Foundations: Soil & Seed

Guide 11 · Foundations Reference

Version 2026.05 · Revised 2026-05-16

Soil-Building · Composting · Seed Starting · Propagation

Contents

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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** · IPM + Cochise wildlife - **Guide 11 — Foundations: Soil & Seed** (this guide) · soil-building, composting, seed starting, propagation - **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 soil-building, composting, seed starting, and propagation. The crop guides defer here for these topics. Where this guide touches irrigation water, the bicarbonate routine and water-sourcing reference is in **Guide 13** (and the hydroponic version in **Guide 3 §4**); the hydroponic nutrient line — Masterblend ratios, EC-by-stage, pH-up/pH-down replacements for alkaline Cochise water — is in **Guide 4**; pest-driven decisions (damping-off, soil-borne fungi, seedling cutworm) cross-reference **Guide 10**; season-extension structures that let you stretch the seed-start window are **Guide 14**.

How to use this guide

Two questions sit upstream of every crop guide in this library: *what is the soil under the plant doing*, and *where did the plant come from*. This is the reference where those two questions are answered in depth. Every other guide assumes you know what is in here.

The guide is in two parts:

1. **Part 1 — Soil-building for the Dragoons** (chapters 1–11). The Dragoons baseline, how to read soil, the amendments that move it where you want it, the four composting methods that work in dry-air country, manure sourcing, cover crops, mulching, and a five-year soil-building plan.
2. **Part 2 — Seed starting & propagation** (chapters 12–24). Seed sourcing, the indoor seed-start setup, germination temperatures by crop, direct-sow vs transplant logic, hardening off, asexual propagation (slips, cuttings, divisions, air layering), saving your own seed, and a month-by-month seed-start calendar for the Dragoons.

The two halves connect at the bed. A transplant is only as good as the soil it goes into; a perfectly amended bed wastes the season if you sowed a 90-day variety on June 1. Both halves have to land for a Dragoons garden to perform.

If you're new here, read three things first. §1.1 — the Dragoons soil baseline (alkaline, low organic matter, caliche close to the surface) explains why you can't just follow a Pacific-Northwest gardening book. §16 — the germination temperature table tells you when to start every common crop. §24 — the month-by-month seed-start calendar tells you what to start *this week*. Cover those three and you have the operating manual for the first season.

LOCAL TIP

The two single best returns on investment for a new Dragoons garden are (1) a **soil test** from the University of Arizona Cooperative Extension's Cochise County office — about $50 for a full nutrient panel and pH/EC/OM, and the only way to know what you're actually starting with — and (2) a **finished-compost subscription**: 2–3 cubic yards a year, delivered. The Dragoons soil moves toward "good" only with annual investment, and both of those investments compound. Almost everything else in this guide is detail on top.

Part 1 — Soil-building for the Dragoons

1 · Why soil-building is the biggest lever

The Dragoons baseline · what compounds over years · the OM-percentage target

Most of what separates a productive Dragoons garden from a struggling one is not variety choice, not irrigation gear, not pest pressure — it is the soil. Hydroponics is the explicit workaround (Guides 2 and 3); for everything growing in the ground, soil is the system. And the Dragoons soil baseline is honest about what it asks of you: alkaline, low in organic matter, well-supplied with mineral calcium and magnesium from the same caliche that gets in your way, and shallow enough in many sites that the caliche pan itself defines the root zone.

1.1 The Dragoons soil baseline

These numbers describe a typical unworked Dragoons bed at 4,500–5,000 ft elevation in the foothills of the range. Site-to-site variation is real — a wash-bottom site can read pH 7.4 and 3% OM, an exposed ridge can read 8.3 and 0.6% — but this is the central tendency.

Parameter	Dragoons typical	What target soils look like	Implication
pH	7.6 – 8.1	6.0 – 7.0 (most vegetables)	Most micronutrients are partially locked out at this pH; acidification is the highest-leverage chemistry change
Electrical conductivity (EC)	0.4 – 1.2 mS/cm	0.3 – 0.8 mS/cm	Variable — irrigation history and manure history dominate
Organic matter (OM)	1 – 2%	4 – 6% (productive vegetable soil)	The single biggest deficit; nearly every amendment in chapter 3 is aimed at this number
Texture	Sandy loam to loamy sand; gravel in many sites	Loam to silt loam	Drains too fast; needs OM to hold water
CEC (cation exchange capacity)	8 – 15 meq/100 g	15 – 25 meq/100 g (vegetable soil)	Low — fertilizer leaches fast; small frequent feedings beat big single ones

Parameter	Dragoons typical	What target soils look like	Implication
Calcium	High (3,000 – 6,000 ppm)	1,500 – 3,000 ppm	Abundant from caliche; you almost never need to add calcium
Magnesium	Adequate to high	300 – 600 ppm	Usually fine; Mg deficiency in the Dragoons is almost always a pH-lockout symptom, not a real deficit
Phosphorus	Variable — often locked by pH	30 – 50 ppm available	Even when total P is fine, *available* P is low at pH > 7.8
Iron, zinc, manganese	Total fine; available locked	Available 4 – 10 ppm	Alkaline lockout — visible as interveinal chlorosis on young leaves
Caliche depth	8 – 36 inches	No hardpan	Site-specific; rebar-probe before planting (chapter 3 §3.6)

The Dragoons baseline in one sentence. Alkaline (pH ~7.8), low in organic matter (~1.5%), well-drained to a fault, and underlain by a calcium-carbonate hardpan (caliche) that may be 8 inches down or 3 feet down depending on the site. Almost everything in Part 1 of this guide is built on that one sentence.

1.2 Why annual investment compounds

A first-year Dragoons bed at 1.5% OM is producing food, but it is producing food the hard way — fast irrigation cycles, frequent fertigation, narrower margins on every crop. Each season's compost top-dress and cover-crop turn-under adds organic matter. The math is slow but real:

- A 2-inch annual top-dress of finished compost into a 10-inch root zone, fully incorporated, raises OM by roughly 0.5–0.8 percentage points per year — and that number drops over time because microbial respiration burns OM continuously in warm dry soil.
- A turned-under cover crop adds another 0.2–0.4 percentage points per year, depending on biomass.

- Counter-eroding all of that is **mineralization** — the warm dry Dragoons climate burns OM faster than a cooler or wetter region would. The equilibrium ceiling for unirrigated desert soil sits around 1–2% OM; an irrigated, mulched, annually amended Dragoons bed can stabilize at 4–6% OM if you keep at it.

Year 1 to year 5 is where the gains are most visible. Bed water-holding doubles. Irrigation frequency drops. Color and texture change — the soil becomes darker, crumbles in your hand, smells like a forest floor instead of like dust. The full multi-year plan is in chapter 11.

> **LOCAL TIP**
>
> Take one photo of your bed surface every September, from the same angle, with a quarter (or a hand) for scale. Five years of photos tells the soil-building story better than any data table — and the visible difference between year 1 and year 5 is what keeps the routine going through the unrewarding middle years.

2 · Reading your soil

pH · EC · OM · texture (the jar test) · the UA Cooperative Extension panel

Before you amend anything, know what you have. A Dragoons garden ruined by random sulfur additions is just as broken as one ruined by neglect — overshooting pH or salinity is harder to fix than starting alkaline.

2.1 The four numbers that matter

These are the four readings worth knowing for any soil bed in the Dragoons. Everything else (boron, sulfate, sodium, individual micros) is useful detail; these four set the strategy.

Reading	What it tells you	How to measure	Frequency
pH	Whether nutrients are chemically available to roots	Inexpensive probe ($30) or send-out lab	Annual, plus any time growth looks “stuck”
EC (electrical conductivity)	How salty the soil is (fertilizer + native salts)	Same probe (many do both); or lab	Annual, more often if you use manure
OM (organic matter, %)	How much carbon is in the soil — proxy for water retention, biology, CEC	Send-out lab (loss-on-ignition); estimate visually	Every 2–3 years
Texture	Sand / silt / clay ratio — drives water and nutrient behavior	Jar test (free, §2.4) or lab	Once per site; doesn’t change

2.2 pH — the master variable

pH (the chemistry term for acidity / alkalinity, on a 0–14 scale where 7 is neutral) determines whether the nutrients in your soil are *available* to plant roots. The Dragoons soil is alkaline (pH 7.6–8.1) because of three converging conditions: arid climate (rainfall does not leach calcium carbonate out of the profile), parent material rich in limestone and granite, and caliche close to the surface.

At pH 7.8 and above:

- **Iron, zinc, manganese, copper** become partially insoluble — visible as interveinal chlorosis (yellow leaves with green veins) on the young growth of broccoli, peppers, blueberries, blackberries, and any acid-loving plant.
- **Phosphorus** binds with calcium to form insoluble calcium phosphates — the soil test reads “adequate” but the plant cannot reach it.

- **Boron, molybdenum, and sulfate** behavior changes; boron uptake declines.

Vegetables and most fruit trees prefer pH 6.0–7.0. Brassicas tolerate up to 7.5. Sweet potatoes prefer 5.5–6.5 (Guide 7). Grapes accept 6.0–7.0 (Guide 5). Blueberries demand 4.5–5.5 and are not realistic in unamended Dragoons soil at all.

2.3 EC — soluble salts

EC (electrical conductivity, in mS/cm or dS/m — the same unit) is a proxy for total dissolved salts in the soil solution. The Dragoons inherit a moderate native salt load from the parent material; irrigation water (chapter discussion in Guide 13) adds more. The dangerous combination is **feedlot manure** (often 4–8 mS/cm before aging) added to **already-salty soil** watered with **mineral-rich well water** — that stack produces salt-burn on transplants and a salt rind on the bed surface after warm dry weeks.

A workable target: bulk soil EC below 1.5 mS/cm (1:1 soil-water slurry method, which is what most home probes use). Above 2.0 mS/cm, you start losing salt-sensitive crops (carrots, onions, lettuce, beans). Above 3.0, almost nothing performs.

2.4 The jar test — measuring soil texture

Soil texture (the ratio of sand, silt, and clay) does not change over your lifetime. You only have to measure it once. The jar test is free and reliable.

1. **Dig a sample** to 8-inch depth. Discard the top half-inch (mostly mulch and organic debris). Crumble out roots and rocks. Aim for 1 cup of soil.
2. **Fill a clear quart jar half full** with the sample. Add water to about 80% full. Add a teaspoon of dish soap (this breaks up clumps).
3. **Cap and shake hard for 1 minute.**
4. **Set the jar on a level surface and wait.** Sand settles in 1 minute. Silt settles in 2 hours. Clay can take 24 hours or more.
5. **Read the layers.** Mark each band with a marker as it settles. Measure each band's thickness. Sand : silt : clay percentages by depth tell you the texture.
6. **Classify** using the USDA soil texture triangle. Most Dragoons sites land in sandy loam, loamy sand, or sandy clay loam.

A typical Dragoons reading: 65% sand, 20% silt, 15% clay — **sandy loam**. That texture drains quickly, holds little water, and holds little of any nutrient that isn't tied to organic matter. The fix is not changing texture (impractical) — it is adding organic matter (chapter 3).

2.5 The UA Cooperative Extension soil panel

The **University of Arizona Cooperative Extension** Cochise County office (520-458-8278, Sierra Vista) brokers soil samples through the University of Arizona soil-testing lab in Tucson. The standard agricultural panel runs about $50 and covers:

- pH, EC, lime requirement
- Organic matter (%)
- Available P, K, S, Ca, Mg, Na
- Available Fe, Zn, Mn, Cu, B
- Texture (estimated) and cation exchange capacity
- Recommendations for amendment

How to submit:

1. **Sample correctly.** 8 to 12 sub-samples from across the bed, mixed in a clean bucket, then 1 cup of the mixed composite submitted. Sample 6–8 inches deep for vegetable beds; 12 inches for orchard sites.
2. **Air-dry the sample.** Spread on newspaper for 2–3 days. Do not oven-dry — it skews several readings.
3. **Bag and label** with site, date, depth, intended crop.
4. **Drop off at the Sierra Vista office** or follow current submission instructions on the Cochise County Cooperative Extension web page. Results return in 2–4 weeks.

> **LOCAL TIP**
>
> Do the full panel once when you start a new bed, and then a cheaper pH/EC/OM-only panel every other year after that. The micronutrient readings do not move fast in irrigated soil; the macros and OM are the ones that change as you amend. Save the first full panel as your “year zero” baseline.

2.6 Home probes — what they’re good for

A $30 dual-probe soil meter (pH + moisture) is approximate but useful for **trend** rather than absolute number. Probes drift, and the calibration on cheap meters is rough. A reading of 7.6 from a probe might be 7.5 or 7.9; what matters is whether next month’s reading is higher or lower than this month’s. For absolute numbers, defer to the lab.

For EC, a hand-held conductivity meter (the same kind used for hydroponics — see Guide 4) works for a 1:1 soil-water slurry reading. Mix one part soil to one part distilled water by volume, stir, settle 30 minutes, decant, measure.

> **WARNING**
>
> **Do not use tap water for any home soil-test reading.** Cochise County tap water carries 0.6–1.0 mS/cm of its own dissolved minerals, which will swamp any soil EC reading. Use distilled water (gallon jugs at any grocery store) or rainwater for all home tests.

3 · Soil amendments for the Dragoons

Compost · aged manure · elemental sulfur · gypsum · biochar

This chapter is the amendment reference. Each amendment has a job. None of them are “fertilizer” in the immediate sense — they change the soil’s chemistry, structure, or biology over weeks to seasons, and the change is durable.

3.1 The amendment cheat sheet

Amendment	What it does	Application rate	Cost (Cochise County, 2026)	Dragoons fit
Finished compost	Adds OM, biology, slow-release N/P/K; buffers pH	2–3 inches/year, worked into top 8”	$40–$70 per cubic yard delivered	●●●●● — universal foundation
Aged horse manure	Adds OM, moderate N, K; some salts	1–2 inches/year, aged 6+ months first	Free to $20/load (chapter 8)	●●●●○ — workhorse if sourced clean
Aged cattle manure	Adds OM, slow N; higher salt	1 inch/year, aged 9+ months	$5–$15/cu ft bagged; free farm-direct	●●●○○ — watch the EC
Composted chicken manure	High N, P; very hot	½ inch/year max, fully composted	$10–$15 per 40-lb bag	●●●●○ — small amounts only
Elemental sulfur	Acidifies soil over months; lowers pH	1–2 lb / 100 sq ft per season	$15 per 25-lb bag	●●●●● — the pH lever
Gypsum (calcium sulfate)	Adds Ca and S without raising pH; flocculates clay	2–5 lb / 100 sq ft	$10 per 40-lb bag	●●●○○ — useful in salty or sodium-affected soil only
Biochar	Adds permanent C, CEC, micropore habitat for biology	5–10% by volume of root zone, one-time	$20–$40 per cu ft (or DIY)	●●●●○ — long-term play
Alfalfa meal	N, K, triacontanol (growth stimulant)	5 lb / 100 sq ft pre-plant	$20 per 40-lb bag (Willcox feed)	●●●●○ — local, balanced

Amendment	What it does	Application rate	Cost (Cochise County, 2026)	Dragoons fit
Feather meal	Slow-release N (12-0-0)	2 lb / 100 sq ft pre-plant	$25 per 25-lb bag	●●●○○ — clean N, slow
Bone meal	Slow P, Ca	2 lb / 100 sq ft at planting hole	$15 per 10-lb bag	●●●○○ — useful for P-locked beds
Wood ash	K and lime — *raises* pH	Avoid in the Dragoons	Free if you burn wood	●○○○○ — almost never appropriate here
Greensand	Slow K, trace minerals	5 lb / 100 sq ft	$25 per 50-lb bag	●●○○○ — slow, mostly unnecessary if composting
Kelp meal	Trace minerals, plant hormones	1 lb / 100 sq ft	$30 per 5-lb bag	●●●○○ — small effect, nice insurance

WARNING

Wood ash is one of the few amendments that is actively wrong for the Dragoons in most cases. Wood ash is alkaline (pH 9–11) and our soil is already alkaline. Wood ash raises pH and adds calcium, both of which we already have in surplus. Use it for the compost pile if you must (it raises C:N), but do not broadcast on a bed. Save it for the chicken-coop floor or for icing the driveway.

3.2 Compost — the foundation amendment

Compost does more for a Dragoons bed than any other single amendment. It adds organic matter (the OM number from chapter 2), supplies slow-release N/P/K, increases water-holding capacity, builds CEC, buffers pH downward over time, and brings biology — bacteria, fungi, protozoa, nematodes — that the bed otherwise lacks.

Application rate: 2–3 inches of finished compost worked into the top 8 inches of bed, once a year, after the bed is cleared in fall (for spring beds) or in late summer (for fall brassica beds, per Guide 6 §2.1). Heavy first-year application: 4–6 inches when breaking new ground.

What counts as "finished": the compost should smell like forest floor, be dark and crumbly, no recognizable food scraps, and run between 100–110°F if you stick a thermometer in (i.e., it should have stopped heating). Half-finished compost ("hot

compost" still active) **will burn roots** and can drive nitrogen drawdown — fast-decomposing carbon temporarily consumes the soil's available N as microbes use it.

Sourcing in Cochise County is covered in chapter 4 (composting in dry climate). The short version: most home growers can produce 30–50% of what their beds need; the rest is bought from a local hauler (chapter 8 §8.6).

3.3 Elemental sulfur — the pH lever

If you only have one amendment to move pH, it's elemental sulfur. Soil microbes oxidize elemental sulfur to sulfuric acid over weeks to months, which neutralizes the calcium carbonate driving the alkaline pH and slowly drops the bed reading.

Rate: 1–2 lb per 100 sq ft per season for a sandy loam. The math, rough:

Starting pH	Target pH	Sulfur (lb / 100 sq ft, sandy loam)
7.5	7.0	1.0
7.8	7.0	1.5
8.0	7.0	2.0
8.0	6.5	3.0 (split over 2 seasons)
8.3	7.0	2.5–3.0 (split over 2 seasons)

Application: broadcast over the bed surface, work into the top 4–6 inches with a fork or broadfork, water in. Apply 4–6 weeks before planting for first effect; the full pH shift takes a season.

Caveats:

- Sulfur **does not work in cold soil** — microbial oxidation needs soil temperature above 55°F. Apply March through October in the Dragoons.
- Caliche **buffers** the change. Beds with caliche close to the surface need ongoing annual sulfur applications to hold pH; the carbonate is a near-infinite buffer.
- Acidified water (Guide 13 bicarbonate routine) supports the sulfur — you cannot acidify a bed long-term while watering it with pH 8.3 well water.

> **The sulfur rule for the Dragoons.** First season: 2 lb / 100 sq ft, worked in 6 weeks pre-plant. Every season after: 0.5–1 lb / 100 sq ft maintenance, broadcast and watered in during spring or fall bed prep. Without maintenance, the caliche buffer pulls pH back up over 2–3 seasons.

3.4 Aged manure

Manure is the dominant local amendment in Cochise County because cattle, horse, llama, alpaca, and chicken operations are common and most will give it away to anyone who will haul it. The chemistry varies enormously by source — see chapter 8 for the source-by-source breakdown including the salt problem and the herbicide-carryover problem. The short rule:

> **Never apply fresh manure to a bed you'll plant within 90 days.** Fresh manure is hot (high in ammonia and soluble N), often high in salts, and may carry pathogens (*E. coli* particularly from cattle). Always age in a separate pile for at least 6 months — preferably composted (heated, turned, finished) — before bed application.

3.5 Gypsum (calcium sulfate)

Gypsum is calcium sulfate ($CaSO_4 \cdot 2H_2O$). It adds calcium and sulfur without raising pH (unlike lime or wood ash), and it flocculates clay — meaning it helps individual clay particles aggregate into larger crumbs, which improves drainage in heavy or sodium-affected soils.

Honest assessment for the Dragoons: most Dragoons soils don't need gypsum. We already have abundant calcium (caliche supplies more than any plant could use), and most local soils aren't clayey enough to need flocculation. Gypsum is genuinely useful in two specific cases:

- **Sodium-affected soil** (high Na, often from salt-loaded manure or irrigation water with > 100 ppm sodium): gypsum's calcium displaces sodium from soil exchange sites, which then leaches out with irrigation.
- **Heavy clay sub-bedding** in some wash-bottom sites: a one-time 5 lb / 100 sq ft application helps break up dense clay layers.

Outside these two cases, skip gypsum and put the money into compost.

3.6 Biochar

Biochar is charcoal made by pyrolysis (heating wood or other biomass in low-oxygen conditions). The end product is nearly pure carbon, full of micropores, that lasts in soil for centuries. The micropores serve as habitat for soil microbes; the surface area binds nutrients and water; the carbon does not decompose.

Application: 5–10% by volume of the root zone, one-time, **inoculated first**. Raw biochar is sponge-like — it will absorb nitrogen and water for the first few months, robbing the bed. Soak it in compost tea or mix into a finished compost pile for 30+ days before bed application.

Dragoons fit: very good in theory. Our soil has low CEC; biochar adds CEC permanently. Our soil holds little water; biochar holds water. The cost (in money or in time to make) is the barrier. A reasonable plan is to add biochar gradually — a wheelbarrow's worth per bed per year, inoculated in the compost pile.

DIY biochar in the Dragoons: a simple cone kiln or 55-gallon barrel kiln, fed with mesquite trimmings or pruned fruit-wood, produces 20–30 gallons of biochar per burn. Best done in the cool dry months (Nov–March) when fire danger is lowest.

3.7 Caliche — when you have to break through

Caliche is a calcium-carbonate hardpan formed over millennia of arid soil chemistry. In the Dragoons, caliche depth varies from 6 inches (worst sites) to over 4 feet (best sites). Anywhere shallower than 18 inches affects rooting, drainage, and your amendment strategy.

Probing for caliche: drive a 4-foot length of #3 rebar into the bed with a small sledge. Where it stops is your caliche depth. Probe in 5–10 spots across the future bed — caliche depth varies sharply across short distances.

Caliche depth — what to do:

Depth	Options
> 30 inches	Plant normally; caliche is below the root zone for most vegetables
18–30 inches	Plant normally for shallow-rooted crops; auger through for orchard trees and tomatoes
8–18 inches	Build raised beds (12–18 inches deep) on top, or pickaxe/auger through and amend the broken zone
< 8 inches	Raised beds are the only practical option; treat the native ground as the slab below the bed

Breaking through: a 4-inch hand auger turned by two people will get through 6 inches of soft caliche in about 30 minutes per hole. Hard caliche (the "petrocalcic" layer, almost concrete) requires a pickaxe or a rented gas-powered post-hole digger. Once broken, the hole acts as a drainage chimney — fill with a 50/50 native soil + compost mix and plant directly into it for orchard trees (see Guide 9).

4 · Composting in a dry climate

Water retention · the moisture problem · bin design · turning frequency

Composting in the Dragoons is harder than in most of the United States. The dominant problem is not too-wet — the dominant problem is **too-dry**. A textbook compost pile in Vermont takes care of moisture by accident; in the Dragoons, you fight desiccation every week the pile is active.

4.1 The moisture problem

A compost pile needs to be 40–60% moisture (the "wrung-out sponge" feel) for thermophilic microbes to do their work. In 8% humidity Dragoons air, a pile loses moisture from every exposed surface continuously. A 4×4×4-foot pile built wet on a Saturday is bone-dry on the outer 6 inches by the following Tuesday. Inner heat is fine; outer mass is just dry compost-shaped material that will never decompose.

The implications:

- **Build the pile wet.** Soak each layer as you build it. The pile should *drip* slightly when squeezed.
- **Cover the pile.** A tarp, lid, or thick straw "duvet" cuts evaporation by half. The cover must let some air through — fully sealing causes anaerobic souring.
- **Water weekly.** Even a covered pile needs a deep watering once a week through the warm months.
- **Bigger piles dry slower.** A 3-foot cube has 54 sq ft of surface area; a 5-foot cube has 150 sq ft for 3x the volume — same surface ratio. Build piles at the largest end of practical.

4.2 Bin design that works in the Dragoons

The bin design that holds moisture and stays workable in arid country:

Component	Specification	Why
Footprint	4 × 4 ft minimum, 5 × 5 ft better	Bigger ratio of volume to surface area; less evaporation
Height	4 ft when freshly built	Settles to ~3 ft; max workable height for a hand-fork turn
Walls	Solid on three sides (wood, straw bale, cinder block)	Solid walls hold moisture; wire-mesh bins dry out
Front	Removable boards or hinged door	Access for turning

Component	Specification	Why
Floor	Bare soil (with weed barrier or pallets above)	Lets earthworms enter from below
Roof	Tarp, shade cloth, or removable lid	Cuts evaporation and blocks summer sun
Three-bin layout	Building / working / finishing	Lets you stage piles year-round

A useful three-bin layout: bin 1 collects raw inputs (kitchen scraps, garden clippings, manure deliveries). When bin 1 is full and the C:N is right, dump and turn into bin 2 — the active pile. Bin 2 ages 6–8 months, with monthly turns. When bin 2 reaches ambient temperature and looks finished, move to bin 3 (curing for 4+ weeks) or screen and apply.

4.3 The C:N ratio in dry climate

The classic compost recipe is roughly 30:1 carbon-to-nitrogen by weight. In practical terms, that translates to **3 parts "brown" (dry, woody, carbonaceous) to 1 part "green" (wet, soft, nitrogenous) by volume**. In the Dragoons, where green material is harder to come by than browns, that ratio actually fits the available inputs well — you have a near-infinite supply of mesquite duff, dry oak leaves, and straw, and a constant trickle of kitchen scraps, fresh grass clippings (rare here), and manure.

Material	C:N (approximate)	Category
Dry oak leaves	50:1	Brown
Dry mesquite duff / pods	40:1	Brown
Pine needles	80:1	Brown (resists decomposition)
Straw (wheat / alfalfa stems)	80:1	Brown
Wood chips	400:1	Brown (very slow)
Cardboard, shredded	350:1	Brown
Coffee grounds	20:1	Green
Vegetable kitchen scraps	25:1	Green
Fresh grass clippings	20:1	Green
Fresh weeds (pre-seed)	25:1	Green
Chicken manure (fresh)	7:1	Green (very hot)
Horse manure (with bedding)	25–30:1	Green-leaning, near-ideal alone
Cattle manure (fresh)	20:1	Green

Horse manure with straw bedding is essentially a complete compost on its own. If you can source it (chapter 8), it simplifies the recipe dramatically.

4.4 Turning frequency

Hot composting in the Dragoons:

- **Initial build**: layer browns and greens 3:1, soak each layer. Build the whole pile in one session if possible. Cover.
- **Day 3–5**: pile should reach 130–150°F internal temperature. Check with a long compost thermometer. If it doesn't heat: too dry, too small, or not enough N.
- **First turn**: when internal temp drops below 110°F (usually day 10–14), turn the pile — outside in, inside out. Water as you turn. Cover.
- **Second turn**: 2–3 weeks after the first, repeat. The pile should heat again, less intensely.
- **Subsequent**: turn monthly until pile no longer heats. Then cure for 4 weeks before use.

A 4×4×4-foot pile, built properly, finishes in 4–6 months under this regimen. A cold pile (no turning, no monitoring) takes 12–18 months.

4.5 What goes in and what stays out

Goes in	Stays out
Kitchen vegetable scraps, coffee grounds, eggshells	Meat, fish, dairy, oils (animal-attracting)
Garden clippings (disease-free)	Diseased plant material (powdery-mildew leaves, late blight stems)
Aged manure (horse, llama, alpaca, chicken in moderation)	Pet waste (dog, cat)
Straw, leaves, mesquite duff	Treated/painted wood; sawdust from CCA lumber
Cardboard (shredded, ink-free)	Glossy magazines, color-printed cardboard
Spent coffee filters, paper towels	Synthetic fabric; "compostable" plastic (rarely fully composts)
Hair, feathers, bone meal	Cat litter; charcoal-grill ash (lighter-fluid residue)

WARNING

Persistent herbicides (aminopyralid, clopyralid, picloram) survive composting and can ruin a garden for 2–3 years. They enter the compost stream

through hay and straw fed to horses on sprayed pasture, and through the resulting manure. See chapter 8 §8.4 for the herbicide test before using any sourced hay, straw, or horse manure.

5 · Vermicomposting

Indoor year-round · red wigglers · bin design · feeding rules

Vermicomposting — composting with worms — solves two problems at once. It runs indoors, at room temperature, year-round, which means it doesn't care about Dragoons winter or Dragoons heat. And it produces *vermicompost* (worm castings), one of the highest-quality soil amendments available — higher in available N, P, K, and microbial diversity than even good hot compost.

5.1 *Eisenia fetida* — the red wiggler

The composting worm is *Eisenia fetida* (red wiggler or "tiger worm"). It is **not the same** as the earthworm you find in the bed — that's *Lumbricus terrestris*, a soil-dwelling species that won't survive in a bin. Red wigglers are surface feeders, evolved for leaf-litter and compost-pile habitat. They thrive at 55–80°F, eat half their body weight per day in food waste, and double their population every 2–3 months under good conditions.

> **LOCAL TIP**
>
> Red wigglers can be purchased locally from a few Cochise County sources: occasional Saturday markets in Bisbee and Sierra Vista, the Willcox Feed Store (sometimes seasonal), and reliably online from Uncle Jim's Worm Farm or Meme's Worms (mail order). Plan on $35–$50 for the starter pound (~1,000 worms), enough to seed one home-scale bin. Within 6 months a healthy bin produces enough worms to seed a second.

5.2 Bin design

A working vermicompost bin can be as simple or elaborate as you want. Two designs that work:

Two-bucket flow-through: stack two 5-gallon buckets with holes drilled in the bottom of the upper bucket. Bedding and worms go in the upper. Liquid drains to the lower (the "worm tea" — a useful fertilizer). When the upper is full, start a new top bucket with fresh bedding above the old one; worms migrate up through holes, leaving finished castings behind.

Single tote: a 10–20 gallon plastic tote with small drilled holes in the lid (air) and bottom (drainage, with a drip pan below). Bedding, food, worms. Harvest by pushing the finished half to one side and adding fresh bedding to the other; worms migrate to fresh side over 2–3 weeks, leaving casting to harvest.

Component	Specification
Volume	10–20 gallons for a household; bigger for production
Location	Indoors at 55–80°F (garage works in mild seasons; main floor in summer/winter)
Light	Dark — cover or lid; worms are photophobic
Bedding	Shredded cardboard, newspaper, dry leaves, coir; 3–4 inches deep
Moisture	Wrung-out sponge — re-wet weekly as needed
pH	Neutral (6.5–7.0) — avoid heavy acidic inputs

5.3 What to feed and what not to

Feed: vegetable kitchen scraps, coffee grounds (great), tea bags (paper only), banana peels, melon rinds, eggshells (crushed), bread/grain scraps in moderation, soft yard waste. Chop or blend large pieces to speed processing.

Avoid: meat, fish, dairy, oily food (will rot, attract pests). Citrus and onion in large amounts (acidic; slows the bin). Garlic and very spicy peppers (worms avoid them). Glossy paper or colored cardboard (inks). Pet waste. Salty processed food.

Feeding rate: a healthy 1-lb (worm-weight) bin processes about ½ lb of food per day. New bins start small — feed half a cup of scraps every 2–3 days for the first month, then ramp up. Bury the food under the bedding; open scraps on top attract fruit flies.

> **WARNING**
>
> **A vermicompost bin that smells bad is in trouble.** A healthy bin smells like a forest floor — earthy, not unpleasant. Sour, ammonia, or rot smells mean overfeeding (food rotting before worms reach it), too wet (anaerobic), or too acidic (citrus overdose). Fix by reducing food, adding dry bedding, and tossing in a handful of crushed eggshell. If a bin goes anaerobic, harvest the worms, refresh bedding, and restart.

5.4 Harvesting castings

Castings are ready when the bin contents look uniformly dark and granular, with no recognizable food scraps. A working bin produces 4–6 lb of finished castings per pound of worms per year — about a 5-gallon bucket from a household-scale bin.

How to use: top-dress 1–2 cups per square foot of bed twice a year, or steep ½ cup

in a gallon of water for 12 hours to make worm-castings tea for transplant water and foliar feed. Castings are a *low-rate, high-quality* amendment — they punch above their weight.

6 · Bokashi

Fermentation-based · faster cycle · cold-weather operation

Bokashi is a Japanese pre-composting method that uses anaerobic fermentation rather than aerobic decomposition. It's fast, can handle food categories vermicomposting and hot composting reject (meat, dairy, oils), and runs indoors in any weather.

6.1 How bokashi works

Bokashi inoculant — typically a wheat-bran substrate inoculated with *Lactobacillus*, yeasts, and phototrophic bacteria (collectively "EM" or Effective Microorganisms) — is sprinkled over food scraps in a sealed bucket. The microbes ferment the scraps over 2–4 weeks. The result is not finished compost — it's a pickled, slightly sour-smelling pre-compost that still has full structure. The "finishing" happens after burial in soil or in a hot pile, where the fermented material breaks down in 2–4 weeks.

The advantages in the Dragoons:

- **Cold-weather operation.** Bokashi buckets ferment at room temperature; winter doesn't shut them down the way a cold outdoor pile is shut down.
- **No moisture management.** Sealed bucket — no evaporation problem.
- **Accepts almost everything.** Meat, fish, dairy, citrus, onion, and cooked food all go in (none of which work in vermicomposting).
- **Fast.** 2 weeks in the bucket plus 2–4 weeks in soil to finished compost — about 6 weeks total.

6.2 Bucket setup

A bokashi bucket is a 5-gallon bucket with a spigot at the base for draining the leachate ("bokashi tea") and a tight-fitting lid. Many home growers run a pair, alternating: bucket A fills over 2 weeks, then ferments sealed for 2 weeks while bucket B is filling.

Component	Specification
Vessel	5-gallon bucket with spigot, food-grade plastic
Bran	Bokashi inoculant (1 cup per 1 gallon of scraps), purchased or home-made
Lid	Airtight
Plate or weight	Pressed over the scraps to exclude air
Drainage	Daily — spigot at base, drain leachate into a jar

Process:

1. Add 2–3 inches of food scraps to the bottom of the bucket.
2. Sprinkle 1–2 tablespoons of bokashi bran over.
3. Press down with a plate or hand to exclude air.
4. Repeat each day until bucket is full.
5. When full, seal the lid for 2 weeks at room temperature. Drain leachate every 2–3 days.
6. After 2 weeks, the scraps are fermented (sour-pickle smell, intact structure). Bury 8 inches deep in a garden bed or add to an active hot pile. 2–4 weeks later, fully composted.

6.3 The leachate

Bokashi leachate — the liquid drained from the bucket — is highly acidic (pH 3–4) and concentrated. Dilute 1:100 with water and use as a soil drench. Undiluted, it doubles as a drain cleaner (pour into kitchen drain weekly).

6.4 Caveats

Bokashi is fast and clean, but the output is pickled — not finished compost — and it must finish in soil or a hot pile before plant roots will tolerate contact. Don’t plant directly into a fresh bokashi-buried area; wait 3–4 weeks.

7 · Sheet composting / lasagna beds

Breaking new ground over a season · layer order · timing

Sheet composting (also called “lasagna gardening” or “no-dig bed building”) is composting *in place* — building a bed by stacking compostable layers directly on the ground where the bed will be. Over a season, the layers break down into a deep, fluffy, weed-free planting medium. It is the lowest-effort way to convert ground that has never been a garden into a productive bed.

7.1 When to use it

Sheet composting is the right tool when:

- You’re breaking new ground over an existing weedy / grassy / caliche area and don’t want to dig.
- You have time — sheet beds need 4–6 months minimum to break down before planting.
- You have the materials in volume: cardboard, straw, manure, leaves, compost.

It’s not the right tool for: a bed you need to plant this week; a bed with active perennial weeds (Bermuda grass, nutsedge, bindweed — these come through cardboard).

7.2 The layer order

The classic lasagna stack, built directly on the future bed location:

Layer	Depth	Purpose
1. Cardboard / newspaper (overlapped)	1/4 inch	Smothers existing grass and weeds; biodegrades in 6 months
2. Aged manure or compost	2 inches	Nitrogen source; jumpstarts the decomposition
3. Brown carbon (straw, dry leaves, mesquite duff)	4–6 inches	Bulk; carbon for the microbes
4. Green (kitchen scraps, fresh garden clippings, fresh manure)	2 inches	Nitrogen, biology
5. Brown carbon	4–6 inches	More bulk
6. Compost (finished, or near-finished)	2–4 inches	The planting medium for year 1 — the only layer roots immediately touch

Layer	Depth	Purpose
7. Mulch (straw, wood chip)	2 inches	Moisture retention

Total stack: 16–22 inches deep, settling to 8–10 inches over the season.

7.3 Timing in the Dragoons

The best window for building a sheet bed in the Dragoons:

- **Build in October–November.** Existing weeds and grass die back with cold; cool damp winter weeks (and the monsoon-recharged fall soil) drive decomposition; bed is finished by April for spring planting.
- **Water during the build.** Each brown layer wants to be soaked. A dry layer won't decompose.
- **Cover the top.** Tarp or thick mulch keeps moisture in through the dry winter weeks.

You can also build April–May for a fall planting bed, but the summer heat dries the stack faster and decomposition is less even. October build is the higher-percentage move.

8 · Manure sourcing in Cochise County

Horse · cattle · chicken · llama · alpaca · the salt problem · herbicide carryover

Cochise County has many small ranching and equestrian operations, and manure is the most abundant local soil amendment. The full chemistry varies more by *source* than by *species* — a horse on irrigated alfalfa pasture produces different manure than a horse on dry hay shipped from out of state.

8.1 Source-by-source comparison

Source	N (% as is)	C:N	Salt load	Dragoons fit	Age before use
Horse + straw bedding	0.5–0.8	25–30	Low–moderate	●●●●○ — workhorse, watch the herbicide question	6 months minimum
Cattle (corral / feedlot)	0.5–1.0	18–20	**High** (often 4–8 mS/cm fresh)	●●○○○ — only if no other option, and only well-aged	9–12 months
Cattle (pasture-raised)	0.5–0.8	20	Low–moderate	●●●●○ — much better than feedlot	6 months
Chicken (with shavings)	1.5–4.0	7–10	Moderate	●●●●○ — high-N, use sparingly; fully compost first	6 months composted
Llama / alpaca	1.5–2.0	15	Low	●●●●● — “the Cadillac of manures”; pelleted, low odor, low salt	1 month
Goat	1.0–1.5	17	Low	●●●●○ — pellet form, easy to apply, low salt	3 months

Source	N (% as is)	C:N	Salt load	Dragoons fit	Age before use
Rabbit	2.0–2.5	12	Low	●●●●● — coldest manure (won't burn), good direct application	None needed
Pig	0.5–0.7	20	Moderate	●●○○○ — uncommon locally; manage carefully	9 months

Three manures stand out for the Dragoons. Llama and alpaca manure (low salt, low odor, pelleted, can apply almost immediately) is the easiest premium amendment. Rabbit manure (cold enough to apply directly, lowest salt, highest nitrogen-to-volume) is the best small-scale source. Properly aged horse manure with straw bedding is the everyday workhorse — abundant, well-balanced, free at most stables.

8.2 Where to find it in Cochise County

- **Equestrian operations**: most boarding stables and private barns give away manure for the hauling. Sulphur Springs Valley (the Willcox–Kansas Settlement area), the Sonoita–Elgin equestrian corridor, and the Sierra Vista–Hereford area all have stables that produce more than they can use.
- **Cattle**: small ranches around Tombstone, Pearce, and Sulphur Springs; ask at the Willcox or Sierra Vista feed stores for current arrangements.
- **Chicken**: small-flock keepers (more numerous than cattle ranchers); local online classifieds; the egg vendors at Bisbee Farmers Market often know who's selling/giving coop cleanout.
- **Llama / alpaca**: smaller operator base but vocal; Cochise County Fiber Guild members often have surplus. Ask at any Sierra Vista or Bisbee fiber show.
- **Rabbit**: Cochise County 4-H rabbit projects produce surplus; ask at the County Extension office.

8.3 The salt problem

Feedlot manure (cattle confined and fed grain-and-hay rations) carries the highest salt loads in the local manure landscape. Animals on high-mineral feed excrete the excess; manure piles concentrate it; rainfall-poor Cochise climate doesn't leach it. A

fresh feedlot manure can read 6–8 mS/cm — directly applying that to a Dragoons bed (already 0.5–1.0 mS/cm) pushes the bed into salt-toxicity territory.

The fix: **age and leach**. A 12-month aged pile, rained on (or hose-leached weekly), drops salt by 50–70%. Test EC of the finished material before bed application. Reject anything over 4 mS/cm in the finished pile.

8.4 The herbicide-carryover problem

Persistent herbicides — **aminopyralid, clopyralid, picloram, sometimes triclopyr** — are sprayed on grazing pasture and hay fields to control broadleaf weeds. They pass through ruminants unchanged, survive composting, and remain biologically active in soil for 2–3 years. A vegetable bed amended with contaminated manure shows the symptoms within weeks: cupped, deformed new growth on tomatoes, beans, peppers, lettuce — looks like an herbicide drift event.

> **WARNING**
>
> **Always run a bioassay test on any horse or hay-fed manure before bed application.** The protocol: fill three 6-inch pots with 50/50 garden soil + the manure in question. Plant two pea or bean seeds per pot. Plant the same in three control pots (50/50 soil + known-clean compost). Water and grow indoors for 3 weeks. If the manure pots show cupped, distorted leaves while the control pots are normal, the manure carries herbicide residue. Reject it. The test costs nothing and prevents 2–3 years of bed damage.

8.5 Aging and pile composting before use

For any sourced manure, the standard pre-bed protocol:

1. **Pile in a separate location**, not in the bed-amendment compost. 4 × 4 ft minimum.
2. **Water weekly** through warm months.
3. **Cover with tarp** to retain moisture and prevent rain runoff (during monsoon).
4. **Turn twice** over the aging period (months 2 and 5).
5. **At month 6, test**: EC < 4 mS/cm; smell earthy not ammoniacal; bioassay if hay-pasture origin is uncertain.
6. **Apply** 1–2 inches per year, worked into the top 8 inches.

8.6 Bulk compost suppliers in Cochise County

Beyond manure direct from operations, several Cochise County and nearby suppliers deliver bulk compost or composted manure:

- **A&A Materials** (Willcox) — bulk soil products by the cubic yard, including compost
- **Tucson Mountain Compost** (Tucson, deliveries to Cochise) — premium aged com-

post
- **Sierra Vista Soil & Stone** — varies by season
- **Willcox Feed Store** — bagged composted alfalfa compost, small-scale
- **Local CSAs** (Sleeping Frog Farms, etc.) — sometimes sell composted cover-crop residue and bedding

A 2–3 cubic yard delivery per year covers a 200 sq ft household garden's full top-dress need.

9 · Cover cropping

Winter rye · hairy vetch · crimson clover · buckwheat · daikon radish · the Dragoons cover-crop calendar

A cover crop is a crop grown not for harvest but for the soil. It builds organic matter, fixes nitrogen (legumes), breaks up compaction (deep-rooted brassicas), suppresses weeds, and holds soil over the off-season. In a climate where bare soil bakes and erodes through nine dry months, cover cropping pays back faster than in milder country.

9.1 The Dragoons cover-crop palette

Cover crop	Type	Sow window	Cut / turn-under	What it does best	Dragoons fit
Winter rye (*Secale cereale*)	Grass, cool-season	Sep 15 – Nov 1	Mar – Apr	Biomass, soil structure, winter cover; allelopathic to weeds	●●●●●
Hairy vetch (*Vicia villosa*)	Legume, cool-season	Sep 1 – Oct 15	Apr – May (at flowering)	N-fix (~120 lb/acre), biomass	●●●●○
Crimson clover (*Trifolium incarnatum*)	Legume, cool-season	Sep 1 – Oct 1	Mar – Apr (at red bloom)	N-fix (~80 lb/acre), beautiful crimson bloom, beneficials	●●●●○
Austrian winter pea (*Pisum sativum* var. *arvense*)	Legume, cool-season	Sep 15 – Oct 30	Mar – Apr	N-fix, edible shoots, tender residue	●●●●○
Buckwheat (*Fagopyrum esculentum*)	Broadleaf, warm-season	May – Aug	40 days from sowing (at bloom)	Fast biomass, smother weeds, beneficials	●●●●●
Sorghum-sudangrass (*Sorghum bicolor*)	Grass, warm-season	May – Jul	Aug – Sep	Massive biomass, deep roots, scavenges leftover N	●●●●○

Cover crop	Type	Sow window	Cut / turn-under	What it does best	Dragoons fit
Cowpea (*Vigna unguiculata*)	Legume, warm-season	May – Jul	Aug – Sep	N-fix, heat tolerance	●●●●○
Daikon radish (*Raphanus sativus* var. *longipinnatus*)	Brassica, cool-season	Sep 1 – Oct 1	Winter-kills below 20°F	"Bio-drilling" — taproot punches into caliche-adjacent layers	●●●●○
Mustard (*Brassica juncea*)	Brassica, cool-season	Sep 15 – Oct 30	Mar (before flowering)	Biofumigant (glucosinolates suppress soil pathogens)	●●●○○

9.2 The Dragoons cover-crop calendar

The Dragoons cool season (Sep–April) is the dominant cover-crop window — most of our beds want to be in food during the warm season. A common rotation:

Month	Cover-crop action
August	Plan winter cover; order seed
September	Sow winter rye + hairy vetch mix into emptied summer beds (after pepper, tomato, cucurbit removal)
October	Sow remaining beds; sow daikon radish in compaction-prone spots
Nov–Feb	Cover crops grow slowly through cool months; minimal irrigation
March	Cover crops accelerate; vetch flowers begin
April	Cut / mow cover at peak biomass (vetch in bloom, rye at boot stage); leave residue 2 weeks; turn under or sheet-mulch over
May	Bed is ready for warm-season transplants
June–August	Summer beds in food; some beds get short 40-day buckwheat between successions

9.3 Mowing, cutting, and turning under

The single biggest cover-crop mistake is mowing too late, after the crop has set seed — you've now planted a weed for next year. The right cuts:

- **Vetch**: cut at first flower (purple buds opening). N peak.
- **Crimson clover**: cut at crimson bloom. Same logic.
- **Winter rye**: cut at "boot stage" — when seed head is forming inside the stem but not yet emerged. After boot, lignification makes it hard to incorporate.
- **Buckwheat**: cut at peak bloom (about 40 days from sowing). Don't let it seed — buckwheat reseeds vigorously.
- **Daikon**: leave to winter-kill below 20°F; no cutting needed. Roots decompose in place by April.
- **Sorghum-sudan**: mow at 3 ft to encourage regrowth and deeper rooting; final cut before frost.

After cutting, the standard sequence:

1. **Mow or scythe** to 2-inch stubble. Leave residue on the surface.
2. **Wait 2 weeks**. Residue starts to break down; soil microbes spool up.
3. **Lightly incorporate** with a broadfork or shallow tillage (top 4 inches only).
4. **Wait 2 more weeks** before planting. Decomposition continues; transplant roots will not face high N immobilization or allelopathic compounds.

9.4 The nitrogen contribution

A well-grown vetch / rye mix turns under roughly 80–120 lb of nitrogen per acre — which works out to about 0.2 lb of N per 100 sq ft, or roughly the same as a generous compost top-dress. The grass component (rye) provides the carbon to balance the legume's N; together they build organic matter without ammonia loss.

> **LOCAL TIP**
>
> The single highest-return cover-crop move in the Dragoons is a **September 15 broadcast of rye + vetch mix** into the bed the moment peppers or tomatoes come out. The bed gets seven months of root activity over winter, fixes 80+ lb N/acre by April, smothers winter weeds, and breaks down in May for a clean transplant bed. Cost: about $8 in seed per 100 sq ft. Return: a measurable jump in OM and the elimination of one full compost application.

10 · Mulching strategies

Straw · wood chip · pine needle · gravel · pros and cons in dry-hot climate

Mulch — any layer covering bare soil — does five things in the Dragoons: cuts evaporation by 50–70%, moderates soil temperature, suppresses weeds, prevents crust formation from monsoon rain impact, and slowly builds OM as it breaks down. In a climate that loses surface moisture continuously and bakes bare soil to 130°F in June, mulch is essentially mandatory.

10.1 The mulch comparison

Mulch	Depth	Where it shines	Where it fails	Lifespan	Cost
Straw (wheat, oat, alfalfa)	3–4 inches	Vegetable beds, paths, transplants	Blows in wind; may carry herbicide (test!); seeds if not weed-free	1 season	$10–$15 / bale
Wood chip (arborist, mesquite)	3–4 inches	Perennials, orchard floor, paths	Robs N if tilled in fresh; coarse for tight beds	2–3 seasons	Often free (arborist)
Pine needle	2–3 inches	Acid-loving plants, around blueberries (if grown), orchard	Slight pH drop (helpful here); fire risk near structures	1–2 seasons	Free if you have pines
Mesquite leaf / pod duff	2–3 inches	Native xeriscape, perennials	Pods germinate everywhere if not aged	1 season	Free locally
Cardboard / newspaper	1 layer	Under other mulch; bed-building (chapter 7)	Looks ugly alone; tears	1 season	Free

Mulch	Depth	Where it shines	Where it fails	Lifespan	Cost
Compost (as mulch)	2 inches	Vegetable beds, transplants	Dries out and crusts in summer; needs second mulch over it	1 season	$40+/cu yd
Gravel / de-composed granite	2 inches	Drylands perennials, succulent beds, paths	Doesn’t build OM; reflects heat onto leaves; permanent	Indefinite	$50/cu yd
Black plastic	1 layer	Heat-loving crops (sweet potato, melon) in cool springs	Permanent; degrades to microplastic; bakes soil in summer	1–2 seasons	$20/roll
Landscape fabric	1 layer	Permanent paths, under gravel	Roots grow through; tears; doesn’t build soil	5+ seasons	$30+/roll

10.2 Straw — the workhorse vegetable mulch

For annual vegetable beds, straw is the default. 3–4 inches over the bed surface, pulled back slightly from plant stems (to discourage rot and rodent damage), watered down once to prevent blow.

Source it carefully. The herbicide-carryover problem (chapter 8 §8.4) applies to straw and hay as much as to manure. Wheat straw from a known farmer who didn’t spray is safe; bagged straw from a big-box store is often unknown. The bioassay test (§8.4) catches problems.

Alfalfa hay is a step up from straw — higher in N, breaks down faster, adds nutrition to the bed. Costs more ($20–$25 / bale vs $10–$15 for wheat straw), but the higher break-down rate offsets the per-bale cost.

10.3 Wood chip — the perennial and orchard mulch

For perennial plantings — fruit trees, grapes, asparagus, rhubarb, perennial herbs — wood chip is the long-term mulch. 3–4 inches over the root zone, pulled back from the trunk (the “donut, not the volcano” rule — see Guide 9).

Sourcing: arborist chips are free from any tree service that's working locally. Call Cochise County tree services in the fall (post-monsoon pruning season) — most will drop a truckload free or for a small fee. **Mesquite chips** are particularly good — slow to decompose, mild allelopathy that suppresses weeds, and the chip itself is dense.

LOCAL TIP

Two reliable mesquite-chip sources in Cochise County: (1) call any of the Sierra Vista or Bisbee tree-service companies in October–November when post-monsoon pruning generates volume, and (2) Cochise County road-maintenance often chips mesquite cleared from county right-of-way and stockpiles it at maintenance yards; ask at the Sierra Vista yard about availability.

WARNING

Fresh wood chip applied directly to a tilled bed will drive nitrogen drawdown. Microbes decomposing the chip consume soil N as they work, leaving less for plants. The fix: keep wood chip as a *surface* mulch, never tilled in. Roots below get the benefit (moisture, weed suppression) without the N penalty.

10.4 Gravel mulch — the desert special

Gravel mulch (1–2 inches of decomposed granite or pea gravel over the soil surface) is the traditional southwest dryland mulch — used in pre-irrigation agriculture for centuries. It cuts evaporation, looks tidy, and lasts indefinitely.

The cost is real, though: gravel mulch doesn't build organic matter, reflects heat upward onto leaf undersides on hot days, and permanently changes the bed character (hard to switch back to straw mulch later without sifting). Reserve gravel mulch for xeriscape perennials, native plant beds, and paths — not annual vegetable production.

11 · Long-term soil-building plan

Year 1 through year 5 · what compounds · the OM-percentage target

Soil-building is a multi-year commitment. The numbers below are realistic for an irrigated, mulched, annually amended Dragoons bed — a bed left alone moves only marginally. This plan is the practical answer to "what do I actually do, when?"

11.1 The five-year arc

Year	OM target	Bed activities	What you'll notice
Year 0 (baseline)	1–2%	Soil test; jar test; rebar probe for caliche	Bed is hard, dries fast, fertilizer leaches
Year 1	2–3%	4–6 inches compost at break-in; sulfur at 2 lb/100 sq ft; cover crop fall→spring; mulch throughout	Visible color change; some crops do well, others struggle
Year 2	3–4%	3 inches compost; sulfur at 1 lb/100 sq ft; cover crop continues; introduce biochar; vermicompost online	Bed is recognizably "garden soil"; water frequency drops
Year 3	4–5%	2 inches compost; sulfur maintenance at 0.5–1 lb/100 sq ft; full rotation in place	pH stabilized in low 7s; crops uniformly performing
Year 4	4–6%	Same as year 3 — maintenance mode	OM holding; needs less and less external input
Year 5+	5–7% (ceiling)	Maintenance: 1–2 inches compost; cover crop; mulch	Bed self-sustains; only fine-tune adjustments needed

The OM-percentage target for the Dragoons. Aim for 4–5% organic matter in vegetable beds, 3–4% in fruit-tree beds, 2–3% in grape beds (grapes prefer slightly leaner soil). Above 6%, you're in diminishing returns. Below 3%, you're still actively building.

11.2 What compounds and what doesn't

What compounds (the long-payoff investments):

- **Organic matter** added year over year. Each year's OM persists at ~70–80% of the previous year's into the next (mineralization losses). Net gain compounds.
- **Microbial biology** seeded by compost and cover-crop residue. Once established, the community sustains itself.
- **Soil structure** built by roots and earthworms. Improves year over year if not disturbed by heavy tillage.
- **pH adjustment** from sulfur and continuous OM additions. Slowly buffers the alkaline parent material.

What doesn't compound (the annual recurring investments):

- **Soluble fertilizers** — leach within a season.
- **Mulch on the surface** — must be reapplied as it breaks down (which is the *point*; the breakdown is feeding the OM compound).
- **Cover-crop biomass** — disappears each year by definition; the cumulative effect is in OM, which does compound.
- **Caliche** — does not move. If shallow, it's permanent; you build *above* it.

11.3 The annual rhythm — once you reach steady state

A mature Dragoons bed at 4–5% OM, year 5+, runs on this rhythm:

Time of year	Action
Late summer (Aug)	Pull spring crops; broadcast sulfur maintenance; top-dress 1 inch compost
Fall (Sep–Oct)	Plant cool-season crops or sow cover crop
Winter (Nov–Feb)	Cover crop grows; minimal management
Early spring (Mar)	Cut cover crop; let residue rest 2–4 weeks
Late spring (Apr–May)	Top-dress 1 more inch compost; transplant warm-season crops
Summer (Jun–Aug)	Mulch maintained; drip irrigation; bed in food

Annual inputs at steady state: ~2 inches compost, ~0.5 lb sulfur per 100 sq ft, one cover-crop cycle. That's about a quarter of the year-1 work, for a bed producing several times as much food.

Part 2 — Seed starting & propagation

12 · Seed sourcing for the Dragoons

Native Seeds/SEARCH · regional seed companies · saving your own seed · what to look for in a catalog

Seed quality and adaptation matter more than most growers realize. A variety bred for the Pacific Northwest will struggle in the Dragoons not because of pest pressure but because its day-length response, heat tolerance, and chilling requirement were tuned to a different latitude. Sourcing seeds from the right places is the single highest-leverage decision you make before planting.

12.1 The four-tier sourcing strategy

Tier	Source	Best for	Cost
Tier 1	**Native Seeds/SEARCH** (Tucson)	Heritage Southwest varieties; chiles, beans, squash, corn, tepary beans, devil's claw	$4–$6 per packet
Tier 2	Regional / Southwest-focused seed companies	General vegetables adapted to hot-dry climate	$3–$5 per packet
Tier 3	National open-pollinated seed companies	Broad library; reliable but less locally adapted	$3–$4 per packet
Tier 4	Your own saved seed	Anything you've grown that ripened well	Free

12.2 Native Seeds/SEARCH

Native Seeds/SEARCH (Tucson, AZ) is the regional seed bank for the desert Southwest — a nonprofit that conserves heritage crop varieties from O'odham, Hopi, Navajo, Apache, Tarahumara, and other indigenous traditions of the U.S.–Mexico borderlands. For Dragoons growers, NS/S is the first place to look for any traditional desert-adapted crop: chiltepin, Tohono O'odham 60-day cowpea, Tarahumara melon, Hopi blue corn, *tepary* beans (*Phaseolus acutifolius* — drought-tolerant native beans), devil's claw, Mayo blusher tomatillo, and many traditional chile varieties.

Their catalog also documents adaptation notes — elevation tolerance, water needs, traditional growing practice — that no commercial seed catalog provides.

12.3 Other regional seed companies worth knowing

Company	Location	Strength
Native Seeds/SEARCH	Tucson, AZ	Heritage Southwest; the standard for the region
Baker Creek Heirloom Seeds	Mansfield, MO	Massive heirloom catalog; tolerates a wide range
Johnny's Selected Seeds	Winslow, ME	Commercial-quality reliable performers; F1 hybrids well-trialed
High Mowing Seeds	Wolcott, VT	Certified organic; northeast-bred, less locally adapted
Botanical Interests / Sow True Seed	Asheville, NC	Heirloom focused; broad
Seed Savers Exchange	Decorah, IA	Member-driven heirloom exchange; rare varieties
Tomato Growers Supply	Fort Myers, FL	Tomato-and-pepper specialty; broad pepper library
Pinetree Garden Seeds	New Gloucester, ME	Small packets, low cost — good for trial
San Diego Seed Company	San Diego, CA	Specifically Southwest-bred selections

12.4 What to look for in a seed catalog

The catalog is denser than it first appears. The numbers and codes carry the information.

- **Days to maturity (DTM)**: from sowing for direct-sown crops; from transplant for transplanted crops. A "65-day broccoli" reaches harvest 65 days *after transplant out*, not after sowing.
- **OP vs F1**: open-pollinated (OP, including heirlooms) — seed saves true to parent. F1 hybrid — vigorous and uniform first generation, but saved seed segregates (you cannot save F1 seed and expect the same crop next year).
- **Disease resistance codes**: V, F1, F2, N, TMV, etc. — codes for verticillium wilt, fusarium wilt, nematode, tobacco mosaic virus, and others. For the Dragoons, the most relevant are TMV (tobacco mosaic virus, relevant for peppers) and *Fusarium* / *Verticillium* in tomato. Resistance codes are listed on the packet or the catalog entry.
- **Climate adaptation notes**: "heat tolerant," "bolt resistant," "short season," "long season." Most matter to us.
- **Indeterminate vs determinate** (tomato): see Guide 7.

12.5 What “Dragoons-suited” looks like on a packet

For a vegetable seed packet to be a strong fit for the Dragoons, look for one or more of:

- Bred or selected in the Southwest, Texas, southern California, Mediterranean climates, or high-desert mountain regions
- Listed as heat-tolerant, drought-tolerant, or “for hot summer conditions”
- Short-day or day-neutral varieties (for onions especially — see Guide 6)
- Listed as “early” or short-season (for spring brassicas racing against May heat — see Guide 6)
- Open-pollinated heirloom from a similar climate

Avoid: varieties explicitly bred for “cool maritime” climates (UK, Pacific Northwest), or with long maturity dates (115+ days) that won’t fit our windows.

13 · Reading a seed packet

Days to germination · days to maturity · seed depth · soil temp · light requirements

The packet tells you almost everything you need to know to start the seed. Reading it carefully — every line — is the difference between germination and a wasted tray.

13.1 The packet fields

Field	What it means	Typical range
Days to germination	How long from sowing to visible seedling	3 days (radish) to 28 days (pepper, parsley, parsnip)
Days to maturity (DTM)	From sowing (direct-sown) or transplant (transplanted) to first harvest	25 days (radish) to 120+ days (Brussels sprouts, leek, sweet potato, ghost pepper)
Sowing depth	How deep to bury the seed	1/8 to 1/2 inch for most; rule of thumb: 2–3 × seed diameter
Soil temperature for germination	Minimum and optimum soil temp for germination	35°F (peas) to 85°F (peppers, melons)
Light requirement at germination	Whether seeds need light or darkness to germinate	Most: darkness. Lettuce, some herbs: light.
Spacing in the row	Final crop spacing after thinning	1 inch (carrots) to 36 inches (Brussels)
Seed life / viability	How long the seed remains viable when stored well	1 year (onion, parsnip) to 5+ years (tomato, brassicas)

13.2 Days to germination vs days to maturity

These are two different numbers and they live in different places. **Days to germination** is on the back of the packet near the sowing instructions. **Days to maturity** is on the front of the packet, near the variety name, as a single number.

A 75-day tomato that germinates in 8 days means: 8 days from sow to seedling, then ~6 weeks to a transplant-ready plant, then 75 days from transplant to first ripe fruit. The full timeline from packet to harvest is about 130 days.

13.3 Seed depth — the 2× rule

The general rule: **sow seed at 2–3× its longest dimension**. Big seeds (beans, squash, corn) go 1 inch deep; small seeds (carrot, lettuce, basil) go 1/8 inch deep; very small seeds (most herbs) get pressed onto the surface and barely covered.

Seed	Depth
Lettuce, celery	Surface — barely cover (some need light, §13.4)
Carrot, basil, dill	1/8 inch
Onion, leek, broccoli, cabbage	1/4 inch
Tomato, pepper, eggplant	1/4 inch
Cucumber, melon	1/2 inch
Bean, pea, corn, squash	1 inch
Sweet pea (large seed)	1 inch

13.4 Light requirement at germination

A few crops germinate better in light, not darkness. This matters because if you bury them, they don't sprout.

Need LIGHT to germinate	Need DARKNESS
Lettuce	Tomato
Celery	Pepper
Snapdragon, columbine, dill	Brassicas (broccoli, cabbage, kale)
Some herbs (chamomile, savory)	Cucurbits (cucumber, melon, squash)
Carrot (mild preference)	Most root crops

For lettuce: surface-sow, mist, do not cover with potting mix. A scant sprinkle of vermiculite is acceptable; full burial under 1/4 inch of potting mix can cut lettuce germination by 60% or more. This is the single most common seed-starting mistake.

13.5 Soil temperature for germination

The number that beats every other number. See chapter 16 for the full table.

14 · Indoor seed starting setup

Lights · heat mats · trays · soil-block makers · rockwool · coco pellets

The Dragoons seed-starting season runs roughly January through April for warm-season crops, plus an indoor or shaded outdoor seed-start window in July for fall brassicas. Most of this work happens indoors under controlled conditions — temperatures and light that the outside world won't deliver yet.

14.1 The basic setup

A minimum viable seed-starting setup for a home grower:

Component	Specification	Cost	Notes
Shelf rack	4-tier wire shelf, 18" × 48"	$80	Each shelf holds two 1020 trays side by side
Grow lights	4-ft T5 fluorescent or LED full-spectrum, two per shelf	$40–$60 per shelf	Hang 2–4" above plants; raise as they grow
Heat mats	20" × 20", thermostat-controlled	$30 per mat	Pepper, tomato, eggplant trays only
Thermostat for heat mats	Inkbird ITC-308 or similar	$35	Holds mat at exact temp — critical
1020 trays	Standard 10" × 20" propagation trays	$4 each	Reusable; rinse with bleach between batches
Humidity domes	Clear plastic covers for 1020 trays	$5 each	Use until germination, then remove
Cell inserts	50- or 72-cell plug trays, or 4-cell jumbo packs	$1–$3 per insert	Match cell size to crop (§15)
Seedling mix	Sterile peat-based or coco-based mix	$20 per 8-cu-ft bale	Pro-Mix, Fox Farm, or similar
Watering tools	Spray bottle, fine-rose watering can	$15 each	Bottom-water from the tray when possible
Plant labels	Stake markers, pencil	$5	You will forget what's in every cell
Timer	Digital outlet timer	$15	16 hours on, 8 off

Component	Specification	Cost	Notes
Soil thermometer	Probe-style	$10	Trust the probe, not the mat label

A full setup runs about $250–$400 the first season; near-free after. Most of the hardware lasts a decade or more.

14.2 Lighting — T5 vs LED

For a home seed-starting station, both T5 fluorescent and LED work. The differences:

Factor	T5 fluorescent	LED full-spectrum
Light output (PPFD at 6”)	200–300 µmol/m²/s	400–700 µmol/m²/s
Heat output	Moderate (warms shelf 3–5°F)	Low
Lifespan	20,000 hrs (3 yrs of seasonal use)	50,000+ hrs
Replacement bulb cost	$15 per bulb	Whole fixture (5+ yrs)
Upfront cost	$40 per shelf	$60–$120 per shelf
Spectrum control	Daylight 6,500K only	Often adjustable

For a beginner, two 4-foot T5 daylight bulbs per shelf are perfectly adequate and inexpensive. For someone running a year-round indoor seedling operation or also keeping seedlings going under lights for 3+ weeks past germination, a quantum-board LED (Mars Hydro TS series, HLG, or similar in the 100–150W class) gives substantially more PPFD per dollar over time.

Either way: **lights 2–4 inches above seedling tops, 16 hours on per day, raised as plants grow**. Distant lights (8+ inches above) produce stretchy, leggy seedlings.

14.3 Heat mats

For peppers, tomatoes, eggplant, basil, and any warm-germination crop (chapter 16), a heat mat under the tray is the single most useful piece of equipment in the seed-start setup. The mat alone — set to a fixed wattage — heats the tray surface to roughly 10–15°F above ambient. A thermostat (Inkbird ITC-308 or similar) regulates exactly to setpoint.

Target soil temperatures: 80°F for tomato, pepper, eggplant. 85°F for the slowest pepper species (*C. chinense* — habanero; *C. pubescens* — rocoto, slightly less at 78–80°F).

Once germinated, **remove from heat mat**. Continuing heat under emerging

seedlings encourages legginess and damping-off. Heat is for germination only; growth happens under light at room temperature.

14.4 The seedling mix

Use a **sterile, soilless mix** — not garden soil. Garden soil contains pathogens, weed seeds, and is too dense for tiny roots. The standard mix is a peat- or coco-based "soilless" blend with perlite for drainage and a starter charge of fertilizer.

Mix	Source	Notes
Pro-Mix BX	Garden centers, Amazon	Peat + perlite + lime + mycorrhizae; the standard
Fox Farm Light Warrior	Hydroponic shops	Higher-end; pre-buffered
Espoma Seed Starter	Big-box stores	Convenient; smaller bags
Sunshine Mix #4	Wholesale / large bales	Professional bedding-plant mix
Coco coir + perlite (DIY)	Online	70/30 mix; saturate with calcium-magnesium first

WARNING

Do not use garden soil or finished compost as seedling mix. Even excellent garden compost is too dense, may carry soil-borne pathogens, and dries unevenly in small cells. Damping-off fungus is especially likely from un-sterilized media. Seedling mix is one of the few places where a sterile commercial product is genuinely worth it.

15 · Soil-blocks vs cell-packs vs rockwool

The three main seed-start media options · trade-offs · when to use which

How you contain the soil matters as much as the soil itself. Three formats are common.

15.1 The comparison

Format	What it is	Pros	Cons	Best for
Soil blocks	Cubes of compressed seed mix, no container	No transplant shock — roots air-prune at edges; reusable maker; no plastic	Initial cost of block-maker ($35–$80); requires correct mix consistency	Brassicas, lettuce, alliums, anything you'll pot up or plant out
Cell-packs / plug trays	Plastic inserts in 1020 trays, 6–200 cells	Cheap; widely available; reusable	Root spiral in cells; plastic waste over time; harder to extract small plants	General-purpose; nursery production
Rockwool cubes	Inert mineral wool cubes	Excellent moisture retention; sterile; standard for hydro	Synthetic; doesn't biodegrade; high upfront cost; some health concern with fibers	Hydroponic transplants (Guide 3); peppers and tomato going to Bato buckets
Coco pellets (Jiffy)	Compressed coco coir disks	Convenient; biodegradable	Limited size; can stay too wet	Casual users; small-scale starts
Peat pots	Pressed-peat cups	Plant-out with cup intact	Wick moisture out of root ball; many roots can't penetrate	Limited use; mostly avoided now

15.2 Soil blocks — the case for them

A **soil-block maker** (Ladbrooke Mini-4, Mini-20, Maxi-1; or the larger Hand-Held series) presses standard seed mix into self-contained cubes. The cubes hold together because the mix is wet enough to compress; roots air-prune at the cube's edges; when you transplant or pot up, there's *no transplant shock* — the cube goes straight into the next medium.

The Ladbrooke Mini-20 (1.5” cubes, 20 cubes per press) is the workhorse for vegetable starts. The Mini-4 (2” cubes, 4 per press) is the upsize for tomatoes and peppers that need more room before transplant. Many growers use a “20 then pot up to a 2” or 4” container” workflow.

> **WARNING**
>
> **Soil-block mix consistency matters more than recipe.** Mix too dry: blocks crumble. Mix too wet: blocks slump. The “right” consistency is the wet-but-coherent texture of fresh-made playdough — when you squeeze a handful, water beads at your fingers but doesn’t drip. Many first-time block-makers give up because they tried the maker with dry potting mix and got piles of crumble. The fix is just more water, mixed in thoroughly.

A standard soil-block mix recipe (Eliot Coleman’s, adapted):

- 3 parts peat (or coco) — sieved
- 2 parts coarse sand or perlite
- 1 part finished compost — sieved
- 1 part garden soil — sieved (optional, brings biology)
- Per gallon of mix: 1/4 cup blood meal, 1/4 cup colloidal phosphate or bone meal, 1/4 cup greensand, 1/8 cup lime, water to playdough consistency

15.3 Cell-packs — the default

For most home gardeners, plastic cell trays in a 1020 tray are the simplest path. 72-cell trays for small crops (lettuce, onion, brassicas), 50- or 36-cell trays for tomatoes and peppers, 12-cell jumbo packs for squash and cucumbers.

Reuse trays across seasons. Wash with 10% bleach solution between batches to prevent damping-off pathogens carrying over.

15.4 Rockwool — for hydroponic destination

Rockwool cubes (Grodan, Cultilene) are the standard for plants destined for hydroponic systems — peppers and tomatoes that will move into Bato buckets (Guide 3). They hold moisture extremely well, are inert and sterile, and transplant cleanly into hydroponic media.

Pre-soak rockwool in pH-balanced water (Guide 4 — pH 5.5, calcium-magnesium charge) for 24 hours before use; the cube manufactures are alkaline from the rock-spinning process and need conditioning.

For soil-destined transplants, rockwool offers no advantage over soil blocks or cells, and the synthetic material doesn’t biodegrade in a bed.

16 · Germination temperatures by crop

Soil temperature is the master variable for germination

The single most useful seed-starting table. Every crop has a minimum, optimum, and maximum soil temperature for germination. Below the minimum, the seed sits — eventually rotting. Above the maximum, the seed is heat-killed. The optimum is where germination is fastest and most uniform.

16.1 The master germination table

Crop	Min soil temp	Optimum	Max	Days to germ at optimum	Heat mat?
Pepper (*Capsicum annuum*)	65 °F	80–85 °F	95 °F	7–14	Yes
Pepper (*C. chinense* — habanero, ghost)	70 °F	80–85 °F	95 °F	14–28	Yes — required
Pepper (*C. pubescens* — rocoto, manzano)	60 °F	75–80 °F	85 °F	14–28	Yes
Tomato	60 °F	75–85 °F	95 °F	6–14	Yes
Eggplant	65 °F	80–85 °F	95 °F	7–14	Yes
Tomatillo, ground cherry	60 °F	75–85 °F	95 °F	7–14	Yes
Broccoli, cabbage, cauliflower	45 °F	70–80 °F	95 °F	5–10	Optional
Kale, kohlrabi, brussels sprouts	45 °F	70–80 °F	95 °F	5–10	Optional
Lettuce	35 °F	65–75 °F	85 °F (heat dormancy above)	4–10	No
Spinach	35 °F	60–70 °F	85 °F	5–14	No
Arugula, mustard	40 °F	60–75 °F	85 °F	5–10	No

Crop	Min soil temp	Optimum	Max	Days to germ at optimum	Heat mat?
Carrot	45 °F	65–80 °F	95 °F	10–21	No
Beet, chard	50 °F	65–80 °F	95 °F	7–14	No
Turnip, radish	45 °F	65–80 °F	95 °F	4–10	No
Parsnip	45 °F	65–75 °F	85 °F	14–28	No
Onion (seed)	50 °F	70–75 °F	95 °F	7–14	Optional
Leek	50 °F	70–75 °F	95 °F	7–14	Optional
Bean (*Phaseolus*, snap and dry)	60 °F	75–85 °F	95 °F	5–10	No (direct-sow)
Tepary bean (*Phaseolus acutifolius*)	65 °F	80–85 °F	100 °F	4–8	No
Pea	40 °F	60–75 °F	85 °F	7–14	No
Cowpea, southern pea	65 °F	75–85 °F	95 °F	5–10	No
Corn	55 °F	75–85 °F	95 °F	5–10	No
Cucumber	60 °F	75–85 °F	95 °F	4–8	Optional
Squash, zucchini	65 °F	75–85 °F	95 °F	4–8	Optional
Melon (cantaloupe, watermelon, honeydew)	70 °F	80–90 °F	100 °F	4–10	Yes (or warm room)
Pumpkin	65 °F	75–85 °F	95 °F	5–10	Optional
Okra	65 °F	80–90 °F	100 °F	7–14	Yes
Basil	65 °F	75–85 °F	95 °F	5–10	Yes
Cilantro	50 °F	60–70 °F	80 °F (bolts above)	7–14	No
Parsley	50 °F	65–75 °F	85 °F	14–28	No
Dill	50 °F	65–75 °F	85 °F	7–14	No

Crop	Min soil temp	Optimum	Max	Days to germ at optimum	Heat mat?
Oregano, thyme, sage	60 °F	70–80 °F	90 °F	14–28	Optional
Rosemary	65 °F	75–80 °F	90 °F	14–28	Yes

16.2 The pepper rule

> **The single most useful germination fact for the Dragoons.** Tomato germinates well at 75°F. Pepper *minimum* is 65°F; pepper *optimum* is 80–85°F. *Capsicum chinense* (habanero, ghost, scotch bonnet) needs 80°F+ to germinate at all, and even then takes 14–28 days. **Without a heat mat, hot peppers will not germinate reliably in any Dragoons indoor setup before April.** A $30 heat mat with a thermostat is the single highest-return seed-start equipment purchase you'll make.

16.3 The cool-season heat ceiling

The reverse trap — some seeds *don't germinate when it's too warm* — catches Dragoons growers attempting cool-season starts in late summer.

- **Lettuce** goes into heat dormancy above 85°F. Lettuce sown in August in a hot bed often refuses to germinate.
- **Spinach** is even more sensitive — above 75°F germination drops sharply.
- **Cilantro** germinates fine at 70°F but bolts immediately in summer heat once up; it's a fall/winter/early-spring crop.

For warm-soil cool-season starts: pre-chill seed in the refrigerator for 1 week before sowing, sow into a shaded location with cool moist mix, or wait until soil is below 75°F.

17 · Direct sow vs transplant — decision matrix

By crop family · how to choose · why both options exist

A foundational decision for every crop: start indoors and transplant, or sow seed directly into the bed? The right answer is crop-specific. The wrong answer wastes a generation of work.

17.1 The decision principles

Direct sow when:

- Seedlings transplant poorly (taproot crops; cucurbits hate root disturbance)
- The crop matures fast (radish, lettuce, arugula — under 60 days)
- Indoor space is limited and the season is long enough
- The crop direct-seeds reliably in your soil at your timing

Transplant when:

- Indoor head start buys 4–6+ weeks of additional season (long-season crops)
- Seed predation is heavy (white-crowned sparrow on August brassica beds — see Guide 6)
- Precise spacing matters in tight beds
- Germination is slow/erratic in field conditions (peppers, eggplant)

17.2 The decision matrix by crop

Crop	Direct sow	Transplant	Verdict	Notes
Carrot	●●●●●	●○○○○	Direct sow always	Taproot — disturbance ruins shape
Beet	●●●●○	●●○○○	Direct sow	Will tolerate transplant if young
Radish	●●●●●	—	Direct sow	Too fast to transplant
Parsnip	●●●●●	●○○○○	Direct sow	Taproot
Turnip	●●●●●	●○○○○	Direct sow	Same as carrot
Spinach	●●●●●	●●○○○	Direct sow	Tap-rooted; transplants if young
Lettuce	●●●●○	●●●●●	Either	Transplant for precise spacing

Crop	Direct sow	Transplant	Verdict	Notes
Arugula, mustards	●●●●●	●●○○○	Direct sow	Fast
Mâche	●●●●●	—	Direct sow	Too small to transplant
Kale	●●●●○	●●●●○	Either	Direct sow is fine; transplant for sparrow protection
Broccoli, cauliflower	●●○○○	●●●●●	Transplant	Long-season; sparrow predation
Cabbage	●●○○○	●●●●●	Transplant	Same
Brussels sprouts	●○○○○	●●●●●	Transplant always	Needs every week of the season
Kohlrabi	●●●●●	●●●○○	Direct sow	Fast and reliable
Onion (seed)	●●○○○	●●●●●	Transplant	Long-season; weak first roots
Leek	●○○○○	●●●●●	Transplant always	200+ day crop
Garlic	●●●●● (cloves)	—	Direct-plant cloves	Not a seed crop
Pepper	●○○○○	●●●●●	Transplant always	Long-season; warm-soil germ
Tomato	●○○○○	●●●●●	Transplant always	Long-season
Eggplant	●○○○○	●●●●●	Transplant always	Heat-loving; long start
Cucumber	●●●●○	●●●○○	Direct sow preferred	Sensitive to root disturbance
Squash, zucchini	●●●●●	●●○○○	Direct sow	Same
Melon	●●●●○	●●●○○	Direct sow preferred	Same
Pumpkin	●●●●●	●●○○○	Direct sow	Same
Bean	●●●●●	●○○○○	Direct sow always	Bean roots resent transplant

Crop	Direct sow	Transplant	Verdict	Notes
Pea	●●●●●	●●○○○	Direct sow	Same
Cowpea, tepary	●●●●●	●○○○○	Direct sow	Same
Corn	●●●●●	●○○○○	Direct sow always	Block planting needed
Okra	●●●●○	●●●○○	Direct sow	Taproot
Sweet potato	—	(from slips, Guide 7 §10.2; chapter 19 here)	Slips only	Not a seed crop
Basil	●●●○○	●●●●●	Transplant	Buys 6 weeks
Cilantro	●●●●●	●●○○○	Direct sow	Bolts when transplanted
Parsley	●●○○○	●●●●●	Transplant	Slow germination
Dill	●●●●●	●●○○○	Direct sow	Resents transplant
Sunflower	●●●●●	●●○○○	Direct sow	Taproot

For more nuanced per-crop reasoning, see the crop guides — Guide 2 (peppers), Guide 6 (cool-season), Guide 7 (warm-season), Guide 8 (herbs).

18 · Hardening off

The 7-day protocol · common mistakes · wind and UV exposure ramp

A seedling that's spent six weeks under cool stable indoor light is shock-vulnerable to a Dragoons outdoor environment — direct UV at 4,700 ft elevation, daily 30–40°F temperature swings, dry wind, intense afternoon sun. **Hardening off** is the gradual exposure that lets the plant adapt before transplant.

18.1 The 7-day protocol

Day	Outdoor time	Location	Watering
1	1 hour	Deep shade (north side of building, under tree, shade cloth)	Light morning water
2	2 hours	Same shaded spot	Light morning water
3	3 hours	Shaded; allow some indirect light	Same
4	4 hours, including 1 hr filtered sun	Light shade with breaks of indirect sun	Same
5	6 hours; first direct morning sun (cool early hours only)	Direct morning sun, shade by 11 am	Possibly increasing
6	8 hours; morning sun + afternoon shade	Same	Watch closely; may need midday top-up
7	Full day outdoors + overnight	Full sun if forecast allows; cover if hard freeze	Normal field watering
8+	Transplant	Bed	See crop guide

Adjust for the crop: brassicas can move through the ramp in 5 days; peppers and tomatoes appreciate the full 7+; eggplants and basil need 10. Adjust for weather: pause the ramp during high wind, dust storms, hail forecasts.

18.2 The Dragoons specifics

UV intensity at 4,700 ft elevation is roughly 25% higher than at sea level. A seedling that hardened off fine in a coastal-California seed-starting blog will sunscald in the Dragoons under the same schedule. **Slow the ramp** — add an extra 2–3 days of

partial-shade exposure before any direct midday sun.

Wind is the other under-rated stressor. The same plant that handles direct sun fine collapses when wind pulls moisture from leaves faster than roots can replace it. Hardening off in a sheltered courtyard, then moving to an exposed bed, requires an extra day of "wind exposure" — somewhere with a steady 5–10 mph breeze, not the gusty afternoons.

18.3 Common hardening-off mistakes

- **Skipping it.** A seedling moved straight from light bench to bed is sunburned, windburned, and water-stressed within 24 hours. Survival is possible; performance lag is permanent for the season.
- **Going too fast.** A 3-day ramp instead of 7 produces the same lag at lower intensity.
- **Not watering during the ramp.** Outdoor plants dry faster than indoor; check soil twice daily during the ramp.
- **Wrong weather window.** A windy or freezing forecast in the middle of the ramp will set the plant back. If the forecast looks rough, pause indoors for a day.
- **Ramp under indoor lights as "shade".** Hardening off has to be *outdoors* — the UV, temperature swings, and wind are exactly what you're acclimating to.

> **WARNING**
>
> **Never start hardening off the day before a forecast hard frost or hail event.** A plant in mid-ramp is its most vulnerable — exposed to outdoor conditions but not yet hardened. Check the forecast before day 1. If the next 7 days look unsettled, wait.

19 · Slip propagation — sweet potato

From a stored tuber to ready-to-plant slips

Some plants don't grow from seed at home — they grow from *slips* (short sprouts pulled from a sprouting tuber). Sweet potato (*Ipomoea batatas*) is the main example. This is the propagation method referenced from Guide 7 §10.2; the canonical procedure lives here.

19.1 What slips are

A slip is a 6-inch shoot grown from the eye of a stored sweet potato tuber. Each tuber produces 10–20 slips over 4–6 weeks. The slips are twisted off, rooted in water, then planted. One $5 organic sweet potato from the previous fall produces enough slips for a 30-foot home row.

19.2 The slip-growing protocol

1. **Start February 1.** Source 2–3 organic sweet potatoes — saved from a previous harvest or bought organic (conventional supermarket sweet potatoes are often treated with sprout inhibitors and won't slip).
2. **Suspend in water.** Insert 4 toothpicks around the middle of each tuber; suspend in a glass jar with the bottom half submerged. Alternative: lay the tuber on a tray of damp sand.
3. **Place in warm bright light.** 75–80°F is ideal. A sunny south-facing windowsill works; a heat mat under the jar speeds the process.
4. **Wait 4–6 weeks.** Sprouts emerge from the eye end (the end with visible buds). Each sprout will become a slip.
5. **When slips are 6 inches tall, twist them off.** Grip the base of the slip and twist gently. The slip should detach cleanly from the tuber, no flesh attached.
6. **Root the slips.** Place each slip in a small jar of water, leaves above water. Roots emerge in 5–7 days.
7. **Plant when soil reaches 70°F.** Typically May 20 in the Dragoons (Guide 7 §10). Plant slips with 2-inch roots, burying 2/3 of the slip below soil.

> **LOCAL TIP**
>
> Sweet potato slips are also available locally at Cochise County feed stores (Willcox Feed, Willcox Tractor Supply) from mid-May. $1–2 per slip; bundles of 25 for $20. Worth buying if you want a specific variety you didn't store, or want to skip the February startup work. The local slips arrive freshly cut without roots; plant the same day in well-watered soil.

20 · Stem cuttings

Rosemary · basil · mint · lavender · fig · grape · rooting hormone · mist vs covered jar

A stem cutting is a piece of a parent plant — typically 4–8 inches long — rooted to form a new genetically identical plant. For perennial herbs, soft fruits, and some trees, taking cuttings is faster than seed and produces predictable copies of the parent.

20.1 What roots from cuttings, and when

Plant	Cutting type	Time of year	Time to root	Success rate
Rosemary	Semi-hardwood	May–Aug	4–8 weeks	●●●●●
Lavender	Semi-hardwood	May–Aug	4–8 weeks	●●●●○
Sage	Semi-hardwood	May–Aug	4–8 weeks	●●●●○
Thyme	Soft tip	Apr–Jun	3–4 weeks	●●●●○
Oregano, marjoram	Soft tip	Apr–Jun	2–3 weeks	●●●●●
Basil	Soft tip	Anytime (warm)	7–10 days	●●●●● — almost always works in water
Mint, lemon balm	Soft tip / runner	Anytime warm	7–10 days	●●●●● — also divisions (chapter 21)
Geranium / pelargonium	Soft tip	Anytime	2–3 weeks	●●●●○
Fig	Hardwood	Dec–Feb (dormant)	6–10 weeks	●●●●● — Dragoons specialty
Grape	Hardwood	Dec–Feb (dormant)	6–10 weeks	●●●●○ (own-rooted, see Guide 5)
Pomegranate	Hardwood	Dec–Feb	6–10 weeks	●●●○○
Olive	Hardwood	Dec–Feb	8–16 weeks	●●○○○ — slow; misting tent helps
Tomato	Soft tip / sucker	Anytime warm	7–10 days	●●●●● — rooted from prunings
Blueberry	Softwood	Jun–Jul	6–10 weeks	●●○○○ — difficult; misting required

Plant	Cutting type	Time of year	Time to root	Success rate
Citrus	Semi-hardwood	Apr–Jun	8–12 weeks	●●○○○ — air layering often easier (chapter 22)

20.2 Cutting types — soft, semi-hardwood, hardwood

- **Softwood / soft tip**: the most recent flush of growth — green, bendy. Roots quickly, but wilts easily. Best for fast-rooting herbs (basil, mint) and softwood-friendly trees (blueberry).
- **Semi-hardwood**: this year's growth that has begun to firm up — bendy but with some woody resistance. The default for most herbs and shrubs.
- **Hardwood**: last year's fully woody growth, taken when the plant is dormant in winter. The default for figs, grapes, pomegranates.

20.3 The cutting procedure (semi-hardwood and softwood)

1. **Take in cool morning.** Stress is lower; cells are turgid.
2. **Cut 4–6 inches** with a clean sharp knife or pruner. Cut just below a node (the swollen joint where a leaf attaches).
3. **Remove lower leaves.** Strip the bottom 2/3 of the cutting to leave only 2–4 leaves at the top.
4. **Optional — wound the base.** Scrape the bottom inch of bark with a knife. Stimulates rooting in woody species.
5. **Dip in rooting hormone.** Powdered IBA (indole-3-butyric acid) rooting hormone, available as Hormex, Clonex (gel), or Dip 'N Grow (liquid). Skip for basil, mint, and tomato — they root without it.
6. **Insert into rooting medium.** A 50/50 mix of perlite and coco coir, or pure perlite for woody species. Pre-moisten the medium. Insert the cutting 2–3 inches deep; firm in.
7. **Cover for humidity.** Clear plastic dome, cut-open soda bottle inverted over the cutting, or daily misting in a covered tray.
8. **Place in indirect light.** Direct sun cooks cuttings. Bright window with no direct sun is ideal.
9. **Mist or check moisture daily.** Medium should stay moist, not soggy.
10. **Wait.** Don't pull to check — disturbance breaks new roots. Wait the rooting time in the table; once you see new top growth, roots are usually established.
11. **Pot up** to a 4-inch pot of standard potting mix once rooted. Continue indoors or in a sheltered spot for 4–6 more weeks before planting out.

20.4 The water-jar method (for fast-rooting species)

For basil, mint, oregano, tomato, mojito mint, and other soft-stem herbs:

1. Take a 4-inch cutting just below a leaf node.
2. Strip the lower leaves.
3. Place in a glass of water, leaves above water.
4. Place in bright but not direct light.
5. Change water every 2–3 days (algae, bacteria).
6. Roots appear in 5–14 days.
7. Pot up when roots are 1 inch long.

Almost zero equipment, almost zero failure rate for these species.

20.5 Fig and grape — the Dragoons specialty cuttings

The Dragoons winter dormant season (Dec–Feb) is the right window for hardwood cuttings of figs and grapes (Guide 5 §5 on own-rooted vines). Both root readily here.

Fig: take 8–10-inch cuttings from 1-year-old wood (last summer's growth, now dormant). Diameter pencil-thick. Top cut at an angle; bottom cut flat, just below a node. Bundle 5–10 in damp newspaper, store in a cool place (40–50°F) for 4 weeks of "callusing", then stick the bottom 4 inches into a 4-inch pot of perlite/coir or directly into a sheltered nursery bed. By April most have rooted; by May they push leaves.

Grape: same protocol — 8–10 inch dormant cuttings from 1-year-old wood, callused 4 weeks, then stuck. Own-rooted grape vines are viable in the Dragoons because of phylloxera-suppressing alkaline soils (Guide 5 §5).

> **LOCAL TIP**
>
> A single mature Mission, Black Madeira, or Brown Turkey fig in a Dragoons backyard produces 30–50 hardwood cuttings every winter pruning. Stick a dozen each year and within five years you have a self-propagated fig hedge or rows of giveaway saplings for neighbors and the local plant swap. Cuttings cost nothing once the parent tree is in.

21 · Root divisions

Mint · oregano · chives · garlic chives · comfrey · rhubarb · timing

Root division is the simplest propagation method — dig up a clump of a perennial, split it into pieces, replant each piece. Each piece grows into a new plant. Works for plants that grow in clumps or run rhizomes.

21.1 What divides well

Plant	Divide every	Best time	Number of divisions p
Mint (any species)	1–2 years	Early spring or fall	4–10 — runs aggressiv
Oregano, marjoram	3–4 years	Early spring	3–5
Chives	3–4 years	Early spring	4–8
Garlic chives	3–4 years	Early spring or fall	4–8
Lemon balm	2–3 years	Early spring	3–6
Tarragon (French)	3–4 years	Early spring	2–4
Comfrey	3–4 years	Early spring or fall	4–10 — root pieces gr
Rhubarb	5–7 years	Late fall (dormant)	2–4
Asparagus (crowns)	Avoid dividing once established	—	—
Daylily	3–4 years	Spring or fall	4–10
Iris	3–4 years	Late summer (rhizome)	4–8
Strawberry	Use runners, not divisions	Spring	Unlimited from runne
Hops	2–3 years	Early spring	4–10 (rhizome pieces)
Sorrel	3–4 years	Early spring	3–6

21.2 The division procedure

1. **Wait for the right window.** Most divisions go in early spring — soil workable, plant just stirring from dormancy. Rhubarb and iris are exceptions (late fall, late summer respectively).
2. **Soak the plant.** Water deeply the day before lifting.
3. **Lift the entire clump.** Dig wide and under the root mass. Try to keep most roots intact.
4. **Wash off soil.** Hose the root ball gently so you can see structure.
5. **Identify natural divisions.** Most clumping plants have visible “crowns” — points where shoot meets root. Each crown is a potential division.
6. **Cut or pull apart.** Use a sharp knife, two garden forks back-to-back, or your hands for soft-rooted plants. Each division should have at least one crown and a healthy root section.

7. **Replant immediately.** Don’t let roots dry. Plant at the same depth the parent was growing. Water in.
8. **Shade for 3–5 days.** Newly divided plants are stressed; afternoon shade helps recovery.

21.3 Comfrey — propagating from root cuttings

Comfrey (*Symphytum* spp.) propagates from root pieces alone, no crown needed. Dig a comfrey plant; cut roots into 2-inch pieces; bury 2 inches deep in any reasonable soil; water. Each piece grows a new plant in 4–6 weeks. The implication for the garden: comfrey is nearly impossible to fully remove once planted — site it where you want it permanently.

22 · Air layering

Figs · citrus · technique and timing

Air layering is propagation that doesn't separate the plant from the parent until roots have formed — a section of branch is wounded, wrapped in moist medium, and allowed to grow roots while still attached to the tree. Once rooted, the branch is cut off below the new roots and potted as a finished young tree. The technique gives nearly 100% success on species that are otherwise difficult to root from cuttings.

22.1 What air-layers well

Plant	Best time	Time to root	Notes
Fig	Spring (May–June)	6–10 weeks	Easiest; cuttings work too
Citrus	Spring (April–May)	8–14 weeks	The standard propagation for own-rooted citrus
Pomegranate	Spring	8–12 weeks	Faster than cuttings
Jujube	Spring	10–14 weeks	Hard to root from cuttings; air-layer works
Apple, pear	Spring	10–16 weeks	Less common; usually grafted instead
Avocado	Spring	12–16 weeks	Difficult crop in the Dragoons; experimental
Loquat	Spring	10–12 weeks	Works well
Pluot, plum, apricot	Spring	10–14 weeks	Variable
Houseplants (ficus, rubber tree, schefflera)	Anytime warm	4–8 weeks	Easy practice species

22.2 The air-layer procedure

1. **Select a healthy branch.** Pencil-thick to 1-inch diameter, 1–2 feet of straight section, vigorous wood from the most recent year or two.
2. **Wound a ring of bark.** With a sharp knife, make two parallel cuts around the branch, 1–1.5 inches apart. Peel the bark and cambium between the cuts, leaving the inner wood exposed. This forces stored energy to accumulate above the cut, which drives root formation.

3. **Optional — dust the cut with rooting hormone.** Powdered IBA (Hormex or similar).
4. **Wrap with moist sphagnum moss.** A double-handful of pre-soaked long-fiber sphagnum moss packed around the wounded area.
5. **Wrap with plastic.** Plastic wrap or a cut-open zip bag, tightly sealed at top and bottom with electrical tape or twist ties. The seal traps moisture; the moss inside stays wet for weeks.
6. **Cover with foil or shade-cloth.** Direct sun cooks roots through clear plastic. Aluminum foil wrapped around the plastic moderates temperature.
7. **Check at 4 weeks.** Loosen the foil and peer through. Roots should be visible inside the moss.
8. **Sever when rooted.** Cut the branch off below the new root ball.
9. **Pot up.** Plant the rooted branch in a 1- or 2-gallon container of potting mix, keep moist and shaded for 2–4 weeks while roots fill the pot.
10. **Plant out.** After the rooted layer has acclimated, plant in the bed or orchard.

> **LOCAL TIP**
>
> A fig already growing in the Dragoons is the best candidate for first-time air layering — figs root almost regardless of technique. Practice on a fig branch in May, learn the procedure, then apply to higher-value species (citrus, jujube) the following year. The same fig can run 3–4 air layers simultaneously without harming the parent.

23 · Saving your own seed

Open-pollinated vs F1 · isolation distance · harvest and dry · viability storage

Saving seed from your own garden is the oldest soil-and-seed loop. Done well, it produces an annual supply of seed perfectly adapted to your bed, your climate, your timing — for free.

23.1 Open-pollinated vs F1

- **Open-pollinated (OP, including heirlooms)**: seed saves *true* to the parent. A *Brandywine* tomato seed grows another *Brandywine* tomato. This is the only seed worth saving.
- **F1 hybrid**: seed from a cross between two stable parent lines. The F1 plant is vigorous and uniform. Seed *saved from an F1* is the F2 generation — genetically scrambled, unpredictable. Some F2 seedlings may resemble one parent; many will not. Don't save F1 seed and expect the same crop.

Look at the seed packet. "Open-pollinated" or "heirloom" — you can save. "F1" or "hybrid" — you can grow, but don't save for seed.

23.2 Self-pollinating vs cross-pollinating crops

How easy seed-saving is depends on whether the crop pollinates itself or relies on insects/wind.

Crop	Pollination type	Isolation distance	Save-ability
Tomato	Self (mostly)	10 ft	●●●●● — easiest of all
Bean (common, *Phaseolus vulgaris*)	Self	10 ft	●●●●● — easy
Pea	Self	10 ft	●●●●● — easy
Lettuce	Self	10 ft	●●●●● — easy
Pepper	Self (mostly), some cross via bees	50 ft, more for purity	●●●●○ — easy, mind cross-pollination
Eggplant	Self (mostly)	50 ft	●●●●○
Tomatillo, ground cherry	Cross — need 2+ plants	500 ft	●●●○○ — needs pair
Squash, melon, cucumber	Cross — heavily	1/2 mile (!) for purity; 200 ft adequate	●●○○○ — hand-pollinate and bag if pure seed wanted

Crop	Pollination type	Isolation distance	Save-ability
Brassicas (broccoli, cabbage, kale)	Cross — within species	1/2 mile	●●○○○ — biennial; difficult
Onion, leek	Cross	1/2 mile	●●○○○ — biennial
Carrot, parsnip	Cross	1/2 mile	●●○○○ — biennial; need to overwinter for seed
Corn	Cross (wind)	1 mile or 2-week time isolation	●●○○○ — challenging
Beet, chard	Cross (wind)	1/2 mile	●●○○○ — biennial
Tepary bean	Self	10 ft	●●●●● — well-suited to Dragoons seed-saving
Cilantro, dill	Cross	1/4 mile	●●●○○ — easy if just one variety
Basil	Cross — bees	500 ft	●●●○○
Sunflower	Cross	1/2 mile	●●●○○

> **For first-time seed-savers in the Dragoons: tomato, bean, pea, lettuce, pepper, tepary bean.** These six crops self-pollinate, have minimal isolation requirements, save easily, and produce reliable seed within a single home garden. Start there.

23.3 Harvest and dry

The procedure depends on whether the seed is dry-fruited or wet-fruited.

Dry-fruited crops (beans, peas, lettuce, brassicas, onion, basil, dill):

1. Let the seed fully ripen on the plant. Pods or flower heads brown and dry.
2. Harvest before they shatter (release seed). Cut the whole stalk; bring inside.
3. Lay out on a screen or paper, indoors out of sun, for 1–2 more weeks.
4. Thresh — rub pods between hands, or stamp in a bag — to release seed.
5. Winnow — pour seed and chaff in front of a fan; chaff blows; seed falls.
6. Store (§23.4).

Wet-fruited crops (tomato, pepper, eggplant, cucumber, melon, squash):

1. Let fruit fully ripen on the plant — past kitchen-ripe, into “overripe” for tomatoes.
2. Harvest fruit; cut open; scoop seeds with surrounding pulp into a jar.

3. **For tomato**, ferment 3–5 days: add a little water, cover loosely, stir daily. The ferment dissolves the gel coat around each seed (which inhibits germination). When a layer of mold forms on top and seeds sink to the bottom, the ferment is done.
4. Rinse seeds in a fine sieve under running water.
5. Spread on a paper plate (not paper towel — sticks) for 1–2 weeks until completely dry.
6. Store.

23.4 Storing seed for viability

Seed wants three things in storage: **cool, dry, dark**. Each variable that gets worse cuts viability roughly in half.

The rule of thumb: **temp (°F) + relative humidity (%) ≤ 100** for long storage.

Storage condition	Approximate viability for common vegetable seed
Room temp, ambient humidity (Dragoons dry pantry)	1–3 years
Refrigerator (40°F), sealed jar with silica gel	5–10 years
Freezer (0°F), sealed jar with silica gel	10–30 years

A useful home protocol:

1. **Dry thoroughly.** Seeds must be at < 8% moisture before sealing. Test: bend a seed coat — should crack, not flex.
2. **Pack in paper envelopes** with variety and date written on each. Paper breathes; seeds release moisture during early storage.
3. **Place envelopes in a glass jar** with a silica gel pack (food-grade desiccant).
4. **Seal jar; refrigerate.** Bottom shelf, away from veg drawer humidity.
5. **Label the jar** with contents and date.
6. **When using**, let jar come to room temperature for 4+ hours before opening to prevent condensation on seed.

23.5 Typical viability by crop

Crop	Years at refrigerator storage
Onion, leek, parsnip, parsley	1–2 years
Corn, pepper, okra	2–3 years
Carrot, sunflower, salsify	3 years
Bean, pea	3–4 years
Brassica (broccoli, cabbage, kale, etc.)	4–5 years

Crop	Years at refrigerator storage
Tomato, eggplant, lettuce	4–6 years
Squash, cucumber, melon	5–6 years
Beet, chard, spinach	4 years

These numbers are conservative; properly dried seed in a fridge with desiccant routinely doubles them.

LOCAL TIP

The Dragoons climate is unusually friendly to seed-saving. Low humidity through most of the year means seeds dry naturally on the stem or on a screen indoors with minimal effort, and a dry pantry holds seed better than a humid one. Some Dragoons gardeners run a 10-year tomato or bean seed-library out of a single closet shelf with no refrigeration — the climate does the work for them.

24 · The Dragoons seed-starting calendar

Month-by-month — what to start when

This calendar is the practical companion to chapters 16 and 17. It says, for any given week of the year, what should be on the heat mat, what should be moving up to a 4-inch pot, what should be going outside to harden off, and what should be sown directly. Tape a copy to the shed door.

24.1 The annual calendar

Month	Indoor starts	Move outside / harden off	Direct sow	Notes
January	*C. pubescens* peppers (rocoto, manzano); first overwintered-onion check; start sweet potato tubers Feb 1	—	Garlic still possible (window closing); peas under row cover late month	Heat mat critical; coldest indoor month
February	*C. chinense* peppers (habanero, ghost, scotch bonnet); start onions for spring; start parsley	—	Peas; spinach; spring radish	Sweet potato slip tubers in water Feb 1 (chapter 19)
March	*C. annuum* peppers (jalapeño, serrano, bell, poblano); tomato (most varieties); eggplant; basil; tomatillo	Onion seedlings to cold frame; cool-season transplants begin hardening	Carrot; beet; turnip; parsnip; chard; lettuce; arugula; cilantro; dill; mustards; spinach	Last-frost still possible; row cover ready

Month	Indoor starts	Move outside / harden off	Direct sow	Notes
April	Last call for tomato/pepper indoor sowings; succession basil; cucumber and squash 2 weeks ahead of last frost	Tomato, pepper transplants begin 7-day ramp last week of April	Peas (last chance); carrot, beet succession; lettuce succession; spring brassicas direct-sow	Last frost typically April 5–25
May	Continue basil succession; second-batch tomato/pepper if first batch failed; cucumber, melon, squash, okra (final indoor week)	Tomato, pepper, eggplant transplant out after last frost (typically May 1–15)	Bean (all kinds, after soil > 65°F); cowpea; tepary bean; corn; cucumber, melon, squash, pumpkin (after May 10); sunflower; okra	Sweet potato slips plant out May 20
June	—	—	Succession beans; succession lettuce in shade; succession cucumber, summer squash; basil	Last warm-season direct-sow window
July	Fall brassicas indoors (broccoli, cauliflower, cabbage) under lights or shade	—	Buckwheat cover crop; carrot under shade cloth for fall; last sweet corn (short-season variety)	Brassicas indoors July 15–Aug 5
August	Fall brassicas continued; first fall lettuce, mustards under shade	Fall brassica transplants harden off late month	Carrot; beet; turnip; kale; mustards; spinach late month; lettuce late month under shade	Fall direct-sow window opens late month as soil cools

Month	Indoor starts	Move outside / harden off	Direct sow	Notes
September	Indoor lettuce continued	Brassica transplants out (broccoli, cauliflower, cabbage) early month; second wave of greens	Garlic prep; kale; spinach; lettuce succession; arugula; mustards; radish; turnip; carrot; beet; mâche late month; cool-season cover crop sown (rye + vetch)	Soil cools through 75°F → 65°F
October	—	Final brassica transplants (early month); leeks for spring	Garlic (Oct 15 onwards); shallots; spring onion sets; carrot succession; spinach; arugula; mâche; last lettuce	First frost late month (Oct 25–Nov 10)
November	—	—	Garlic (window closing); winter rye + vetch (if not yet); fava beans for green manure	Bed mulching for winter
December	Plan next year; order seed; sharpen tools; review notes; start hardwood cuttings of fig, grape, pomegranate (chapter 20)	—	—	The off-season; cuttings stratify outdoors or in cool garage

24.2 The annual planning rhythm

A few habits that compound across years:

- **November–December**: order seeds. Native Seeds/SEARCH, Baker Creek, Johnny's, and any specialty source for the season ahead. Seeds shipped in January are often back-ordered or substituted.
- **January**: clean and bleach trays, refill seedling mix, replace any failed heat-mat thermostats. The seed-starting station needs to be ready by Feb 1.
- **February 1**: sweet potato tubers in water; first peppers on heat mat. The seed year begins.
- **August 1**: re-clean trays for the fall round. Brassica starts begin.
- **November 15**: bed cover-crops in; mulch over; system winterized.

The single highest-return habit for a Dragoons grower is a written seed-start journal. Date sown, date germinated, days from sow to germ, percent germination, transplant date, harvest date. After three seasons, your journal is more accurate than any general gardening book — it tells you, for your bed, your variety, your timing, when to do what. The seed-starting calendar in §24.1 is a starting point; your journal is the refined version.

Closing — soil and seed together

The Dragoons are honest about their soil. Year 1 in an unworked bed is hard; the alkalinity, the low organic matter, the caliche, the dry air, the 4,700 ft UV — every one of those is real. What separates a struggling Dragoons garden from a productive one over five years is exactly two things: persistent investment in the soil (Part 1 of this guide), and the seed-start discipline that puts the right transplant into the right bed at the right time (Part 2 of this guide).

Almost every other guide in this library inherits these foundations. The pepper guide (Guide 2) is built on a January heat-mat start (chapter 16, this guide) and a compost-amended sulfur-acidified bed (chapters 3 and 11, this guide). The cool-season guide (Guide 6) inherits the soil-prep routine (chapter 3) and the direct-sow vs transplant decisions (chapter 17). The sweet-potato section in Guide 7 defers to chapter 19 (slip propagation). The grape guide (Guide 5) inherits the own-rooted cutting protocol (chapter 20). The orchard guide (Guide 9) inherits the air-layer technique (chapter 22) and the wood-chip mulch standards (chapter 10).

Soil and seed are the upstream variables. Get them right, and most of the rest of growing in the Dragoons is just paying attention.

Sources & further reading

- **University of Arizona Cooperative Extension — Cochise County** (Sierra Vista; 520-458-8278). Soil testing, regional agriculture, master gardener program.
- **Native Seeds/SEARCH** (Tucson). Heritage seed conservation; the regional seed bank.
- *Plant Propagation: Principles and Practices* — Hartmann & Kester. The reference for stem cuttings, air layering, and seed propagation.
- *The Soil Will Save Us* — Kristin Ohlson. Accessible introduction to soil biology and carbon sequestration.
- *Teaming with Microbes* — Jeff Lowenfels & Wayne Lewis. Soil food web for the home grower.
- *The New Organic Grower* — Eliot Coleman. Soil blocks, seedling mix recipes, season-extension foundations.
- *The Resilient Gardener* — Carol Deppe. Seed-saving, breeding, and adaptation for the home grower.
- *Seed to Seed* — Suzanne Ashworth. The canonical seed-saving reference, crop by crop.
- *The Worm Farmer's Handbook* — Rhonda Sherman. Vermicomposting at every scale.
- *Bokashi Composting* — Adam Footer. Fermentation-based composting; the indoor-friendly method.
- *USDA-NRCS Web Soil Survey* (websoilsurvey.nrcs.usda.gov). Site-specific soil maps for any address in Cochise County.

Index