aged manure from local ranches
Transplant establishment	Low N, root emphasis	Fish emulsion 1 tbsp/gal drench at planting	Fish emulsion (purchase), dilute compost tea
Vegetative growth	Moderate N, balanced P/K	Balanced fertiliser (10-10-10) every 2–3 weeks	Aerated bat guano tea; dilute fish emulsion + wood ash water
First flower buds visible	Reduce N, increase P/K	Switch to low-N formula (5-10-10 or similar)	Bone meal (P) + wood ash (K) + compost. Stop heavy nitrogen now.
Peak fruiting	Low N, high K and Ca	Potassium-rich liquid feed every 2 weeks	Sulfate of potash drench; kelp meal; caliche-vinegar calcium extract
Late season	Reduce all	Taper off — allow plant to focus on ripening	Foliar iron spray if yellowing appears from pH-related lockout

Calcium management — blossom end rot prevention

Blossom end rot (BER) — the dark sunken spot on the bottom of the fruit — is caused by calcium deficiency at the fruit, usually from irregular watering or pH issues that prevent calcium uptake, not from calcium absence in the soil. Dragoon soils have abundant calcium from caliche. The problem is getting it into the plant.

- **Most important fix:** consistent, even watering via drip. BER disappears in most cases when moisture is stabilised.

- **pH correction:** calcium locks out below pH 5.5 and above pH 8.0 — keeping pH at 6.0–7.0 keeps calcium available.
- **Calcium foliar spray:** dissolve 1 tsp calcium nitrate per quart of water, spray directly on developing fruits in early morning.
- **Avoid excess potassium:** high K competes with Ca uptake — don't overdo wood ash if BER is a problem.

Magnesium — often deficient in sandy Dragoon soils

- **Symptom:** yellow leaves between green veins, starting on older leaves — classic Mg deficiency.
- **Fix:** dissolve 1 tbsp Epsom salt per gallon water, apply as soil drench OR foliar spray. Repeat 2–3 times at 2-week intervals.
- **Local source:** natural epsomite deposits found around mineral seeps in the Sulphur Springs Valley — identical to commercial Epsom salt.

5.5 Soil track seasonal calendar

Month-by-month tasks for 4,500 – 5,500 ft elevation.

Month	Key Tasks	What's Happening
January	Start Rocoto and habanero seeds indoors. Set up heat mats. Apply elemental sulfur to beds if pH > 7.5 — needs weeks to work.	Rocoto seedlings germinating
February	Start all <i>C. annuum</i> varieties (jalapeño, cayenne, poblano, etc.) indoors. Continue soil amendment. Order drip irrigation supplies.	Pepper seedlings under grow lights
March	Pot up seedlings to 4" containers as they grow. Continue indoor growing. Last chance to apply sulfur before spring planting. Prep raised beds.	Indoor seedlings 4-6" tall
April	Begin hardening off late April. Check soil temp — wait for 60°F+. Transplant after last frost (late April at lower elevations). Install drip irrigation immediately.	Transplant to garden late April
May	Final transplants out. Mulch heavily. First fertiliser application. Watch for late frost — keep frost cloth ready until mid-May.	All varieties in ground; rapid growth
June	Peak heat and drought pre-monsoon. Monitor daily. First flower buds appear — switch to low-N fertiliser. Install shade cloth if temps consistently above 95°F.	Flowering begins; blossom drop risk

Month	Key Tasks	What's Happening
July	MONSOON BEGINS. Reduce drip irrigation immediately as rains arrive. Stake heavy-bearing plants. Watch for aphids in humidity. Rocoto begins flowering heavily — perfect conditions.	Fruit sizing rapidly; monsoon rains
August	Peak production for most <i>C. annuum</i> varieties. Harvest jalapeños, serranos, cayenne. Habaneros just beginning. Rocoto fruit approaching maturity.	Harvest most varieties; Rocoto ripening
September	● BEST MONTH. Cool nights return. Pepper plants revive if stressed. Harvest red jalapeños (chipotles), fully-ripe poblanos (anchos), cayenne. Habanero peak harvest. Rocoto fully ripe.	Peak harvest for all varieties
October	Continue harvesting. First frost possible late October at higher elevations. Pot up Rocoto and overwintering plants before frost. Allow remaining peppers to fully ripen before cold.	Final harvest; frost watch begins
November	Frost ends outdoor growing at most elevations. Bring overwintering plants indoors. Dry and process remaining harvest. Apply compost to empty beds. Plant garlic.	End of season; preservation
December	Overwintered plants resting indoors under grow lights. Plan next season varieties. Order seeds. Test saved seeds from this season.	Indoor overwintering

6 · Hydroponic Track

System selection · water · EC/pH · nutrients · environmental control

If you have never grown hydroponically, read Guide 3 (Bato Bucket Hydroponic Systems) before this chapter. Guide 3 covers the bench build, the bicarbonate water-treatment protocol, and the daily routine — the operational foundation that this chapter assumes you already understand. Guide 4 (Hydroponic Nutrients) covers the Masterblend recipes. With those two read, §6 below is the pepper-specific layer on top.

Hydroponic peppers in the Dragoons exploit every climate advantage in §1 while bypassing the two real soil obstacles — caliche and pH 8 alkalinity. What you trade in is daily reservoir discipline. This chapter gives the pepper-specific operational layer; the system build itself and the bicarbonate water-treatment protocol live in Guide 3, and the Masterblend recipes and pH chemistry live in Guide 4.

RELATED GUIDES

Guide 3 — Bato Bucket Hydroponic Systems carries the parts list, bench construction, the RAINPOINT solar pump schedule, and the 5-step bicarbonate water-treatment protocol. **Guide 4 — Hydroponic Nutrients** carries every Masterblend recipe, pH-down/up alternatives, and indoor/LED precision growing. Cross-references below assume both are nearby.

6.1 System selection by variety

The right system depends on the variety's size and root mass. Use the §2 variety table as the upstream filter; this table maps each variety to the hydroponic system it prefers. Three system acronyms appear in the table below: **DWC** (*deep water culture* — roots suspended in an oxygenated nutrient reservoir, usually a 5-gal bucket with an airstone), **NFT** (*nutrient film technique* — a thin stream of solution running through shallow troughs past bare roots), and **Dutch / Bato Bucket** (drip-fed perlite-filled buckets, the dominant Dragoon system — see Guide 3). **Kratky** is passive DWC with no pump — the reservoir level drops as the plant drinks.

Variety	Best Hydro System	Why
Bell Pepper	Dutch Bucket	Bulky root mass, large canopy — needs volume. Reservoir cooling matters above 85°F.

Variety	Best Hydro System	Why
Poblano / Ancho	Dutch Bucket ●	Thick stems, heavy fruit load. Same form factor as the Bato Bucket build in Guide 3.
Anaheim / Hatch	Dutch Bucket	Similar to poblano. Long fruiting season rewards a big media volume.
Hungarian Wax	DWC or Dutch Bucket	Mid-size plant; either works.
Jalapeño	DWC ●	Classic pepper for 5-gal DWC buckets. Airstone is non-negotiable.
Serrano	DWC or NFT	Compact plant, prolific — fits well in an NFT channel if water is tight.
Chipotle (smoked jalapeño)	DWC	Grow in DWC, smoke after harvest — process is the same.
Cayenne	DWC or NFT	Thin-walled, dries perfectly outdoors after harvest.
Chiltepin (native)	NFT, Kratky, or DWC	Small, tough, perennial. Best Kratky candidate in the library.
Thai / Bird's Eye	NFT or Kratky	Small-plant / small-reservoir varieties.
Habanero	Dutch Bucket ●	Needs the heat reservoir insulation can't fully solve. Bury buckets or insulate heavily.
Ghost / Bhut Jolokia	Dutch Bucket	Very long season — only Dutch Bucket holds up for 100+ days of fruiting.
Scotch Bonnet	Dutch Bucket	Same as habanero.
Rocoto (Red/Yellow)	Dutch Bucket ●	Large semi-vining plant, deeply sensitive to reservoir temp — see Rocoto notes below.
Manzano	Dutch Bucket	Same as Rocoto.
Aji Amarillo	Dutch Bucket	Tall plant (36–48"); needs staking and volume.

Variety	Best Hydro System	Why
Lemon Drop	DWC or Dutch Bucket	Drought-tolerant in soil, forgiving in hydro.

System notes

System · Setup	Dragoon Notes
Dutch / Bato Bucket ● · 5-gal buckets, perlite media, 1 plant/bucket	Best system for the Dragoons — insulate buckets against temperature swings. Bury partially to keep root zone below 72°F. For the field-tested build, see Guide 3.
DWC (Deep Water Culture) · 5-gal dark buckets, 3" net pots, airstone	Simplest system. Excellent for medium peppers. Critical: keep reservoir below 72°F — insulate or bury.
NFT (Nutrient Film) · 4" channels, 12-18" plant spacing	Best water efficiency — important in the Dragoons. Not suited for large varieties with heavy root mass.
Kratky (passive DWC) · Mason jar or 1-gal container, no pump	Excellent off-grid option. Works well outdoors in shade during monsoon. Refill every 5-7 days with fresh nutrient solution.
Ebb & Flow · Tray with timer and pump, perlite or hydroton media	Good for multiple smaller plants. Monitor EC carefully — solution concentrates faster in Dragoon heat.

Growing media

Media	Best System	Notes	Local Source?
Perlite (70%) + Hydroton (30%)	Dutch Bucket ●	Best drainage and aeration. Reusable. Standard commercial pepper mix.	Purchase
Pure Perlite	Dutch Bucket, Ebb & Flow	Excellent drainage, very light. Needs more frequent irrigation cycles.	Purchase

Media	Best System	Notes	Local Source?
Coarse granite grit (washed)	Dutch Bucket, DWC net pots	Free local alternative to hydroton. Rinse in dilute acid first to remove carbonates.	● Local — crush granite
Washed local pumice	Any system	Volcanic pumice found in SE Arizona. Excellent drainage and aeration.	● Local — Dragoon geology
Rockwool cubes (starter)	Seedling propagation	Best seedling medium for transitioning to hydroponics.	Purchase

6.2 Reservoir temperature — the #1 Dragoon challenge

Root-zone temperature is the single biggest hydroponic management challenge in the high desert. Roots above 72°F lose dissolved oxygen, become susceptible to *Pythium* root rot, and stop absorbing nutrients efficiently — even when the solution is perfectly balanced.

- **Bury or insulate reservoirs** — underground tanks stay 10-15°F cooler. Even wrapping in foam insulation makes a significant difference.
- **Use dark/opaque containers** — prevents algae and reduces heat absorption.
- **Cover all reservoir surfaces** — evaporation in the high desert is extreme; an open 5-gallon bucket loses a gallon per day in June.
- **Monsoon advantage:** July-September ambient temps drop significantly — your hardest reservoir-cooling period ends right when peppers hit peak production.

LOCAL TIP

Reservoir cooling in a Dragoon summer is the single biggest hydroponic intervention available. A buried 15-gal tub stays 10-15°F cooler than the same tub sitting exposed on a patio. A wrap of 1" rigid foam is the cheapest insurance a Rocoto grower can buy.

6.3 Starting seeds for hydroponics

Same indoor-start timing as the soil track (\$5.2) — the only difference is the medium. Use rockwool cubes rather than soil-based mix for a clean transition into your system.

Factor	Target	Notes
Media	1.5" rockwool cubes ●	Soak cubes in pH 5.5 water before use. Rockwool transitions into hydro systems with no root disturbance.
Substrate temperature	80–85°F (<i>C. annuum</i>); 75–80°F (Rocoto)	Heat mat under seed trays. Most critical germination factor.
Germination time	7–21 days (<i>C. annuum</i>); 14–28 days (<i>C. pubescens</i>)	Do not give up early on Rocoto and habanero.
Initial nutrient solution	EC 0.4–0.6 — very dilute	Seedlings need almost no nutrients. Half-strength Masterblend or plain water.
pH of water/solution	5.8–6.0	Pre-treat rockwool with pH 5.5 water (acidic). Soak 1 hour before seeding.
Light after sprouting	16 hrs LED, 200–300 PPFD	Quantum board or T5 LED 2–4" above seedlings. Keep cool to prevent stretch.

Transitioning seedlings into the system

1. **Wait for visible roots** — move to system only when roots are visible at the base of the rockwool cube, usually when the seedling is 3–5" tall.
2. **Place cube in net pot** — set rockwool cube directly in a 3" net pot. Fill around with hydroton or perlite to support. No bare-rooting needed.
3. **Drop reservoir level** — for DWC, start with water level 1" below the net pot base. Roots will grow down to find the solution within days.
4. **Start at low EC** — first week in system: EC 0.8–1.0. Increase to vegetative level (1.4–1.8) once plant shows active new growth.
5. **Protect from UV** — Dragoon UV at elevation is intense. Provide 30% shade cloth for the first 2 weeks outdoors.

6.4 Water quality & reservoir management

SE Arizona well water is among the hardest in the country — high in dissolved calcium, magnesium, and bicarbonates that constantly push pH upward. Pre-treating your water before mixing nutrients is the single most impactful practice for stable,



Figure 1: Pepper seedlings just after transplant into the single-row patio build. The reservoir sits at the foot of the row; the RAINPOINT drip cycle runs once every 8 hours through this establishment phase.

predictable pepper production in the Dragoons.

RELATED GUIDES

See **Guide 3 — Bato Bucket Hydroponic Systems**, §4 (Water treatment) for the 5-step bicarbonate pre-treatment protocol — that is the canonical version. **Guide 4 — Hydroponic Nutrients**, Part 3 carries every pH-down/up recipe (prickly pear vinegar, citric acid, phosphoric acid, oak ash lye, KOH).

Water source quality

Source	Baseline EC	Suitability	Recommendation
RO filtered water	~0.0	●●●●● Perfect	Best baseline. Mix nutrients from zero. Most consistent results.
Monsoon rainwater (collected)	< 0.05	●●●●● Excellent	Collect July–Sept. Store in dark sealed tanks. Nearly equal to RO.
RO / rain blend 50:50	0.1–0.2	●●●● Very Good	Stretches RO supply while maintaining low baseline.
Treated well water	0.3–0.8	●●● Usable	Requires full bicarbonate scrub (Guide 3). Reduce nutrient dose to account for baseline minerals.
Untreated well water	0.3–0.8	●● Difficult	pH will be unstable all season. Invest in RO filter for best results.

pH targets for hydroponic peppers

- **Target pH: 5.8 - 6.2** — tighter than soil growing. Peppers tolerate up to 6.5 but micronutrient availability drops above 6.2.
- Blossom end rot in hydroponics is almost always a pH or EC problem, not a calcium deficiency — check these first.
- Check pH daily for the first 2 weeks of a new reservoir to learn your water's drift rate.

Reservoir management schedule

Task	Frequency	Notes
pH check	Daily	Adjust to 5.8–6.2. Note drift direction — tells you about plant uptake.
EC check	Daily	Top off with half-strength mix if EC drops; top off with plain water if EC rises.
Water level top-off	Daily	Never let roots dry out. High-desert evaporation is significant — even covered reservoirs lose water.
Full reservoir change	Every 7–10 days (fruiting); every 14 days (veg)	Prevents salt buildup. Flush system with clean water between changes.
Root inspection	Weekly	Healthy = bright white. Brown/slimy = Pythium root rot — check reservoir temp first.
Meter calibration	Monthly	Calibrate pH meter with buffer solution (pH 4.0 and 7.0). Inaccurate readings are the #1 cause of unexplained crop problems.

6.5 Nutrient solution management

Peppers are heavy feeders with evolving nutrient needs throughout their season. The Masterblend 3-part system (4-18-38 + Epsom salt + Calcium Nitrate) delivers everything peppers need. The key is adjusting concentration — not the ratio — as the plant moves from vegetative growth to fruiting. Peppers need more magnesium than tomatoes — double the Epsom salt dose once fruiting begins.

RELATED GUIDES

The full per-gallon Masterblend recipe table, the mixing-order rule (Masterblend → Epsom → Cal-Nitrate **last**), and every DIY substitution live in **Guide 4 — Hydroponic Nutrients**, Part 2. The summary table below is for reference only — Guide 4 is canonical.

Pepper EC & pH targets by stage

Growth Stage	Target EC (mS/cm)	Target pH
Seedling / cutting	0.8 – 1.0	5.8 – 6.0
Early vegetative	1.4 – 1.8	5.8 – 6.0
Late vegetative	1.8 – 2.2	5.8 – 6.2
First flower buds	1.8 – 2.2	5.8 – 6.2
Peak flowering	1.6 – 2.0	5.8 – 6.0
Fruit sizing ●	2.0 – 2.6	6.0 – 6.2
Peak fruiting	2.2 – 2.8	6.0 – 6.2
Late harvest	1.4 – 2.0	6.0

Pepper Mg rule. Peppers are the heaviest magnesium users of all common hydroponic crops. Once fruit sizing begins, increase Epsom salt to **2.4 g/gal** — double the standard Masterblend ratio. Magnesium deficiency (yellowing between green veins on older leaves) is the most common pepper deficiency in hydroponics. The full per-gallon recipe lives in Guide 4, but this 2.4 g/gal target is the load-bearing number — do not skip it.

Nutrient deficiency quick reference

Symptom	Deficiency	Hydroponic Fix	pH Cause
Yellow between green veins, older leaves first	Magnesium (Mg)	Double Epsom salt to 2.4 g/gal for 2 weeks. Foliar spray 1 tbsp/gal.	Locked out below 5.5
Yellow between green veins, new growth first	Iron (Fe) or Mn	Check pH immediately — almost always pH > 6.5. Adjust to 5.8-6.0.	Locked out above 6.5
Blossom end rot (dark spot on fruit base)	Calcium (Ca)	Check pH is 5.8-6.2. Check EC not above 3.0. Ensure Cal-Nitrate was added last and dissolved fully.	Locked out below 5.5 or above 7.0
Purple/red leaf undersides	Phosphorus (P)	Check pH not below 5.0. Warm reservoir above 65°F. Usually resolves with pH correction.	Locked out below 5.0
Pale leaves, slow growth	Nitrogen (N) — low EC	Raise overall Masterblend dose by 0.4 g/gal. Check EC is above 1.4.	N/A — EC issue
Dark green, thick leaves, stunted	Nitrogen excess — high EC	Dilute reservoir. Do partial water change. EC should not exceed 3.0 for peppers.	N/A — EC issue
Curled, distorted new growth	Calcium (Ca) or Boron (B)	Check mixing order — Cal-Nitrate MUST go in last. If order was correct, try a very dilute boron foliar spray.	Locked out above 7.0

EC drift management

- **EC rising between top-offs:** plants drinking more water than nutrients — top off with plain RO/rain water until EC returns to target.
- **EC falling between top-offs:** plants consuming nutrients heavily — top off with half-strength Masterblend mix.

- **EC stable but pH rising daily:** bicarbonate effect — pre-treat next reservoir fill with acid before adding nutrients (Guide 3).
- **Maximum EC for peppers: 3.2 mS/cm.** Above this, salt stress causes tip burn, blossom drop, and stunted fruit.

6.6 Environmental control

Three new acronyms appear in the tables below. **VPD** (*vapor pressure deficit*, in kPa) is the driving force for transpiration — the difference between how much moisture the air holds and how much it could hold. **PPFD** (*photosynthetic photon flux density*, in $\mu\text{mol}/\text{m}^2/\text{s}$) is the instantaneous photosynthetic light intensity at the leaf surface. **DLI** (*daily light integral*, in $\text{mol}/\text{m}^2/\text{day}$) is the total photosynthetic light dose received over a 24-hour period — PPFD integrated across the photoperiod.

VPD targets for hydroponic peppers

Stage	Temp	Humidity	VPD (kPa)	Dragoon Season
Seedling	72–77°F	70–80%	0.4–0.8	Indoor Jan–Mar
Early vegetative	72–82°F	60–70%	0.8–1.1	Indoor/outdoor Apr–May
Late veg / pre-flower	75–85°F	55–65%	1.0–1.4	May–June
Flowering	70–82°F	50–60%	1.2–1.6	June–July (monsoon helps)
Peak fruiting	75–85°F	50–60%	1.2–1.6	July–Sept (ideal naturally)
Late harvest	65–78°F	45–55%	1.4–1.8	Sept–Oct (Dragoon fall peak)

LED lighting for indoor & greenhouse pepper growing

Scenario	PPFD Target	DLI	Photoperiod	Notes
Indoor seedlings	150–250 $\mu\text{mol}/\text{m}^2/\text{s}$	8–14	16–18 hrs	T5 or small quantum board 4" above canopy.
Indoor vegetative	400–600 $\mu\text{mol}/\text{m}^2/\text{s}$	20–30	16–18 hrs	Spider Farmer SF-2000 or equivalent. 18–24" above canopy.
Indoor fruiting	600–800 $\mu\text{mol}/\text{m}^2/\text{s}$	25–35	14–16 hrs	High-output quantum board. Drop to 16 hrs to simulate seasonal change.

Scenario	PPFD Target	DLI	Photoperiod	Notes
Greenhouse supplement	200-400 $\mu\text{mol}/\text{m}^2/\text{s}$ (supplemental)	Adds 8-15 to natural DLI	2-4 hrs extension only	LED bar lights at dawn/dusk to extend photoperiod. Very cost effective.
Rocoto (summer)	200-400 $\mu\text{mol}/\text{m}^2/\text{s}$ (filtered)	12-18	14-16 hrs	Rocoto needs shade in summer. 30-40% shade cloth + LED morn-ing/evening gives ideal levels.

Blossom drop prevention in hydroponics

- **Reservoir stability is your best tool** — consistent EC and pH prevents the nutrient stress that triggers flower drop in soil growing.
- **Temperature:** flowers drop above 90°F daytime or below 55°F nights — the Dragoon monsoon resolves both; June pre-monsoon is highest risk.
- **High EC at flowering:** EC above 3.0 during bloom causes osmotic stress and blossom drop — keep EC at 1.8-2.2 through flowering.
- **Thrips damage flowers directly** — yellow sticky traps near flowering plants; inspect weekly.
- **Monsoon advantage:** cooler nights in July trigger a second major flush of flowering on plants that dropped buds in June heat.

6.7 Rocoto in hydroponics — the three weak points

The species biology and the universal growing protocol live in §3. The hydroponic deltas are reservoir-temperature management, in-system trellising, and in-bucket overwintering.

Problem	Why It Matters in Hydro	Dragoon Solution
Reservoir temp > 72°F	Rocoto is cool-adapted — warm root zones cause Pythium faster than in any other pepper	Bury or insulate reservoir. Use Dutch Bucket, not DWC, above 90°F days. Place on east-facing slope so afternoon shade hits the bucket, not just the canopy.
Plant gets 5-8 ft tall and semi-vining	A 5-gal bucket tips under that weight once fruit sets	Cage at transplant. Train main stem along a trellis from day 1. Anchor bucket to bench with a strap. (Full multi-string spec in §7.)
Truly perennial — 15+ years	Repotting every fall wastes the root mass that makes year-2+ plants so productive	Overwinter in the Dutch Bucket with reduced-EC maintenance solution — see §10.

6.8 Hydroponic seasonal calendar

Month	Key Hydroponic Tasks	System Status
January	Start Rocoto and habanero in rockwool under LEDs. Set up heat mats. Mix dilute seedling solution (EC 0.6). Clean and test all meters.	Rocoto in rockwool; LED seedling stage
February	Start all <i>C. annuum</i> varieties in rockwool. Set up and test reservoirs. Order Masterblend, Epsom salt, and Calcium Nitrate. Order RO filter if needed.	Pepper seedlings under grow lights
March	Pot up seedlings as roots emerge from rockwool. Begin vegetative nutrient solution (EC 1.4-1.8). Inspect system for leaks. Set up monsoon water collection.	Seedlings 4-6" tall in net pots

Month	Key Hydroponic Tasks	System Status
April	Transition outdoor systems. Insulate/bury reservoirs before heat arrives. Install shade cloth. Watch for late frost — bring indoors if below 40°F.	Moving to outdoor systems
May	All plants in outdoor systems. EC at vegetative level (1.4-1.8). Daily pH and EC checks. Stake large varieties immediately.	Rapid vegetative growth
June	First flower buds — reduce EC slightly to 1.8-2.2. Reservoir management critical in pre-monsoon heat. Check reservoir temp daily — must stay below 72°F.	Flowering; blossom drop risk
July	MONSOON BEGINS. High humidity — watch for powdery mildew and aphid surges. Increase Epsom salt to 2.4 g/gal (fruit sizing). Rocoto flowering heavily — perfect conditions.	Fruit sizing; monsoon rain
August	Peak production — <i>C. annuum</i> harvest begins. Change reservoirs every 7 days during peak fruiting. EC at 2.2-2.8 for fruiting stage.	Harvest jalapeños, serranos, cayenne
September	● BEST MONTH. Cool nights return — plant vigour surges. Harvest all fully ripe varieties. Rocoto at peak. Change reservoir weekly. Keep EC at fruiting level.	Peak harvest all varieties

Month	Key Hydroponic Tasks	System Status
October	Harvest continues. Frost watch begins. Move container systems indoors before first frost. Rocoto — pot up and bring inside. Begin transitioning to LED indoor winter grow if desired.	Final harvest; indoor transition
November	Overwinter selected plants indoors under LEDs. Reduce EC to 1.2-1.4 (semi-dormant maintenance). Dry and process harvest. Clean outdoor system for storage.	Indoor overwintering; preservation
December	Overwintered plants under LED at 16 hrs. EC 1.0-1.4 — minimal feeding. Plan next season. Order seeds. Review reservoir notes from past season.	Semi-dormant indoor growing

7 · Staking, Pruning & Support

Cages, single string, multi-string per variety — the commercial greenhouse method, adapted to outdoor Dragoon plots

Pepper plants at the Dragoons' productive elevation can become large and heavily laden. The right support prevents broken branches, maximises fruit production, and — especially in Bato buckets — keeps the whole assembly from tipping in monsoon wind. This chapter unifies the soil staking notes from the old Guide A with the full overhead-string trellising system used in commercial Bato bucket production.

7.1 Support philosophy

Commercial hydroponic pepper growers — in the Netherlands, Israel, Mexico, and across North America — converged on the same support system decades ago. Not because it looks tidy, but because it outperforms every alternative on yield, labour, and disease prevention.

- **Vertical airflow.** A trained vertical plant has open space between stems. Air moves freely, humidity drops, fungal pressure drops with it. A caged or sprawling plant is a microclimate for *Botrytis* and powdery mildew.
- **Maximum light interception.** Each leaf tier is presented to the sun without shading the tier below. Horizontal sprawl wastes light on leaves that already have full coverage.
- **Gravity-assisted fruit set.** Peppers hanging vertically on a trained stem have better air circulation around the flower and developing fruit, reducing blossom drop in humidity.
- **Harvest efficiency.** You find every fruit. No hunting inside a cage or through tangled lateral growth.
- **Bucket stability.** The overhead line carries the plant weight. The bucket anchors the root ball — that is its only structural job.

The same philosophy applies in raised beds with one modification: the overhead line becomes a trellis wire stretched between two T-posts at row ends. Everything below is the same.

What to avoid

Approach	Why It Fails
Tomato cage	Works on young plants; becomes a tangle by mid-season. Harvesting jalapeños or cayenne from a cage at peak production costs 3× the labour of string-trained plants. Hard to anchor in a bucket.

Approach	Why It Fails
Chicken wire wrap	Over-engineered and counterproductive. Blocks airflow, traps moisture against stems, and makes every pruning cut a minor surgery. Inspect time doubles.
Unsupported free-standing	Fine for small jalapeños in ground soil. In a lightweight Bato bucket, a heavy Poblano or Rocoto plant will tip in any meaningful gust.
Single central stake only	Adequate for jalapeños and cayenne. Insufficient for multi-stemmed Poblanos and disastrous for a mature Rocoto.

Set the string before the plant. Drop a string from the overhead line and pin it temporarily to the growing medium surface *before* the seedling is established. Retrofitting support strings onto a bushy pepper plant is unnecessarily difficult — set the infrastructure first.

7.2 Universal practices

These apply to every variety in every system:

- **Stake at transplant time** — not when plants are leaning. Late staking damages roots. Drive a 3-ft stake 6" from the plant.
- **Tie loosely with soft cloth, jute, or silicone tomato clips** — wire or twist ties cut into stems. Reposition as the plant grows.
- **Pinch the growing tip at 6-8" height** — this forces branching and creates a bushy plant with many more fruiting sites than a single stem. (Skip on Rocoto and indeterminate trellis-trained plants.)
- **Remove the first flower buds on transplants for 2-3 weeks** — redirects energy into root and canopy development, resulting in significantly higher total yield.
- **Remove leaves below the first fork** — improves airflow, reduces fungal splash from monsoon rain, and focuses energy upward. This is the single highest-impact pruning act for any pepper.

7.3 Variety-by-variety support

Jalapeño · *C. annuum* · 2-3 ft

The easiest of the four to support. Naturally upright, relatively compact, modest fruit weight.

- **One string per plant** dropped from the overhead line. Loose loop at the base of



Figure 2: A dual-row bato bench under hanging LED rails. The overhead rail does double duty — it lights the canopy and anchors the per-plant support strings dropped to each bucket.

the main stem — never tie directly to the stem.

- **Tomato clip every 6-8 inches** of new stem growth.
- Allow the natural fork at 8-12 inches. Both branches share the single string, or add a second string for the secondary branch.
- At mature height, wrap the growing tip around the overhead line or add a final clip.
- **Pruning:** remove all growth below the first fork. No further pruning required for most plants.

Cayenne · *C. annuum* · 2-3 ft

Same species and height as jalapeño, but a heavier producer with arching brittle lateral branches that snap under fruit weight.

- **One string per main stem; plan for two by mid-season.**
- As lateral fruiting branches extend outward, **loop a soft tie to the vertical string** — this redirects the lateral upward slightly and prevents drooping.
- Do not try to force cayenne vertical the way you would a tomato. Its arching habit works *with* the string, not against it.
- **Pruning:** clear below the first fork. Remove any lateral growing downward. At end of season, top growing tips to push energy into ripening fruit.

Poblano · *C. annuum* · 3-5 ft

Where casual support strategies break down. Wide canopy, heavy fruit (2-4 oz each, 15-25 per plant), multiple strong lateral stems.

- **Multi-string per plant.** Treat each major stem as an independent plant — 3-4 strings per plant typical.
- Drop strings from the overhead line at 6-8 inch intervals *before* the plant establishes its branching pattern.
- Use **5 ft stakes** (not 3 ft) anchored to the overhead line. Poblanos exceed 4 ft.
- **Pruning is mandatory, not optional.** Select 2-3 main stems max from the first fork; remove the rest. Remove inward-facing laterals as the plant grows. Snap off the **king flower** (the bud at the first Y junction). Top growing tips at peak height to push energy into fruit sizing.

Bucket tip risk on poblano is high. Always anchor a 5-ft stake alongside the bucket and tie it to the overhead line. A mature poblano in an unsupported Bato bucket will tip in any monsoon gust.

Rocoto · *C. pubescens* · 4-6+ ft

A different species, a different problem. Semi-indeterminate vine that elongates past 6 ft if not managed, branches prolifically, fruits on both old wood and new growth. The overhead line is structurally essential.

- **2-3 strings per plant**, spaced 6–8 inches apart.
- Select **2 main stems strict** from the initial fork. Remove all others. Rocoto is a heavy feeder; 3+ stems starve each other.
- Train each stem vertically, clipping every 8 inches. Rocoto stems are flexible enough to **spiral loosely around the string**.
- When a main stem reaches the overhead line, **loop it over and let it descend on the other side** (“lowering” — the commercial greenhouse technique). For outdoor setups without vertical clearance: top at the line and train lateral branches horizontally along a parallel wire.
- **Aggressive ongoing pruning.** Clear below first fork. Remove basal shoots weekly. Identify and remove “blind” (non-fruiting) shoots at 3–4 inches. Monthly walk: remove inward and downward laterals. **Do not prune in high heat** — early morning or cloudy days only.
- **Fruit set requires nights below 65°F.** Hard biological requirement, not a preference. Expect heavy blossom drop in June heat followed by sudden heavy set in late summer — this is normal, not a problem.
- **6 ft+ stakes** — Rocoto reaches the overhead line and keeps going.
- **Overwintering value is highest of any variety** — see §10.

Other large varieties

- **Habanero / Scotch Bonnet / Ghost.** Treat as poblano: 3–4 strings, 5 ft stakes, king-flower removal. Long fruiting season demands the same discipline.
- **Aji Amarillo.** Tall (36–48”). Single-string method like jalapeño with one extra string for the inevitable second fork. Stake 5 ft minimum.
- **Bell.** Multi-string like poblano if the variety is large; single string for compact varieties.
- **Chiltepin.** Cage tolerated. In a Kratky jar, no support needed — small plant, small fruit.

7.4 Shade cloth management

Situation	Solution
June pre-monsoon heat above 95°F	30% shade cloth over pepper beds. Reduces leaf temp 10–15°F and prevents blossom drop.
Rocoto in summer	40–50% shade on south and west sides. Rocoto needs shade during the hottest months.
Transplant establishment (May)	Light shade cloth first 2 weeks after transplanting reduces transplant shock from high UV.

Situation	Solution
Fall (Sept-Nov)	Remove all shade cloth. Full sun maximises ripening during the best growing season.

7.5 How to make peppers hotter

The Dragoons' diurnal swings and sunny days already produce hotter chiles than most growing regions. These additional techniques maximise capsaicin:

- **Reduce water in final 2-4 weeks before harvest** — mild stress (not drought) increases capsaicin production significantly. In hydroponics, reduce reservoir topping-off frequency; in soil, stretch the drip interval.
- **Reduce nitrogen after fruit set** — high-N dilutes capsaicin. Switch to potassium-focused feeding. In hydro, drop Masterblend from 3.0 to 2.0 g/gal in the last 3 weeks while keeping Epsom and Cal-Nitrate full.
- **Let fruit ripen fully on the plant** — red jalapeños are 2-3× hotter than green ones.
- **Full sun maximises heat** — remove shade cloth once monsoon cools things down.
- **High PPFD accelerates capsaicin** (indoor only) — push to 700-800 $\mu\text{mol}/\text{m}^2/\text{s}$ in the final 2-3 weeks.
- **Grow Chiltepin** — the native local variety is already among the hottest *C. annuum* peppers in existence.

7.6 Hardware checklist

Item	Purpose & Notes
12-gauge galvanised wire or 1" EMT conduit	Horizontal anchor line — run between two posts at 5-7 ft height.
EMT conduit posts or wood stakes (7-8 ft)	Vertical supports for the overhead line — 2 ft in ground, 5-6 ft above.
Tensioners / turnbuckles	Keep overhead wire taut under full plant load — essential for multi-bucket rows.
Soft tomato twine or jute string	Vertical drop strings. Avoid monofilament or fishing line, which cuts into stems.
Silicone tomato clips (100 pack)	Primary stem attachment — reusable, no cutting, opens flat to adjust (~\$10/100).
Bamboo stakes (3 ft jalapeño/cayenne, 5-6 ft poblano/rocoto)	Secondary bucket anchor — drive alongside bucket, tie to overhead line.
Soft cloth strips or Velcro plant ties	Additional lateral branch support on Poblano and Rocoto.

Item	Purpose & Notes
Bypass pruners	Sharp, clean cuts. Disinfect between plants with dilute bleach.

A full support setup for a 4-plant row costs \$35–55: overhead wire and posts are the main investment, reusable across many seasons. Tomato clips (\$10/100) and string (\$8 per spool) are the only recurring costs. Economics improve significantly at scale.

8 · Pest & Disease Management

One table, soil and hydroponic columns — for the same Dragoon pest spectrum

Most of the pests below apply to both soil and hydroponic plants. The two material differences are: (1) the soil-bed-only pests (cutworms at transplant, javelina, grasshoppers in drought years) — those drop off if your system is on a sealed patio or indoors; (2) the hydroponic-only problems — *Pythium* root rot, reservoir algae, and rockwool fungus gnats — are reservoir-borne and rare in soil. Outdoor Bato buckets get both columns.

Pest / Problem	Season	Signs	Soil Control	Hydroponic Control
Aphids ● most common	Spring & Fall	Dense clusters on new growth; sticky honeydew; ants farming them	Water blast, insecticidal soap, neem oil. Plant basil nearby. Ladybugs.	Same. Hose blast is gentler around net pots — use spray bottle.
Spider mites	June (hot dry)	Tiny webbing under leaves; bronzed, stippled foliage	Mist in morning to raise humidity. Neem or insecticidal soap. Avoid broad-spectrum pesticides.	Same — humidity rise easier indoors.
Thrips	Spring-Summer	Silvery scars on leaves and fruit; distorted new growth; dropped flowers	Yellow / blue sticky traps. Spinosad. Remove affected leaves.	Same.
Pepper weevil	Summer	Small holes in green fruit; premature drop; internal larvae	Remove dropped fruit immediately. Neem on developing fruit. Pyrethrin last resort.	Same.

Pest / Problem	Season	Signs	Soil Control	Hydroponic Control
Cutworms	Spring — transplant time	Seedlings cut off at soil level overnight	Cardboard collar 2" into soil. BT drench. Diatomaceous earth.	Soil only — irrelevant indoors. Cardboard collar still works for outdoor patio Bato buckets.
Grasshoppers	June-Sept (drought years)	Rapid defoliation	<i>Nosema locustae</i> bait. Row covers. Kaolin clay spray. Chickens if nearby.	Soil/outdoor only.
Javelina	Year-round	Entire plants uprooted; strong musk smell	Low-voltage electric fence around bed. Welded-wire cage in first season.	Soil/outdoor only. Bato bucket rows on a fenced patio sidestep this entirely.
Bacterial wilt (Phytophthora)	Post-monsoon rain	Sudden wilt despite wet soil; dark basal crown	No cure — remove plant + surrounding soil. Improve drainage. Rotate solanaceae every 3 years.	Remove affected plant; replace media; flush system. Rotate system location.
Blossom end rot	Peak fruiting	Dark sunken spot on fruit bottom	See §5.4 — consistent watering + pH 6.0–7.0 prevents nearly all cases.	See §6.5 — pH 5.8–6.2, EC < 3.0, Cal-Nitrate mixed last. Almost always a dosing or pH problem, not a Ca deficit.
Sun-scald	June–August	White papery patches on fruit facing the sun	30% shade cloth. Leave enough foliage to shade fruit. Orient rows north-south.	Same.

Pest / Problem	Season	Signs	Soil Control	Hydroponic Control
Powdery mildew	Monsoon season	White powder on leaves — mainly in dense canopy	Improve airflow. Dilute milk spray (1:9). Potassium bicarbonate spray. Increase spacing.	Same. Vertical string trellising (\$7) is the best preventative.
Pythium root rot ● #1 hydro threat	Peak summer — reservoirs > 72°F	Brown/slimy roots; wilting despite full reservoir; sour smell	Rare in soil with good drainage.	Drop reservoir temp below 72°F — bury, insulate, shade. Flush system. Dose 3 ml/gal of 3% hydrogen peroxide. Replace media if severe.
Algae in reservoir	Year-round, worse in summer	Green film on reservoir walls and net pots	n/a	Cover reservoir completely. Use opaque black/blue tubs. Clean between reservoir changes.
Fungus gnats	Cool season in rockwool transition	Small black flies around net pots; larvae in rockwool	n/a	Top-dress with sand or perlite. BTi (Gnatrol) drench on rockwool. Yellow sticky traps.

9 · Harvest, Drying & Processing

When to pick · green vs. red · drying · powder · sauce

Harvest timing and processing are identical for soil-grown and hydroponic peppers — the chemistry of capsaicin and ripening doesn't care about the root medium. Most peppers can be harvested at two very different stages — green (unripe) or fully coloured (ripe) — and each gives a completely different flavour, heat level, and culinary use. The Dragoon fall season gives you excellent natural drying conditions for chile powder and ristras.

Harvest guide by variety

Variety	Harvest Green?	Harvest Ripe?	Colour at Ripe	Dragoon Timing
Jalapeño	Yes — firm, dark green	Yes — red, sweeter and hotter	Red	Aug-Oct
Poblano	Yes ● — classic use; dark green = poblano	Yes — dried red = ancho chile	Red/Dark Red	Aug-Oct
Serrano	Yes — green has brighter flavour	Yes — red/orange is hotter	Red or Orange	Aug-Oct
Cayenne	No — wait for red	Yes ● — dry when fully red	Red	Sept-Oct
Anaheim / Hatch	Yes ● — roast green	Yes — dried red = California chile	Red	Aug-Sept
Habanero	No — wait for full colour	Yes ●	Orange/Red/Chocolate	Sept-Oct
Chiltepin	No — wait for red	Yes ●	Red	Sept-Oct
Rocoto	No — wait for full colour	Yes ●	Red/Orange/Yellow	Sept-Oct (after monsoon cools)
Bell Pepper	Yes — green bell	Yes — red/yellow/orange; sweeter	Red/Yellow/Orange	Aug-Oct

Drying methods for the Dragoon climate

The Dragoon fall season — dry, warm days with low humidity — is perfect for traditional sun-drying and ristra-hanging. This is exactly the climate New Mexico chile growers prize.

Method	Best Varieties	How To	Time
Sun drying ● Best in Dragoons	Cayenne, Chiltepin, Serrano, thin-walled chiles	Lay on wire racks in full sun. Bring in at night. Turn daily. Done when fully dry and brittle.	7-14 days
Ristra (hanging)	Hatch, Anaheim, Cayenne, Chiltepin	Thread through stems with needle and twine. Hang in shade with good airflow. Traditional Southwest method.	3-6 weeks
Oven drying	All varieties	Slice or leave whole. 150-170°F with door cracked. Check every 2 hours.	4-12 hours
Dehydrator	All varieties	125-135°F setting. Slice thick-walled varieties. Single layer on trays.	8-24 hours
Smoke drying (chipotle)	Jalapeño → Chipotle	Cold-smoke over local mesquite or oak 2-3 days. Dragoon area has excellent mesquite for this.	2-3 days

LOCAL TIP

Local mesquite is abundant in the lower Dragoon foothills and Sulphur Springs Valley. Slow-smoking red jalapeños over mesquite wood for 2-3 days produces traditional chipotle with a distinct Dragoon terroir — an artisan product worth making.

End-of-crop hydroponic flush. At the end of a hydroponic plant's life — *not* for overwintered plants — run the H₂O₂ + vinegar system flush from Guide 3, §7 before the next crop goes in. Everything else about harvest and processing is identical for soil and hydroponic.

10 · Overwintering Peppers

Indoor storage · containers · in-bucket hydroponic perennials

Pepper plants are perennial in frost-free climates. At Dragoon elevation, frost ends outdoor growing in October–November, but bringing selected plants indoors for winter restarts them 6–8 weeks ahead of a new plant the following spring — and Rocoto plants are worth keeping alive for decades. This chapter covers both the in-ground/container protocol and the hydroponic in-bucket variant.

10.1 Which varieties are worth overwintering?

Variety	Worth Overwintering?	Why
Rocoto / Manzano (<i>C. pubescens</i>)	●● Absolutely — treat as a permanent plant	Lives 15+ years. Gets more productive each year. Too slow-growing to replace annually.
Habanero / Scotch Bonnet	●● Yes — strongly recommended	Takes 2+ years to reach peak production. Year-2 plants produce 3–4× more than seedlings.
Ghost Pepper / extreme heat	●● Yes — the only way to get reliable harvest	Needs 100–120 day season. Year-2 plants already at full size at bud break.
Chiltepin (native)	● Yes, or let self-seed in protected microclimate	Perennial in the Dragoons if sited against a south-facing wall or rock. Some plants survive mild winters in protected spots.
Jalapeño, Serrano, Cayenne	Optional — mainly for fun	Easy to grow from seed. Overwintering gives 4–6 week head start. Low priority.
Bell Pepper	Not worth it	Inexpensive seedlings. Poor indoor performer. Start fresh annually.

10.2 Soil / container overwintering protocol

1. **Cut back hard before bringing in.** In early October, prune plants back to 6–8" stubs, leaving 3–4 main branches. This reduces transpiration and makes indoor plants manageable.
2. **Inspect and treat for pests.** Check carefully for mites, aphids, and scale before bringing inside. Treat with insecticidal soap spray and let dry before moving

indoors.

3. **Pot up if needed.** Rocoto and habanero do best in 5-gallon containers minimum. Use well-draining mix: 60% potting soil + 40% perlite.
4. **Place under grow lights.** 16 hours of LED light per day. Plants are semi-dormant and need less than during summer.
5. **Water sparingly.** Every 7–10 days — just enough to prevent complete desiccation. No fertiliser until February.
6. **Resume feeding in February.** Start fish emulsion or compost tea in February. Plants will push new growth rapidly.
7. **Harden off and return outdoors in May.** Acclimatise for 1–2 weeks as you would a seedling. Year-2 plants will explode into production within weeks of going back out.

10.3 Hydroponic in-bucket overwintering protocol

The whole point of hydroponic overwintering is to **keep the plant in its Dutch / Bato bucket all winter** rather than repotting. Root mass stays intact — this is what makes year-2+ plants so explosive in spring.

1. **Cut back hard in early October.** Same as soil: prune to 6–8" stubs, 3–4 main branches.
2. **Inspect and treat for pests.** Check carefully for mites, aphids, and scale before bringing inside. Insecticidal soap, let dry.
3. **Keep plant in its hydroponic container.** Leave Rocoto and habanero in their Bato / Dutch buckets with perlite media. No repotting.
4. **Switch to maintenance solution.** EC 1.0–1.2 with the standard Masterblend ratio. Change reservoir every 3–4 weeks over winter. Plants are semi-dormant; uptake is minimal.
5. **Reduce light and water.** 16 hrs LED at reduced intensity (PPFD 200–300). Top off reservoir weekly rather than daily.
6. **Resume feeding in February.** Bring EC back to vegetative level (1.4–1.8). Year-2 Rocoto especially will push new growth rapidly.
7. **Harden off and return outdoors in May.** Same 1–2 week acclimatisation as a seedling. Year-2 hydroponic Rocoto in the original Bato bucket will explode into production within weeks.

LOCAL TIP

A Rocoto in a Bato bucket is a strong overwintering candidate — lift the entire bucket indoors under grow lights. A year-2 Rocoto in an established Bato bucket system produces 3–5× more fruit than a first-year plant and needs no re-establishment time in spring. The bucket makes it logistically simple — lift and move.

11 · Sources & references

Reference material consulted, suggested for further reading, and where to verify or extend the claims in this guide.

Local resources

- **UA Cooperative Extension — Cochise County office (Sierra Vista)** — soil testing, variety advice, IPM consultations, and the *Vegetable Variety Recommendations for Arizona* bulletin. Phone 520-458-8278.
- **Native Seeds/SEARCH (Tucson)** — the regional source for adapted heritage seed of Chiltepin, Hopi corn, teparies, and other Sonoran Desert crops. The Chiltepin seed sold here is the canonical local genetic stock.
- **Borderlands Restoration Network (Patagonia)** — native plant, pollinator, and seed resources for the SE Arizona sky islands.
- **Willcox feed stores and Sulphur Springs Valley alfalfa producers** — bulk alfalfa hay and compost for soil amendment; mesquite for chipotle smoking.

Books & references

- *Growing Food in a Hotter, Drier Land* by Gary Paul Nabhan — Sonoran Desert food crops, native pepper history, and dry-adapted growing techniques. The single most relevant book for the Dragoons.
- *Southwest Foraging* by John Slattery — wild edibles of the Cochise County region, including identification notes on the wild Chiltepin and useful canyon-wash flora.
- *The Pepper Garden* by Dave DeWitt & Paul W. Bosland — variety reference, SHU ratings, and cultivation notes for every cultivated *Capsicum* species.
- *Hydroponic Food Production* by Howard Resh — the standard reference for commercial hydroponic systems; the Dutch / Bato bucket lineage starts here.
- *Plant Propagation: Principles and Practices* by Hartmann & Kester — for seed starting, scarification of tough-coated wild species like Chiltepin, and overwintering cuttings.

Online resources

- **UA Cooperative Extension publications** (extension.arizona.edu) — *Vegetable Variety Recommendations for Arizona*, pH and salinity management bulletins, and Sonoran-specific IPM guides.
- **Chile Pepper Institute, New Mexico State University** (cpi.nmsu.edu) — variety database, Hatch / Anaheim cultivar specifics, and SHU reference data for the Southwest chile region.
- **OMRI (Organic Materials Review Institute)** (omri.org) — verify any input for organic certification before applying.
- **PennState Extension IPM bulletins** (extension.psu.edu) — generic integrated pest management references for pepper-specific pests (thrips, weevils, aphids,

mites) that apply with minor adaptation in the Dragoons.

The Dragoon Mountains are ancestral pepper country. The wild Chiltepin has grown here for millennia, and the cool nights, monsoon rains, intense fall sunshine, and mineral-rich soils create conditions that produce peppers of exceptional flavour, heat, and character. From native Chiltepin growing wild in the washes to Andean Rocoto thriving in the cool evening air — whether in raised beds amended with sulfur, or in a Bato bucket with its reservoir buried against the high-desert heat — this landscape was made for chile.