

Cool-Season Crops in the Dragoons

Guide 6 · Cool-Season Track

Brassicas · Alliums · Greens · Roots

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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** (this guide) · brassicas + alliums + greens + roots - **Guide 7 — Warm-Season Companions** · tomatoes, cucurbits, beans, corn, sweet potatoes - **Guide 8 — Herbs in the Dragoons** · annual + perennial · soil & hydroponic - **Guide 9 — Backyard Orchard in the Dragoons** · figs, pomegranates, jujubes, stone fruits - **Guide 10 — Pest, Disease & Wildlife** · IPM + Cochise wildlife exclusion - **Guide 11 — Foundations: Soil & Seed** · soil-building, composting, seed-starting, propagation - **Guide 12 — Harvest, Preservation & Storage** · canning, fermenting, drying, cellaring - **Guide 13 — Water in Cochise County** · sourcing, testing, treatment, rainwater, conservation - **Guide 14 — Season Extension Structures** · cold frames, low tunnels, hoop houses, high tunnels - **Guide 15 — Native Food Crops of the Sonoran-Madrean Region** · the indigenous food complex of the Dragoons and the wider sky-island region - **Guide 16 — Companion Plantings & Polycultures** · the design layer — companion matrix, anti-companions, cover crops, 9 Dragoons-specific guild designs - **Guide 17 — Recipes & Kitchen Integration** · what to cook with what came out of the garden this morning · by-crop recipes + seasonal menus This is the cool-season counterpart to Guide 2 (Peppers) and Guide 7 (Warm-Season Companions). Where this guide touches water treatment, EC/pH chemistry, or hydroponic recipes, it points back to Guides 2 and 3 rather than restating their content. Water-chemistry baseline is in **Guide 3 §4**; Masterblend and DIY nutrient recipes are in **Guide 4 Part 1**; pH-up / pH-down replacements for alkaline Cochise County water are in **Guide 4 Part 3**.

How to use this guide

Pepper season runs roughly April through October. The remaining months — late August through April — belong to a different palette: *brassicas* (the cabbage family — *Brassicaceae*: broccoli, cauliflower, cabbage, kale, brussels sprouts, kohlrabi, plus mustards and arugula on the greens side), *alliums* (the onion-and-garlic family — *Allium spp.*: garlic, shallots, onions, leeks, chives), salad greens, and root crops. None of them want the heat that peppers thrive in; most of them actually *need* frost to perform their best. The Dragoons cool season is more generous than most American growers realize, and this guide is the practical companion to working it.

The guide is in seven chapters:

1. **Common ground for the cool season** — the climate window, frost behavior, family overview, and the master planting calendar covering every crop in this guide.
2. **Brassicas** — broccoli, cauliflower, cabbage, kale, brussels sprouts, kohlrabi (the bed-anchor crops, soil and hydroponic).
3. **Alliums** — garlic, shallots, onions, *leeks* (the non-bulbing relative grown for its thick white shank — *Allium ampeloprasum*; treat it as a giant scallion you blanch in a trench). The long-runners that go in once and finish next summer.
4. **Cool-season greens** — spinach, mâche, overwintered lettuce, arugula, mustards (the hydro-friendliest cool-season crops).
5. **Root crops** — carrots, beets, turnips, radishes, parsnips (soil only; bed depth is the make-or-break).
6. **Pest management for the cool season** — a cohesive IPM section covering all crop families.
7. **Crop rotation handoff with peppers** — what comes out of the pepper bed, what goes in, and the recommended 4-year rotation.

LOCAL TIP

Almost every crop in this guide tolerates light frost; many actively improve with it. Broccoli, kale, brussels sprouts, carrots, parsnips, leeks, mâche, and spinach all taste markedly sweeter after the first hits below 32°F. The Dragoons winter is not a survival exercise for these crops — it's their **preferred** season. Plan harvests *after* the first frost, not before.

1 · Common ground for the cool season

The Dragoons window · frost behavior · family overview · master planting calendar

1.1 The Dragoons cool-season window

The Dragoon Mountains sit at roughly 4,700 ft in USDA zone 8a. Daytime highs from late September through April are usually in the 50s–70s, with overnight lows from the high 30s into the low 20s during the deepest weeks of January. Hard freezes below 25°F happen but are short — typically 3–6 nights per winter, usually clustered around the second week of January. By national standards, this is a **mild and unusually long cool-growing window**: roughly 230 frost-tolerant days from late August to mid-May, with continuous outdoor harvest available the entire time if you choose the right crops.

The trade-off is **soil temperature and water**. The ground stays warm well into October — soil temperatures at 4-inch depth often read 75°F+ in early September, which delays root establishment if you transplant brassicas or onions too early. And winter watering still matters because rainfall is minimal: from October through April, the Dragoons average less than half an inch of natural precipitation per month, and a dry windy week in March can desiccate an unirrigated bed quickly.

Month	Avg high	Avg low	Frost expected?	Notes for the grower
August (late)	88 °F	62 °F	No	Soil still 75–80 °F; brassica transplant prep window
September	82 °F	56 °F	No	Soil cools through 65 °F; direct-sow window opens
October	73 °F	46 °F	First frost typically Oct 25–Nov 10	Plant garlic; pepper-bed turnover
November	63 °F	36 °F	Yes — light	Row cover for greens; harvest fall brassicas
December	56 °F	30 °F	Yes — most nights	Hard frosts; harvest sweetened roots & kale

Month	Avg high	Avg low	Frost expected?	Notes for the grower
January	55 °F	28 °F	Yes — coldest month	3-6 nights below 25 °F; protect heading crops
February	60 °F	32 °F	Yes — diminishing	Sow spring brassicas indoors
March	67 °F	38 °F	Yes — last frost typically Mar 15-Apr 5	Plant spring leeks, peas; uncover greens
April	76 °F	46 °F	Rare	Spring brassicas race against May heat
May	84 °F	54 °F	No	Cool-season crops <i>bolt</i> (send up a flower stalk and turn bitter — the leaf crop's premature reproductive shift triggered by heat and lengthening days); bed turnover for peppers

1.2 Frost behavior — what hardens off, what doesn't

Not every cool-season crop handles frost the same way. The Dragoons get a wide range of cold events — a glancing frost at 31°F, a long midwinter night at 18°F, a windy hard freeze at 14°F — and crops sort themselves accordingly. Knowing the limits saves a lot of row cover.

Crop	Survives down to (with no cover)	Improves with frost?	Notes
Garlic (established)	-10 °F	Yes — vernalization required	Plant in fall; freezes signal bulb formation
Leeks (mature)	5 °F	Yes	Sweeten dramatically below 25 °F
Mâche (corn salad)	5 °F	Yes	The hardiest salad green; ignores frost
Spinach (Bloomsdale)	10 °F	Yes	Sweeter, slower, more concentrated
Kale (Red Russian, Lacinato)	10 °F	Yes — pronounced	Frost converts starch to sugar
Brussels sprouts	15 °F	Yes — required	Sprouts need 2+ frosts to develop full flavor
Carrots (in-ground)	15 °F (mulched)	Yes — pronounced	Leave in ground; pull as needed all winter
Parsnips (in-ground)	-20 °F (mulched)	Yes — required	Must freeze hard to become edible
Cabbage (savoy)	20 °F	Yes — slight	Crinkled leaves shrug off frost better than smooth
Cabbage (other)	25 °F	Slight	Heads firm up with cold but split if too cold
Overwintered onions	15 °F	Neutral	Survive but pause growth below 35 °F
Beets, turnips	25 °F	Slight	Roots tolerate more than tops
Broccoli, cauliflower (heading)	25 °F	No — heads damage	Curds bruise below 25 °F
Lettuce (Winter Density)	20 °F	No — survives but doesn't improve	Use row cover below 25 °F
Arugula	20 °F	No — bolts in spring	Cold slows growth but keeps it tender
Radishes	25 °F	No	Harvest before hard freeze

The frost rule for the Dragons. Anything that goes into the bed before October 15 should be planted with the expectation that it will see frost. Don't plan to protect crops *from* frost — plan to use frost to your advantage on the crops that tolerate it (kale, brussels, leeks, parsnips, mâche), and only protect the small subset (heading broccoli, cauliflower, lettuce) that genuinely needs it.

1.3 Crop family overview — who fits which slot

Each crop family fits a different slot in the cool-season window. Brassicas are the bed anchors (heavy feeders, long bed occupancy, finish in early winter). Alliums occupy beds for nearly the entire window (garlic goes in October, comes out July). Greens fill the in-between weeks with fast succession sowings. Roots run alongside everything in their own deep-prepped beds.

Family	Bed occupancy	Feeding demand	Frost tolerance	Best fit in the window
Brassicas	80-120 days	Heavy	Moderate-to-high	Aug transplant → Jan harvest; Feb transplant → May harvest
Alliums	240-280 days	Moderate, slow	Very high	Oct plant → June/July harvest (garlic, overwintering onions)
Greens	30-60 days	Light	Very high (most)	Continuous Sept-April under row cover
Roots	60-110 days	Light	Very high (in ground)	Sept sow → Dec-March harvest as needed

1.4 Master cool-season planting calendar

This is the planting calendar that ties the whole guide together. Every crop in the four families fits somewhere in this chart. Cross-reference it with your bed plan before each season — the worst cool-season mistakes are timing mistakes (planting garlic in December, or carrots in mid-October when soil temperature has already dropped below germination range).

Crop	Sow indoors	Transplant out	Direct sow	First harvest	Final harvest
Broccoli (fall)	Jul 15 - Aug 5	Aug 25 - Sep 15	Aug 25 - Sep 25	Late October	January
Broccoli (spring)	Feb 1 - Feb 15	Mar 1 - Mar 15	—	Late April	June
Cauliflower (fall)	Jul 20 - Aug 5	Sep 1 - Sep 25	—	November	December
Cauliflower (spring)	Feb 1 - Feb 15	Mar 1 - Mar 15	—	May	June
Cabbage (early)	Jul 20 - Aug 10	Sep 1 - Sep 20	—	November	December
Cabbage (storage)	Jul 5 - Jul 25	Aug 25 - Sep 5	—	December	January
Cabbage (spring)	Feb 1 - Feb 20	Mar 1 - Mar 20	—	May	June
Kale	—	—	Sep 1 - Oct 15	November	April (continuous)
Brussels sprouts	Jun 25 - Jul 15	Aug 5 - Aug 25	—	November	January
Kohlrabi	—	—	Aug 25 - Nov 1 (succession)	October	March
Garlic (hard-neck)	—	—	Oct 15 - Nov 15 (cloves)	June (<i>scapes</i> — the curling flower stalk hard-neck garlic sends up in late spring, snapped off as a bonus harvest two weeks ahead of the bulb)	July (bulbs)
Garlic (soft-neck)	—	—	Oct 15 - Nov 15 (cloves)	—	July
Shallots	—	—	Oct 15 - Nov 15 (sets)	—	July
Onions (overwintering)	—	Aug 25 - Sep 15 (sets/transplants)	—	—	June

Crop	Sow indoors	Transplant out	Direct sow	First harvest	Final harvest
Onions (spring)	Jan 15 - Feb 1	Mar 1 - Mar 15	Mar 1 - Apr 1	—	July
Leeks (overwinter)	Jul 1 - Jul 20	Sep 1 - Sep 20	—	November	April
Leeks (spring)	Jan 15 - Feb 1	Mar 15 - Apr 1	—	August	October
Spinach	—	—	Sep 1 - Mar 1 (succession)	October	May
Lettuce (winter)	—	—	Sep 1 - Feb 15 (succession)	October	May
Mâche	—	—	Sep 15 - Nov 15	November	April
Arugula	—	—	Sep 1 - Mar 15 (succession)	October	May
Mustards	—	—	Sep 1 - Mar 1 (succession)	October	May
Carrots	—	—	Sep 1 - Oct 15; Feb 15 - Mar 15	November	March (fall sow); May (spring sow)
Beets	—	—	Sep 1 - Oct 1; Feb 15 - Mar 15	November	April; May
Turnips	—	—	Sep 1 - Oct 15	October	February
Radishes	—	—	Sep 1 - Apr 15 (succession)	October	May
Parsnips	—	—	Sep 1 - Sep 25	December	March

LOCAL TIP

Tape a printed copy of this calendar inside the shed door. The Dragoons cool season has more separate planting events than the warm season (roughly 35 distinct sowings if you run successions), and the timing is unforgiving — garlic

planted in December won't size up, carrots seeded in October germinate poorly because the soil cools too fast, spring broccoli transplanted in April bolts. Date discipline matters more here than in mild-winter climates.

2 · Brassicas

Broccoli · Cauliflower · Cabbage · Kale · Brussels Sprouts · Kohlrabi

If you're new to brassicas in the Dragoons: start with kale. Direct-sow *Red Russian* or *Lacinato* in early September, harvest leaves continuously from November through April, and you will have learned 80% of what this chapter teaches with almost no risk. Add broccoli (*De Cicco*) and kohlrabi as a second-year experiment once you have one successful kale bed under your belt. Cauliflower, brussels sprouts, and storage cabbage all reward more discipline than the first season usually allows — save them for year two.

Brassicas are the **cool-season anchor crop** for the Dragoons. The two crops (peppers and brassicas) never compete for bed space, and they reward very different management. Everything in this chapter has been refined through multiple Dragoon seasons.

2.1 Variety reference

Pick varieties bred for short, cool windows. Long-season European cultivars often bolt or fail to form heads here because our cool window is mild rather than long.

Crop	Recommended varieties · profile	Dragoon notes
Broccoli	<i>Calabrese</i> · OP · 60–65 days · loose mid-size heads with abundant side shoots · classic spring crop. <i>De Cicco</i> · 50–60 days · small main head, heavy side-shoot producer · best choice for a long picking window. <i>Belstar</i> F1 · 65–75 days · large tight heads, holds in heat better than most.	<i>Calabrese</i> and <i>De Cicco</i> both keep producing side shoots for 4–6 weeks after the main cut — favored for fall plantings where you want a long harvest before deep frost. <i>Belstar</i> 's heat tolerance is useful for late-summer sowings.

Crop	Recommended varieties · profile	Dragoon notes
Cauliflower	<i>Snowball Y</i> · OP · 60-70 days · classic white head, needs blanching (tie outer leaves over the head). <i>Cheddar F1</i> · 60-65 days · orange self-blanching, no leaf-tying needed · sweet flavor. <i>Graffiti F1</i> · 75-85 days · purple, holds color when cooked briefly.	Cauliflower is fussier than broccoli — needs steady moisture and a narrow temperature band (55–65°F) during head formation. The Dragoons' warm fall makes early sowings risky; aim for transplants going out late September. Self-blanching varieties save 10 minutes per head per week of fussing with twine.
Cabbage	<i>Early Jersey Wakefield</i> · OP · 60-65 days · conical heads, very early. <i>Late Flat Dutch</i> · 100 days · large 8-10 lb flat heads, storage cabbage. <i>Savoy Ace F1</i> · 80 days · crinkled leaves, most cold-hardy.	Wakefield is the spring workhorse here — small enough to size up before the May heat. Savoy Ace overwinters dependably; the heads slow but don't damage through low-20s nights. Storage cabbages need the full 100-day window — plant by September 1 for Christmas harvest.
Kale	<i>Lacinato</i> (dinosaur) · 50-65 days · narrow dark blue-green strap leaves · holds through hard frost. <i>Red Russian</i> · 50-60 days · purple-veined oak-leaf shape · most cold-hardy and most tender. <i>Winterbor F1</i> · 60 days · classic curly green, very productive.	Kale is the easiest brassica in the Dragoons — direct-sow in September, harvest continuously through April. Frost concentrates the sugars; midwinter kale tastes sweeter than fall kale. Red Russian self-sows freely if you let a few plants bolt in May.

Crop	Recommended varieties · profile	Dragoon notes
Brussels sprouts	<i>Long Island Improved</i> · OP · 90 days · classic open-pollinated standard. <i>Diablo</i> F1 · 110 days · tight uniform sprouts, holds long on stalk. <i>Falstaff</i> F1 · 100 days · purple, decorative and flavorful.	Brussels sprouts need the longest run of any brassica — direct-sow or transplant in early August, harvest October through January after multiple frosts. Top the plant (remove growing tip) in late October to push energy into the sprouts. The hardest part is keeping aphids off in November.
Kohlrabi	<i>Early White Vienna</i> · 55 days · pale green, the standard. <i>Purple Vienna</i> · 60 days · purple skin, white flesh. <i>Kossak</i> F1 · 80 days · stores in the ground without going woody up to grapefruit size.	Underrated for the Dragoons — fast, takes light frost, edible at any size from golf ball to softball. Direct-sow in succession every three weeks from late August through early November for a winter-long supply.

Brassicas hate heat at heading time. The single most common failure mode in the Dragoons is transplanting cauliflower or broccoli too early in the fall — warm soil pushes leaf growth, then a hot Indian-summer week in mid-October sends the plants into “buttoning,” where they form a tiny premature head and stop. Wait for the 10-day forecast to drop highs below 80°F before you set out transplants.

2.2 Bed preparation

Brassicas are heavy feeders. They want a loose, fertile bed with steady moisture and a near-neutral pH. The native Dragoons soil is alkaline (typically pH 7.6–8.1), low in organic matter, and drains too fast on slope or too slowly in caliche pockets — none of which suits a broccoli plant well. Bed prep is where most of the work happens.

Soil chemistry targets

Parameter	Target for brassicas	Typical Dragoons baseline	Adjustment
pH	6.5 – 7.0	7.6 – 8.1	Acidify with elemental sulfur (1 lb per 100 sq ft drops pH ~0.5 point over a season) or annual compost amendments
Organic matter	5 – 8 %	1 – 2 %	2–3 inches of finished compost worked into the top 8 inches every fall
Nitrogen	100–150 lb/acre equivalent	low	Aged manure or feather meal at transplant + a side-dress at heading
Calcium	High; cauliflower is especially needy	naturally high in Dragoons soil	Usually no addition needed — caliche supplies it
Boron	1–2 ppm	typically low	A pinch (1/4 tsp) of borax dissolved in 1 gal water, applied per 50 sq ft, prevents hollow stem
Soil temp at transplant	55–70 °F	75 °F+ in early fall	Wait, or shade-cool the bed for 5 days before planting

Practical bed routine

1. **Late July:** Remove pepper plants from the summer bed or pull the cover crop. Pull weeds while they're young.
2. **Late July / early August:** Spread 2–3 inches of finished compost over the bed. If the soil tested alkaline last year, broadcast 1 lb elemental sulfur per 100 sq ft now.
3. **Early August:** Fork or broadfork to 8 inches. Avoid rototilling — you destroy soil structure that brassicas reward.
4. **Mid-August:** Water the bed deeply twice in the week before planting. This wakes the soil biology and cools the surface.
5. **Late August:** Test soil temperature in the morning with a probe. When it's below 75°F at 4-inch depth, you can transplant.

2.3 Direct sow vs transplant

Decision	When to direct-sow	When to transplant
Kale, kohlrabi, mustards, broccoli raab	Almost always — they germinate fast and don't mind being thinned	If you need precise spacing in a tight bed
Broccoli, cauliflower, cabbage	If you've got time and the warm-soil window is still 6+ weeks before frost	The default — buys you 4-6 weeks of growth and avoids the seed-eating birds (white-crowned sparrow, lark sparrow) that hammer bare beds in late August
Brussels sprouts	Never — they need every week of the season	Always — start indoors in early July if you can

For transplants, sow into 4-inch pots in a sheltered shady spot (or indoor under lights at 65–70°F). Pot up once if they outgrow before transplant date. Harden off for 5–7 days before setting out.

2.4 Spacing & companion planting

Crop	In-row spacing	Between rows	Notes
Broccoli, cauliflower	18 in	24–30 in	Tight spacing slightly reduces head size but boosts overall yield per square foot
Cabbage (small/early)	12–15 in	18 in	Wakefield-type can go 12 in
Cabbage (large/storage)	18–24 in	24 in	Late Flat Dutch needs 24 in
Brussels sprouts	24 in	30 in	They grow tall and topple — stake or plant in a sheltered row
Kale	12 in	18 in	Tight spacing keeps plants tender; wider gives bigger leaves
Kohlrabi	6 in	12 in	Closer than you'd think — they don't compete much

Good companions in adjacent rows: **alliums** (onion, garlic) repel cabbage moth; **dill and cilantro flowers** feed the parasitic wasps that kill brassica pests; **nasturtiums** act as an aphid trap. Avoid following or preceding brassicas with other brassicas in the same bed (4-year rotation is the goal — see Chapter 7); avoid pairing with strawberries.

2.5 Per-crop harvest notes

Broccoli

Cut the main head when the buds are tight, dense, and dark green, before any yellow shows. The stem should be tender enough to push a thumbnail in. Cut 5–6 inches below the head with a sharp knife at a 45° angle (so water doesn't pool on the cut surface). Leave the plant — side shoots form at every leaf axil for 4–6 weeks after the main cut, especially on Calabrese and De Cicco.

Cauliflower

When the head is the size of a tennis ball, gather the outer leaves over it and tie loosely with twine or a rubber band — this is “blanching” and keeps the head white. Self-blanching varieties (Cheddar, Snow Crown) wrap themselves. Check daily once heads start to size up; cauliflower goes from perfect to ricey-loose in 3 days at the wrong temperature. Cut the head with a long handle of leaves attached for stem moisture.

Cabbage

Heads are mature when the top feels firm to a fingertip-press and the outer wrapper leaves start to peel back slightly. Cut at the base with a knife, leaving the root and lowest 2 leaves in the ground — small secondary heads will form at the cut and can be harvested in 4–6 weeks. Heads will hold in the ground for weeks in cool weather; they're done when they split (a sign of water uptake after maturity).

Kale

Harvest the outer (largest, lowest) leaves first, leaving the central growing tip and at least 6 leaves to keep producing. Pick continuously from October through April. After hard frost, the leaves taste markedly sweeter; pick frequently to keep new tender leaves coming.

Brussels sprouts

Sprouts mature from the bottom of the stalk upward. Pick when they're firm and 1–1.5 inches across, snapping each off by hand or with a small knife. In late October, **top the plant** (cut off the growing tip and 1–2 small upper leaves) — this stops new sprouts forming and concentrates energy into the existing ones, producing more uniform size. Harvest can continue into January.

Kohlrabi

Pull when the bulb (actually a swollen stem) is 2-4 inches across — they go woody above tennis-ball size, except for Kossak which holds. Slice off roots and leaves; the bulb stores 2 months in the fridge. Don't compost the leaves — they're more nutritious than the bulb and sauté like collards.

2.6 Hydroponic considerations for brassicas

Brassicas are well-suited to hydroponics in the Dragoons, particularly in the cool months when an outdoor or covered-patio Bato bucket setup runs at near-ideal head-forming temperatures. The advantage over soil here is precision: you can hit the calcium, magnesium, and boron numbers exactly, and brassicas grown with those nutrients dialed in form tighter, denser heads.

System selection

System	Suits	Caveats
Bato (Dutch) bucket	Broccoli, cauliflower, cabbage (small varieties), brussels sprouts	Best all-rounder for the bigger plants. See Guide 3 for setup.
NFT channel — <i>nutrient film technique</i> , a thin film of solution flowing past bare roots in a sloped channel	Kale, kohlrabi, lettuce-bed crops	Don't try heading brassicas in NFT — the channels are too small for root mass.
Deep water culture (DWC) — roots submerged in an aerated tank of nutrient solution	Kale, mustards, broccoli raab	Cheap and effective for leaf crops; not recommended for heading types.
Drip-to-drain in coco	All brassicas	A reasonable middle ground — easier than Bato but slower-growing.

For broccoli and cauliflower, **Bato buckets are the recommended system** in the Dragoons. The volume per plant (around 3 gallons of media) supports the root mass; the drip-and-drain cycle keeps oxygen in the root zone; and the bucket spacing matches the 18-inch plant spacing nicely.

Nutrient targets

Brassicas want **less nitrogen and more potassium and calcium** than peppers or tomatoes. They also have a higher boron and sulfur demand than most crops. Start with the recipes in **Guide 4 Part 1** and adjust as below. Two numbers drive every hydroponic decision in the table: **EC** (electrical conductivity, in mS/cm — a measure of

dissolved nutrient concentration in the reservoir) and **pH** (the 0–14 acidity/alkalinity scale, where 5.8–6.5 is the workable hydroponic window).

Stage	EC target	pH	N-P-K	Notes
Transplant to 4 true leaves	1.2–1.4 mS	6.0–6.3	Higher N for leaf bulk	Guide 4 base mix at 75 % strength
Vegetative (rosette)	1.6–1.8 mS	6.0–6.3	Balanced	Full Guide 4 mix
Pre-heading (first sign of curd)	1.8–2.0 mS	6.0–6.5	Reduce N, add K	Cut Part A by 20 %, add 0.3 g/L potassium sulfate
Heading	1.8–2.0 mS	6.0–6.5	Same	Maintain — high N at this stage causes loose heads

Boron and calcium together prevent the two biggest brassica disorders.

Hollow stem (broccoli, cauliflower) and tipburn (cabbage, brussels sprouts) are both deficiency-driven and both common in hydroponics where the medium doesn't supply trace minerals. Add a foliar spray every 10 days during heading: 0.5 g borax + 1 g calcium chloride per liter of water, spray on undersides of leaves at dusk.

Temperature management

This is the hardest part. Brassicas form heads best at 55–65 °F air temperature, 60–68 °F root-zone temperature. In the Dragoons:

- **Fall (Oct-Dec):** Outdoor or covered-patio Bato setups run at near-perfect temperatures during the day; nights drop to the high 30s which slows growth but doesn't damage the plants. Cover with frost cloth on nights below 25 °F.
- **Winter (Jan-Feb):** Reservoir temperature is the issue — solution below 50 °F slows nutrient uptake and invites root pathogens. Either insulate the reservoir or move it indoors. A 100W aquarium heater set to 60 °F handles a 25-gallon reservoir.
- **Spring (Mar-May):** The opposite problem — afternoon highs hit 80 °F by mid-April and stress the plants. Shade cloth (30 %) over the system extends the season by 2–3 weeks.

LOCAL TIP

The same Bato bucket array used for summer peppers (Guide 2) can run cool-season brassicas with no rebuilding. Drain the reservoir at season turnover, scrub with weak hydrogen peroxide, refill, and switch to the brassica nutrient profile. The hardware doesn't care which crop it's holding.

Crop-specific hydroponic notes

Broccoli (Bato bucket): Calabrese and De Cicco perform exceptionally well — slightly smaller heads than soil-grown but denser and earlier. Expect 50-55 days from transplant to first cut. Side shoots are even more prolific than in soil. Plan on 8-10 weeks of total harvest per plant.

Cauliflower (Bato bucket): The most demanding hydroponic brassica. Curd quality is highly sensitive to nutrient swings — keep reservoir EC and pH stable to within 0.1 unit of target during head formation. Self-blanching varieties strongly recommended.

Cabbage (Bato bucket, small varieties only): Wakefield and other compact varieties size up well; storage cabbages get root-bound. Heads are ready 10-14 days earlier than soil-grown, but storage life is shorter — eat fresh or process within 2 weeks.

Kale (NFT or DWC): The easiest crop to run hydroponically. Continuous harvest from week 4 onward; replace plants every 12-14 weeks as they exhaust. Red Russian and Lacinato both thrive.

Brussels sprouts (Bato bucket): Tall plants need bucket stability — fill the bottom of the bucket with extra perlite or pea gravel for ballast and stake the plant to the bucket support. Sprouts about 2 weeks earlier than soil.

Kohlrabi (any system): Extremely tolerant — runs in Bato, NFT, DWC, or coco-drip with similar success. Quick crop (50 days), can be slotted between heading-brassica successions.

3 · Alliums

Garlic · Shallots · Onions · Leeks

If you're new to alliums in the Dragoons: plant hard-neck garlic this October. One bed, one variety (*Music* is the most reliable here), Oct 15–Nov 15 planting, mulch heavily, walk away until March. You will harvest scapes in May and full bulbs in early July of the following year — the longest single bed occupancy in this guide, and the most forgiving crop in it. Once a garlic harvest is under your belt, add overwintering onions (late August transplant) and shallots (October sets) the following year.

3.1 Why alliums work for the Dragoons

Alliums may be the most underused cool-season crop here. They thrive in the exact conditions the Dragoons offer in abundance — mild winters, long cool nights, well-drained alkaline-leaning soil, dry tops in spring. Garlic in particular asks for nothing the Dragoons can't provide. The deep cold of January, which damages tender crops, is actively required for garlic to set proper bulbs (vernalization). And the dry late-spring and early-summer weather — which is a problem for most crops — is *ideal* for curing alliums after harvest.

There's a second practical advantage: **deer and javelina don't bother alliums**. The sulfur compounds that make onions onions are repellent to most browsers. In an unfenced Dragoons garden, alliums are some of the only crops you can plant in unprotected ground.

The trade-off is patience. Garlic occupies a bed for **9 months**. Overwintering onions occupy it for 8. These are not crops you turn over quickly. Plan bed allocation accordingly.

LOCAL TIP

The biggest mental shift for new Dragoons growers is treating alliums as a **fall-planted** crop. Most of the country plants onions in spring; here, the larger and sweeter bulbs come from August–September starts that overwinter and bulb up in May. Spring-planted onions race the heat and rarely size beyond tennis-ball.

3.2 Variety reference

Crop	Recommended varieties · profile	Dragoon notes
Garlic (hard-neck)	<i>Music</i> · standard porcelain · 4-6 large cloves per bulb · classic flavor · stores 6 months. <i>German Red</i> · rocambole · 8-10 cloves · strong flavor · stores 4 months. <i>Spanish Roja</i> · rocambole · 8-12 cloves · the connoisseur choice · stores 4 months.	Hard-necks produce the best flavor and the bonus crop of scapes in June. They store less well than soft-necks but bulb up better in our cold winters. <i>Music</i> is the most reliable Dragoon grower.
Garlic (soft-neck)	<i>Inchelium Red</i> · artichoke · 15-20 cloves per bulb · mild flavor · stores 9 months. <i>California Early</i> · artichoke · 10-14 cloves · widely adapted · stores 8 months. <i>Silver White</i> · silverskin · 14-16 cloves · stores 12 months.	Soft-necks tolerate milder winters and store the longest. <i>Inchelium Red</i> is widely considered the best-tasting soft-neck. Plant if you want braid-able garlic and storage that runs you to next harvest.
Shallots	<i>French Red</i> · classic culinary shallot · purple-skinned, divides into 4-6 bulbs per planted set. <i>Conservor</i> F1 · long-storage commercial type · stores 9 months. <i>Ambition</i> F1 · seed-grown · for spring planting only.	Treat fall-planted shallot sets exactly like garlic — same depth, same timing, same harvest signals. <i>Conservor</i> is the best Dragoon storage choice.
Onions (overwintering)	<i>Walla Walla</i> · sweet, mild · 6-8 oz bulbs · short storage. <i>Bridger</i> F1 · yellow storage type · 4-6 oz · stores 5 months. <i>Top Keeper</i> F1 · the best for our latitude · stores 8 months.	Plant as sets or transplants in early September. Day-length neutral / long-day cultivars work because we sit at ~32°N — true short-day onions are for further south.

Crop	Recommended varieties · profile	Dragoon notes
Onions (bunching / green)	<i>Evergreen Hardy White</i> · perennial bunching · winter-hardy · self-divides. <i>Tokyo Long White</i> · scallion-style · 60 days. <i>Red Beard</i> · pink-stalked · 60 days.	Direct-sow Sept through Feb. Stand all winter, harvest as needed. The perennial Evergreen Hardy White is the single best bed-edge crop in this guide — plant once, divide every 3 years, harvest scallions year-round.
Leeks	<i>American Flag</i> · OP · 120 days · classic large white shanks · cold-hardy. <i>King Richard</i> · early type · 75 days · for summer leeks. <i>Bandit F1</i> · 110 days · the most cold-hardy commercial type · holds through deep winter.	Bandit and American Flag are the overwinter leeks for the Dragoons — both hold their shanks through January and improve in flavor with frost. King Richard is for spring sowings where you want late-summer harvest.

The garlic planting rule for the Dragoons: plant by the first frost, harvest after the summer solstice. Cloves go in the ground October 15 to November 15 — soon enough to root before deep freezes, late enough not to push green tops that will be frost-damaged. Bulbs are harvested late June through mid-July, after the summer solstice, when the lower leaves brown. Off this schedule in either direction and bulbs are small.

3.3 Planting calendar — alliums

Crop	Plant out	Harvest	Bed days
Hard-neck garlic	Oct 15 – Nov 15	Jun 20 – Jul 10	~250
Soft-neck garlic	Oct 15 – Nov 15	Jul 1 – Jul 20	~260
Shallots (fall sets)	Oct 15 – Nov 15	Jul 1 – Jul 15	~250
Overwintering onions	Aug 25 – Sep 15	Jun 1 – Jun 30	~280
Spring onions (from sets/transplants)	Mar 1 – Mar 15	Jul 1 – Jul 30	~120
Bunching onions / scallions	Sep 1 – Feb 15 (succession)	60 days from sow	~60

Crop	Plant out	Harvest	Bed days
Overwintering leeks	Sep 1 – Sep 20 (transplant)	Nov – Apr (continuous)	~210
Spring leeks (for fall harvest)	Mar 15 – Apr 1 (transplant)	Aug – Oct	~150

3.4 Soil preparation for alliums

Alliums want a different soil than brassicas: **well-drained, slightly acidic to neutral, rich in potassium and phosphorus, low in fresh nitrogen.** Heavy fresh manure produces a lot of top growth but small, soft bulbs that don't store. The native Dragoons soil works well once organic matter is built up — alkalinity is a smaller concern than for brassicas because alliums tolerate pH up to 7.5 without issue.

Parameter	Target for alliums	Typical Dragoons baseline	Adjustment
pH	6.2 – 7.0	7.6 – 8.1	Mild acidification helps; not as critical as for brassicas
Organic matter	4 – 6 %	1 – 2 %	2 inches of well-finished (not fresh) compost worked in before planting
Drainage	Excellent	Variable	Plant on raised mounds 4–6 in above grade in caliche pockets
Nitrogen	Moderate, slow-release	low	Bone meal or feather meal at planting; side-dress with blood meal in March (garlic) when tops resume growth
Potassium	High	moderate	Wood ash (1 cup per 10 sq ft) or kelp meal — alliums are K-hungry at bulbing

Parameter	Target for alliums	Typical Dragoons baseline	Adjustment
Phosphorus	High	moderate	Bone meal in planting hole — critical for root development through winter

Practical bed routine for fall-planted alliums

1. **Early September:** Pull summer crop or cover crop. Loosen soil to 8 inches with a fork.
2. **Mid-September:** Spread 2 inches of finished compost + bone meal at 2 lb per 100 sq ft. Work in.
3. **Late September:** Rake smooth, mark rows, water deeply once.
4. **October 15 - November 15:** Plant cloves/sets/transplants. Water in.
5. **Mid-November:** Mulch 3–4 inches deep with straw or shredded leaves. This is the most important step for Dragoon alliums — it moderates winter soil temperature and conserves the limited winter moisture.

3.5 Spacing

Crop	In-row spacing	Between rows	Planting depth
Garlic (single clove, point up)	6 in	10 in	2 in below soil surface
Shallots (single set, point up)	6 in	10 in	1 in below surface (shoulder of bulb at soil line)
Overwintering onions (sets)	4 in	10 in	1 in deep
Bunching onions (seed)	1 in, thin to 2 in	6 in	1/4 in deep
Leeks (transplants)	6 in	12 in	Set deep, in 6-in trenches; backfill as plants grow to blanch shanks

3.6 Maintenance through the season

October-November: Plant, mulch, water deeply once. Walk away.

December-February: Check mulch after wind events; replace if blown. Water once monthly if rainfall has been zero — about a half-inch of irrigation is enough.

March: Pull mulch back from crowns when first green emerges (garlic) or accelerates (onions, leeks). Side-dress with a slow-release nitrogen source (blood meal at 1 cup per 10 ft of row).

April: Resume regular irrigation — drip line at 1 in per week. This is when bulb sizing begins.

May (garlic): Watch for scapes on hard-neck varieties. The flower stalk emerges from the center of the plant, curls into a tight loop, and should be snapped off when it's done one full curl but before the head straightens.

Scape removal is mandatory on hard-neck garlic. A scape left on the plant will divert 20–30 % of bulb energy into flower production. Snap or cut scapes off when they've curled once. Scapes are excellent eating — sauté, pickle, or make scape pesto. This is roughly two weeks before the bulb harvest itself.

June (onions): Watch necks. When 50 % of plants have necks softening and falling over, stop watering. Pull a week later when tops are 75 % browned.

July (garlic, shallots): Watch lower leaves. When 50 % of the lower leaves have browned but 4–6 upper leaves remain green, dig (don't pull — the necks may break). Loosen with a fork.

3.7 Pest pressure for alliums

Alliums are remarkably pest-free in the Dragoons. The main risks:

- **Onion thrips** (*Thrips tabaci*) — silvery flecks on leaves, occurring on overwintered alliums as temperatures rise in March–April. Hose down plants in the morning to disrupt; severe infestations get insecticidal soap. Rarely warrants more than that here.
- **Onion maggot** — not common in the Dragoons (the dry climate doesn't favor it) but possible if you mulch with fresh manure-y straw. Not a routine concern.
- **Botrytis neck rot** — only in storage. Cure properly (next section) and the problem goes away.

There is no significant rodent pressure on alliums; gophers and pack rats avoid them.

3.8 Harvest indicators

Crop	Harvest signal	Window
Hard-neck garlic	Lower 4–5 leaves brown; 4–6 upper leaves still green	7–10 days

Crop	Harvest signal	Window
Soft-neck garlic	Half the leaves brown; tops still upright	10-14 days
Shallots	Tops yellow and falling over	10-14 days
Onions (bulb)	50 %+ of necks softened and bent over	5-7 days
Leeks	Pull as needed at any size — shank diameter $\geq$ 1 in	Continuous
Bunching onions	Cut as needed at any height $\geq$ 6 in	Continuous

WARNING

Don't pull garlic — dig it. The necks on a mature garlic plant are weak and snap easily under upward tension. A broken neck means the bulb won't cure properly and won't store. Loosen with a fork 4-6 inches away from the bulb, then lift gently. Same for shallots.

3.9 Curing & storage

Curing is the step that separates a glut of garlic in July from a working pantry through next April. Most allium failures happen *after* harvest, not before.

Curing protocol

1. **Lift gently.** Don't wash. Don't knock dirt off. Don't cut anything yet.
2. **Lay out in single layers** in a dry, shaded, well-ventilated space — a covered porch, an open shed, a garage with the door cracked. Direct sun bleaches and softens.
3. **Air-temperature target:** 60-80 °F. Relative humidity below 70 %. The Dragoons in July are ideal — 95 °F dry-shade temperatures and 20 % humidity cure garlic in 2 weeks.
4. **Cure for 2-3 weeks** for garlic and shallots, **3-4 weeks** for onions. The necks should be fully dry and tight; the outer skin should be papery; roots should be brittle.
5. **Once cured:** trim tops to 1 inch (or leave whole for braiding soft-necks). Trim roots flush to the basal plate. Brush off remaining dirt — don't wash.
6. **Cull aggressively.** Any bulb with a soft spot, a mold patch, or a wet neck gets eaten first, not stored. One bad bulb in a bin will spread.

Storage conditions

Crop	Ideal temp	Ideal RH	Realistic Dragoons storage life
Hard-neck garlic	32–40 °F or 55–60 °F (avoid 40–55 °F — sprouts)	60 %	4–6 months
Soft-neck garlic	55–60 °F	60 %	8–12 months
Shallots	35–40 °F	60 %	6–9 months
Storage onions	32–40 °F	65 %	5–8 months
Sweet onions	35–40 °F	70 %	6–8 weeks (eat first)
Leeks	In ground; or fridge wrapped in damp paper	—	6+ weeks

A working storage solution for the Dragoons: a mesh-sided bin in the coolest interior room of the house (typically a north-facing pantry or interior closet at 60–65 °F). Avoid the garage — daily summer temperature swings shorten storage life dramatically.

3.10 Hydroponic alliums

Alliums work in hydroponics — **but only as green onions / scallions / leeks for greens**. Bulb-forming alliums (garlic, shallots, full storage onions) need soil. The reasons:

- Bulb formation requires day-length and night-cooling cues that are hard to deliver in indoor or controlled-environment setups.
- The dry-down step (necks softening, tops falling) requires withholding water, which is harder to do in NFT/DWC where the roots are submerged.
- The curing step requires field-dirty bulbs to dry intact — fully clean hydroponic bulbs don't cure as well.

What does work hydroponically:

- **Scallions / bunching onions** — direct-seed into NFT channels; harvest at 8 inches; replant continuously. Production rate is roughly 2× soil for the same area.
- **Leeks for late-season greens** — NFT or DWC produces excellent thin baby leeks at 10–12 weeks. Not the heavy mature leeks of fall soil-grown plants, but good for stir-fries.
- **Garlic greens** — pre-sprouted garlic cloves in DWC produce harvestable greens (like overgrown chives) within 3 weeks. The bulbs never form usefully, but the greens are good.

Use the Guide 4 leafy-greens base recipe — see **Guide 4 Part 1**. Run EC 1.0–1.4 mS,

pH 6.0–6.5, reservoir at 60–65 °F.

4 · Cool-season greens

Spinach · Mâche · Overwintered lettuce · Arugula · Mustards

If you're new to cool-season greens in the Dragoons: direct-sow a 3-foot row of *mâche* and a 3-foot row of *Bloomsdale Long Standing* spinach in mid-September, then again every two weeks through November. Both ignore frost down to single digits, both are nearly pest-free, both grow at full speed when nothing else does. Skip lettuce, arugula, and mustards your first season — they all work, but the timing and bolt-management discipline matter more than for *mâche* and spinach. Use the first cool season to learn the succession-sowing rhythm.

4.1 Why these crops belong in the cool season

Every salad green in this chapter is **bolt-sensitive**. Once daytime temperatures hit 70 °F consistently and especially once nights stay above 55 °F, these plants stop producing tender leaves and rush to flower. The Dragoons cool season — October through April — is precisely the window where the plants can grow at full speed without bolting pressure.

The bonus: most of these crops are extremely cold-hardy. *Mâche* and spinach (especially the *Bloomsdale* family) shrug off frost down to 10 °F and below; winter lettuce varieties hold through low-20s nights under a single layer of row cover. You can keep continuous harvests running from October through early May with succession sowings every 2–3 weeks.

A final reason to plant greens: **they're the best hydroponic match in the cool season**. Brassicas and roots have constraints in hydro; greens have almost none. An NFT or DWC system in a sunroom or covered patio produces salad greens at production rates 3–4× soil performance, with no pest pressure, no temperature crisis, and no bolting if the reservoir is kept cool.

4.2 Variety reference

Crop	Recommended varieties · profile	Dragoon notes
Spinach	<i>Bloomsdale Long Standing</i> · OP · 45 days · the heritage savoyed type · the most cold-hardy. <i>Tyee</i> F1 · 40 days · slow to bolt · disease-resistant. <i>Space</i> F1 · 40 days · smooth-leafed · the best for hydroponics and salad mix.	Bloomsdale outdoors; Space in hydroponic systems. Tyee bridges them. Spinach is the most cold-hardy crop in the chapter — it ignores frost.
Lettuce (winter)	<i>Winter Density</i> · OP · 60 days · romaine-bibb hybrid · the workhorse. <i>Rouge d'Hiver</i> · OP · 60 days · burgundy romaine · cold-tolerant, beautiful. <i>Arctic King</i> · OP · 60 days · butterhead · the most cold-hardy lettuce.	Pick cold-hardy types only — most summer lettuces are killed by Dragoons winter nights. Arctic King survives uncovered down to 20 °F. Use row cover below that.
Mâche (corn salad)	<i>Vit</i> · OP · 50 days · slow-bolting · the standard. <i>Verte de Cambrai</i> · French heirloom · classic.	The single most cold-hardy salad green. Direct-sow Sept 15 through Nov 15; harvest from November through April. Self-sows readily — a patch planted once perpetuates itself.
Arugula	<i>Rocket</i> (<i>Eruca sativa</i>) · 35 days · the classic peppery green · fast. <i>Astro</i> F1 · 30 days · less peppery, slower bolt. <i>Wild arugula</i> (<i>Diplotaxis tenuifolia</i>) · 50 days · perennial · more pungent, smaller leaves.	All three thrive Sept through April. Wild arugula is the best long-term planting — it returns year after year and rarely bolts.

Crop	Recommended varieties · profile	Dragoon notes
Mustards	<i>Red Giant</i> · OP · 45 days · deep purple-red leaves · spicy. <i>Mizuna</i> · OP · 40 days · feathery Japanese type · mild. <i>Tatsoi</i> · OP · 45 days · dark green rosettes · mild and cold-hardy. <i>Green Wave</i> · OP · 45 days · curly, hot mustard for cooking greens.	Plant in mix or alone. Tatsoi is the cold-hardest. Red Giant is the most striking in a winter bed. Most mustards add late-fall pungency that fades to mild in midwinter and returns sharp before spring bolt.

4.3 Direct-sow timing and succession

All greens in this chapter are direct-sown. Transplanting is unnecessary and counterproductive — the plants are so fast that transplant shock costs more time than it saves.

Crop	First sowing	Last fall sowing	First spring sowing	Last spring sowing
Spinach	Sep 1	Nov 1	Jan 15 (under row cover)	Mar 1
Lettuce (winter types)	Sep 1	Oct 30	Jan 15 (under row cover)	Feb 15
Mâche	Sep 15	Nov 15	—	—
Arugula	Sep 1	Nov 15	Jan 15	Mar 15
Mustards	Sep 1	Nov 1	Jan 15	Mar 1

Succession sowing rule: Plant a 3-foot row every 2 weeks. This is more important than total planting area. A 30-foot row planted all at once produces a 2-week glut and then nothing; the same 30 feet planted in 2-week installments produces continuous salad for the entire 6-month window.

4.4 Spacing

These crops are denser-planted than most. Cut-and-come-again harvest works best at high density.

Crop	In-row spacing (final)	Row spacing	Seeding rate
Spinach	4 in	8 in	Thin to spacing at 2 true leaves

Crop	In-row spacing (final)	Row spacing	Seeding rate
Lettuce (whole-head)	8 in	12 in	Thin at 4 true leaves
Lettuce (cut-and-come-again)	1 in	4 in (band)	Thin lightly; harvest as baby leaf
Mâche	2 in	4 in	Broadcast in 4-in band; little thinning needed
Arugula	2 in	6 in	Thin lightly at 2 true leaves
Mustards (mix)	4 in	6 in	Thin to spacing

4.5 Soil preparation

Greens want a different bed than brassicas: **light, well-drained, near-neutral pH, fine-textured topsoil**. Heavy compost is unnecessary and can actually slow these crops — they prefer light feeding and crumbly soil. The native Dragoons soil is fine once it's been worked once or twice; a previous brassica crop leaves a perfect greens bed.

Parameter	Target for greens	Adjustment
pH	6.5 – 7.0	Same as brassicas — sulfur amendments translate
Organic matter	3 – 5 %	One inch of finished compost; do not over-amend
Tilth	Fine, crumbly, no clods	Rake to seedbed quality before sowing
Nitrogen	Moderate	Feather meal at sowing; no side-dress needed for short-cycle greens
Drainage	Excellent	Raised beds in low spots — wet feet bring down young lettuce fast

4.6 Cold protection

The Dragoons cool season is mild enough that most greens *don't need* cold protection most of the time. The exceptions:

- **Heading lettuces (Winter Density, Arctic King) in January** — use a single

layer of light row cover (0.5 oz / sq yd) draped directly on the plants. No hoops needed. This protects against the 3–6 nights of deep cold below 25 °F.

- **Hard-freeze nights below 20 °F** — even mâche and spinach hold up better with a light cover, though they survive uncovered. Use the same row cover.
- **Wind during dry cold snaps** — wind dehydrates more than cold kills. A row cover doubles as a windbreak.

Tools to have on hand:

Tool	Purpose	Notes
0.5 oz/sq yd floating row cover	General frost protection	Pin edges with soil or sandbags; doesn't need hoops
1.0 oz/sq yd heavyweight row cover	Hard freezes below 15 °F	Buy a 10-yard roll once — lasts 4–5 seasons
Low tunnel hoops (1/2-in PVC or wire)	Sustained cold + wind	Useful for the longest beds; overkill for short rows
6-mil clear plastic	Greenhouse equivalent · last resort for cold snap	Vent on sunny days — temp under plastic spikes fast

LOCAL TIP

The most useful single item in the Dragoons cold-season toolkit is a 12 × 50 ft roll of 0.5 oz row cover. It handles 90 % of all winter protection needs across this guide: brassicas at transplant for pest exclusion, greens through January, alliums during late-March wind events, and root crops in early-season frost. One roll lasts about 4 years if you wash it and store dry.

4.7 Harvest — cut-and-come-again vs whole-head

Crop	Cut-and-come-again?	Whole head?	Method
Spinach	Yes — preferred	Yes — for older plants	Cut outer leaves at 4 in tall; comes back in 10–14 days
Lettuce (loose-leaf)	Yes — preferred	No	Scissor-cut 1 in above crown
Lettuce (head types)	No	Yes	Wait for full head; cut at base

Crop	Cut-and-come-again?	Whole head?	Method
Mâche	Yes	Yes — preferred (whole rosettes)	Cut whole rosette at soil line; plant doesn't regrow
Arugula	Yes — preferred	No	Scissor-cut leaves at 3 in; comes back 3-4 cycles
Mustards	Yes	Yes	Cut individual leaves or whole plant

For cut-and-come-again, a sharp pair of scissors (not pruning shears — too coarse) is the right tool. Cut all leaves at once, 1 inch above the crown. Don't pinch or twist — you damage the regrowth point.

4.8 Hydroponic greens — the main cool-season hydro use case

This is where hydroponics genuinely outperforms soil for the Dragoons cool season. Every crop in this chapter runs cleanly in NFT or DWC, and the systems can be sited in any covered or indoor space with reasonable light. A 4-channel NFT setup in a sunroom produces enough lettuce and mâche for two people year-round.

System selection for greens

System	Best for	Notes
NFT (Nutrient Film Technique)	Lettuce, spinach, arugula, mustards	The default. Channels of 3-in PVC or commercial NFT trays. Roots get oxygen; channels are easy to clean between cycles.
DWC (Deep Water Culture)	Lettuce (head), Asian greens	Net pots in 5-gal buckets. Cheap, robust. Slightly slower than NFT but tolerant of neglect.
Raft hydroponics (deep raft)	Mâche, mixed salad	Foam raft on a shallow tank. Best for high-density baby-leaf production.
Vertical tower	Lettuce, herbs	Optional; works but adds complexity vs NFT for the same yields.

System	Best for	Notes
Bato bucket	Not recommended	Way overkill for greens — Bato shines for heading brassicas, peppers, and tomatoes.

Nutrient targets for greens

Greens want **moderate N, very low EC, slightly acidic pH** — the gentlest profile in the hydroponic lineup. Refer to **Guide 4 Part 1** for the leafy-greens Masterblend recipe. Run dilute.

Stage	EC target	pH	Notes
Germination	0.8 mS	5.8–6.2	Guide 4 leafy-greens mix at 50 % strength
Seedling (cotyledon to 4 true leaves)	1.0 mS	5.8–6.2	60 % strength
Production	1.2–1.4 mS	5.8–6.2	Full leafy-greens strength
Pre-harvest (last 5 days)	0.8–1.0 mS	5.8–6.2	Flush — reduces nitrate accumulation in leaves

Reservoir temperature is critical: keep the solution below 70 °F. Greens hydroponics fails when warm reservoirs invite *Pythium* root rot. In a Dragoons sunroom in March, this means either an in-line chiller or a daily ice-bottle in the reservoir.

Crop-specific hydroponic notes

Spinach (NFT): *Space F1* is the variety to use — smoother leaves run cleanly through NFT channels. Production from sow to harvest is 35 days. Continuous turnover.

Lettuce (NFT or DWC): Every variety in the soil section works hydroponically too. Add *Salanova* (multi-cut hydro variety) and *Rex* (greenhouse butterhead) for the hydro-specialist options.

Mâche (raft): Best in deep raft systems — it dislikes the constant root flow of NFT. Sow heavily and harvest as baby rosettes.

Arugula (NFT): *Astro* is the right hydro variety — uniform, slow-bolting. Heavy producer.



Figure 1: Mature romaine heads on a PVC NFT tower with empty channels staged for the next succession. Sown every 2 weeks, harvested whole at the channel, the tower turns over a head per slot roughly every 35 days at the EC and pH targets in the table below.

Mustards (NFT): Mizuna and tatsoi run particularly well in NFT. Red Giant adds visual interest in mixed-channel plantings.

5 · Root crops

Carrots · Beets · Turnips · Radishes · Parsnips

If you're new to root crops in the Dragoons: start with radishes and Hakurei turnips. Both are 25–40-day crops, both are direct-sown, both forgive imperfect bed depth — if there's caliche eight inches down, they still produce. Skip carrots and parsnips for the first season; they reward properly prepped beds and patience, and a forked carrot in year one will sour your interest. Once you have one successful radish-and-turnip succession behind you, build a deep bed (12+ inches of screened soil) and try a row of *Bolero* or *Danvers* carrots the following September.

5.1 Why roots in the cool season

Root crops are temperature-driven from the bottom up. **Soil temperature matters more than air temperature.** Carrots that grow in 60 °F soil with 75 °F air make sweet, tender roots; the same carrots in 80 °F soil with 60 °F air make woody bitter ones. The Dragoons cool season delivers exactly the right combination: soil cools through the 60s and 50s from October through March, while air temperatures stay frost-tolerant or fully frost-immune.

Cold roots also concentrate sugars. Carrots, parsnips, and beets pulled after a hard frost taste markedly sweeter — the plant converts starch to sugar as a natural antifreeze. Parsnips are the extreme case: they're inedibly starchy and harsh until they freeze, then become sweet and aromatic. Don't pull parsnips before December.

The trade-off is **bed depth and tilth**. Roots cannot grow through hard, compacted, or rocky soil. The Dragoons native soil — alkaline, often shallow over caliche — is not naturally a root-crop soil. Bed preparation is the single biggest variable in root-crop success here.

5.2 Variety reference

Crop	Recommended varieties · profile	Dragoon notes
Carrots	<i>Bolero</i> F1 · 75 days · 7-inch Nantes type · disease-resistant · stores well. <i>Scarlet Nantes</i> · OP · 70 days · the classic Nantes · sweet flavor. <i>Danvers 126</i> · OP · 75 days · tapered, holds in heavy soil · best for shallow caliche beds. <i>Mokum</i> F1 · 55 days · fast Nantes · for early harvest.	<i>Bolero</i> is the workhorse — buy the seed in bulk. <i>Danvers</i> handles imperfect soil better than Nantes types. Avoid long-rooted varieties (<i>Imperator</i>) here — they hit caliche.
Beets	<i>Detroit Dark Red</i> · OP · 60 days · the standard · stores well. <i>Chioggia</i> · OP · 55 days · striped Italian heirloom · loses stripes when cooked. <i>Cylindra</i> · OP · 60 days · cylindrical · efficient slicing. <i>Bull's Blood</i> · OP · 60 days · dark red leaves · greens-and-roots dual purpose.	<i>Detroit Dark Red</i> is the storage choice. <i>Chioggia</i> and <i>Bull's Blood</i> are for fresh use. Beets are forgiving of slightly heavier or shallower soil than carrots.
Turnips	<i>Purple Top White Globe</i> · OP · 55 days · the classic · stores well. <i>Hakurei</i> F1 · 38 days · Japanese salad turnip · sweet, eaten raw · the gateway turnip. <i>Tokyo Cross</i> F1 · 35 days · similar to <i>Hakurei</i> .	<i>Hakurei</i> changed turnip's reputation — sweet enough to eat raw out of the bed. Plant a row every 3 weeks September through October. <i>Purple Top</i> is for traditional uses and stores.
Radishes	<i>Cherry Belle</i> · OP · 22 days · round red · the standard. <i>French Breakfast</i> · OP · 25 days · oblong red-and-white · mild flavor. <i>Daikon Long White</i> · OP · 55 days · giant white Asian type · for fall storage. <i>Watermelon (Beauty Heart)</i> · OP · 65 days · green outside, pink inside · winter radish.	Spring/short radishes (<i>Cherry Belle</i> , <i>French Breakfast</i>) sow every 10 days September to April for continuous harvest. <i>Daikon</i> and <i>watermelon</i> are long-season fall sowings — plant by Sept 15.

Crop	Recommended varieties · profile	Dragoon notes
Parsnips	<i>Hollow Crown</i> · OP · 110 days · the heritage standard · long roots · improves with frost. <i>Gladiator F1</i> · 110 days · smoother roots · for difficult soil. <i>Andover</i> · OP · 120 days · the best flavor · long season.	Parsnips need the deepest soil prep — 14 inches minimum. Slow germination (3 weeks); patience is required. The reward is sweet roots that hold in the ground all winter.

Don't transplant root crops. Every root crop in this chapter is direct-sown. Carrots, parsnips, beets, and radishes all develop a tap root in the first 2-3 weeks of growth; disturbing that tap root with a transplant produces forked, twisted, or stunted roots. The seedling-tray temptation is real (especially for parsnips' slow germination), but the result is always worse than a properly direct-sown bed.

5.3 Soil preparation — the make-or-break factor

This is where root-crop success is determined. The Dragoons native soil is too shallow, too rocky, and too alkaline-leaning for unprepared root-crop beds.

Soil chemistry targets

Parameter	Target for roots	Typical Dragoons baseline	Adjustment
pH	6.0 – 7.0	7.6 – 8.1	Sulfur amendments help; roots are more pH-tolerant than brassicas
Organic matter	3 – 5 %	1 – 2 %	Well-finished (not fresh) compost — fresh manure causes forked roots
Workable depth	12 in (carrots, beets, turnips, radishes); 14 in (parsnips)	Often 6-10 in over caliche	Build raised beds; broadfork extensively
Texture	Sandy loam, fine-screened	Variable	Screen out rocks larger than a marble; add coarse sand if heavy clay

Parameter	Target for roots	Typical Dragoons baseline	Adjustment
Nitrogen	Low to moderate, no fresh inputs	low	Bone meal and a small amount of finished compost only
Drainage	Excellent	Variable	Raised beds in low spots

WARNING

Fresh manure causes forked roots. Manure of any kind less than 12 months old is too rich and too nitrogen-heavy for root crops — the tap root forks, branches, and twists. The signs at harvest are unmistakable: carrots with two or three legs, beets that grew sideways, radishes split into impossible shapes. Use only well-aged compost on root-crop beds.

Practical bed routine

1. **Two weeks before sowing:** Build the bed up. If the area has been previously cultivated and is at least 12 inches deep, broadfork it. If it's a fresh area over caliche, frame in a raised bed 12 inches deep and fill with screened topsoil mixed with finished compost (3:1 ratio).
2. **One week before sowing:** Rake smooth. Remove every rock larger than a marble — a stone the size of a pea will fork a carrot.
3. **Day of sowing:** Water deeply. Let the bed drain for 4 hours before seeding.
4. **Sow:** See spacing table below. Press seeds gently into the soil; do not bury deeply.
5. **After sowing:** Cover with 1/4 inch of finely-sifted compost, not heavy soil. Water gently with a fine rose.
6. **Until germination:** Keep the surface from drying out. Carrots and parsnips take 14–21 days; mulch lightly with a single layer of cotton burlap or sieved compost to keep moisture even.

5.4 Spacing & thinning

Crop	Sow spacing	Final spacing	Thinning critical?
Carrots	1/4 in apart in row; 6 in between rows	2 in in row	Yes — non-negotiable. Thin at 2 in tall and again at 4 in tall.

Crop	Sow spacing	Final spacing	Thinning critical?
Beets	1 in apart (multi-seed clusters); 8 in between rows	4 in in row	Yes — beet “seed” is a cluster of 2–4 seeds. Thin to one per cluster.
Turnips	1/2 in apart; 8 in between rows	4 in	Yes — at 2 in tall
Radishes (short)	1/2 in apart; 4 in between rows	1 in	Light thinning only
Radishes (long, daikon)	2 in apart; 12 in between rows	6 in	Yes — at 4 in tall
Parsnips	1/2 in apart; 12 in between rows	4 in	Yes — at 4 in tall (slow-growing — wait until plants are sturdy)

Thinning carrots is non-negotiable. Unthinned carrot rows produce small, twisted, woody roots — every time. The 30 minutes spent thinning a 10-foot row at the right stage is the single highest-return time investment in this guide. Thin twice: at 2 in tall to roughly 1 in spacing, again at 4 in tall to final 2 in spacing. Eat the second-round thinnings as baby carrots.

5.5 Watering — even moisture matters more than total water

Root crops want **steady moisture, not heavy moisture**. The single most common root-crop problem in the Dragoons after bed prep is irregular watering — a dry spell followed by a deep soak, repeated. This produces split carrots, woody beets, and pithy radishes.

A drip line set to deliver 0.5 inches every 3–4 days through the cool season is correct. Avoid:

- Letting the bed dry to wilt point (especially carrots)
- Watering deeply once a week (split roots)
- Watering only the top 2 inches (shallow root development)

The 1-inch-deep root-zone moisture check: push a finger into the bed at root depth (4 inches for radishes, 6 for carrots, 8 for parsnips). If it’s dry, irrigate. If it’s moist, wait a day. This single habit prevents most of the problems above.

5.6 Pest pressure for roots

Root crops are remarkably pest-free in the Dragoons. The two pests worth knowing about:

- **Carrot rust fly** — adults lay eggs at the base of plants; larvae mine the root surface, leaving brown tunnels. Rare in Cochise County (the dry climate and high elevation don't favor it), but possible. Floating row cover at sowing prevents it entirely. Don't use this much cover unless you've seen rust fly damage previously.
- **Root-knot nematodes** — microscopic soil-dwelling nematodes that cause galls and stunting on root crops. More common than carrot rust fly here. Rotation is the only practical control: never grow root crops in the same bed two years running. Marigolds (specifically *Tagetes patula* 'Nemagold') planted as a cover before root-crop beds suppress nematode populations.

There is no significant rodent or vertebrate pressure on root crops in cool weather — gophers slow down in winter; pack rats prefer above-ground crops. Watch for rabbits in March on emerging spring carrots; a single chicken-wire fence keeps them out.

5.7 Harvest indicators

Crop	Harvest signal	Best size
Carrots	Shoulder visible at soil line at expected size	3/4 - 1 in shoulder diameter
Beets	Shoulder visible; days-to-maturity reached	2-3 in shoulder diameter
Turnips (salad)	Shoulder 1 in; tender to thumbnail	1-2 in (Hakurei stays tender longer)
Turnips (storage)	Shoulder 3-4 in; days-to-maturity reached	3-4 in
Radishes (short)	Shoulder 3/4 - 1 in	Pull immediately; split or pith within days
Radishes (long, daikon)	Visible above soil; days-to-maturity reached	12+ in long
Parsnips	First hard frost has passed; days-to-maturity reached	1.5 - 2 in shoulder

5.8 Storage — in-ground vs cellar

Root crops in the Dragoons get a major advantage: **the ground itself is the best winter storage for most of them.** Below 6 inches, soil temperature stays 40-55 °F all winter (warmer than a fridge, cooler than a basement) with constant moderate humidity. Pulling crops as needed all winter is more practical than digging everything

in November and putting it in bins.

Crop	In-ground storage?	Cellar storage if pulled
Carrots	Yes — preferred. Mulch 4 in deep with straw after first frost. Pull as needed through March.	4-5 months in damp sand at 35-40 °F
Parsnips	Yes — preferred. Leave in ground; cannot be pulled too late (sweetest in March).	Poor — pull only as needed
Leeks (overwinter family, see Ch. 3)	Yes — preferred. Mulch heavily	Poor — eat fresh
Beets	OK — short term only (up to Jan); pull and store	Better — 3 months damp-sand cellar
Turnips (storage)	OK — short term	3 months damp-sand cellar
Radishes (short)	No — won't hold	1 week in fridge crisper
Radishes (daikon/winter)	OK — short term	6 weeks in fridge or damp-sand cellar

LOCAL TIP

The simplest Dragoons root-cellar substitute is a 5-gallon bucket of slightly-damp builder's sand kept on the north side of the house under an overhang. Layer cleaned beets or turnips (tops trimmed to 1 in, roots intact, no washing) in the sand. Temperatures under the overhang in winter sit at 35-45 °F — perfect storage. Check monthly; cull any soft ones.

5.9 Hydroponic root crops — soil only

Root crops are essentially the only category in this guide where **hydroponics is not recommended**. There are exotic systems that produce carrots and beets in deep media beds, but none of them outperform a properly prepared soil bed for the same time and effort. The reasons:

- Tap roots need physical resistance to develop straight; hydroponic media provides too little structural support.
- Root crops want low EC and low N; the same nutrient solution wasted on hydroponic carrots could grow 4× as much salad.
- Storage roots cure poorly when grown clean — they expect a soil microbiome.

If you must grow a root crop hydroponically, **short radishes in a deep raft system**

are the only realistic option, and the result is closer to “radish-flavored leaves and a bulge” than a proper radish. Stick with soil for roots; use hydro for greens.

6 · Pest management for cool-season crops

An integrated framework, not a per-crop checklist

The Dragoons cool season has fewer pests than the warm season, but a small handful matter across multiple crops. This chapter consolidates the pest pressure for all four families into a single IPM framework — what to watch for, when, on which crop, and how to respond.

6.1 Pest calendar — what to watch for, when

Pest	Active months	Primary targets	Severity in the Dragoons
Cabbage white butterfly	Aug – Oct, then Mar – May	Brassicas (all)	Moderate
Cabbage looper	Sep – Nov	Brassicas (especially cabbage, broccoli)	Moderate
Harlequin bug	Sep – Nov	Brassicas (all), with mustards and kale especially	High — Dragoon signature pest
Aphids (cabbage, green peach)	Oct – Feb	Brassicas, overwintered alliums, lettuce	Moderate-to-high in late fall
Slugs	Aug – Oct (after monsoon)	Greens, young brassicas	Low-moderate
Cutworms	Aug – Sep (transplant time)	Brassica transplants, lettuce	Moderate
Onion thrips	Mar – May	Overwintered alliums (garlic, onions)	Low
Carrot rust fly	Mar – May	Carrots	Rare
Root-knot nematodes	Persistent in infested beds	Carrots, beets, parsnips	Moderate in old beds
Flea beetles	Mar – May	Mustards, arugula, young brassicas	Low

6.2 The major brassica pests

Cabbage white butterfly (*Pieris rapae*) and cabbage looper

Small white butterflies appear in August, lay eggs on leaf undersides; the green caterpillars eat fast and leave dark frass. Cabbage loopers are similar but more nocturnal; they raise into “looping” inchworm postures when disturbed.

- **Floating row cover** at transplant, until the plants are big enough that perforations don't matter (about 4 weeks). Cover edges with soil; the butterflies will lay through any gap.
- **Bt (*Bacillus thuringiensis*) spray** weekly if row cover comes off. Spray at dusk; Bt breaks down in UV.
- **Hand picking** is realistic for small plantings — 10 minutes a week per 50 sq ft.

Harlequin bug (*Murgantia histrionica*)

Distinctive orange-and-black shield bugs, the dominant fall pest in the Dragoons and the signature local brassica problem. They suck sap and cause yellow-and-white stippling on leaves; heavy populations stunt or kill young plants. Control is harder than for caterpillars because Bt doesn't work on them.

- **Hand picking morning and evening** — they drop when disturbed; hold a jar of soapy water under the plant and tap.
- **Trap crops** — leave a row of mustard or radish flowering nearby; harlequins prefer it and you can vacuum the flowers daily.
- **Neem or pyrethrin** for severe infestations only; both kill beneficial insects too.

Aphids (cabbage aphid, green peach aphid)

Late fall and overwintered plants get hammered by gray-green aphids that cluster in growing tips. Cold weather actually favors them — they outpace their predators in November.

- **Hard water spray** every 3 days knocks populations down. Concentrate on growing tips.
- **Insecticidal soap** for resistant clusters; reapply weekly.
- **Tolerate moderate populations** on outer leaves — you'll strip those at harvest anyway.

6.3 Transplant-time pests (August-September)

Two crops of pests hit at brassica transplant time, which is also lettuce and onion transplant time:

Slugs — peak in August and September after monsoon rains soften the ground. They eat seedling leaves overnight and leave slime trails. Control:

- Beer traps (shallow dishes of cheap beer set at soil level — slugs drown overnight).
- Iron phosphate slug bait (*Sluggo* or equivalent) — safe for pets and wildlife.
- Avoid mulching young plants until October; mulch is slug habitat.

Cutworms — gray-brown caterpillars that sever transplant stems at ground level, usually overnight. The plant is found cleanly cut, lying intact. Control:

- Collar each transplant with a 3-inch cardboard cylinder (toilet-paper tube cut to length) pushed 1 inch into the soil.
- Hand-pick at dusk — they emerge to feed at low light.

6.4 Allium pests

Alliums are the most pest-free crops in this guide. The one problem worth knowing:

Onion thrips (*Thrips tabaci*) — silvery flecks on the inner curl of leaves, appearing on overwintered alliums in March and April as temperatures climb. Damage is rarely catastrophic but can stunt bulb sizing.

- A hose blast in the morning disrupts them; repeat every few days.
- Insecticidal soap is effective on heavy populations.
- Reflective silver mulch around plants disorients them (rarely worth it for home plots).

6.5 Greens pests

Greens are nearly pest-free in cool weather but pick up two problems on the shoulders:

Aphids (same as on brassicas, late fall and early spring) — strip outer leaves, hose down growing tips.

Flea beetles — tiny black jumping beetles that pepper mustard and arugula leaves with pinholes in March–April. Cosmetic damage; significant only on the youngest seedlings. Row cover excludes them; mature plants outgrow the damage.

6.6 Root-crop pests

Carrot rust fly — rare in the Dragoons but possible. Adults lay eggs at the soil line; larvae mine the root surface. The damage is unmistakable: brown tunnels in otherwise healthy roots, discovered at harvest. Floating row cover from sowing through harvest prevents it entirely. Skip the cover unless you’ve seen damage previously — the cover prevents thinning access for 90 days.

Root-knot nematodes — microscopic worms causing galls and stunting on carrots, beets, parsnips. The signs are above-ground stunting and below-ground bumpy lumpy roots. There is no spray cure; rotation is everything:

- Never grow root crops in the same bed two years running.
- Plant *Tagetes patula* ‘Nemagold’ marigolds as a 60-day cover crop before root-crop beds — secondary metabolites suppress nematode populations.
- Solarize infested beds in midsummer (clear plastic over moist soil for 6 weeks) — works in the Dragoons sun.

6.7 Cross-cutting IPM principles

Principle	What it looks like in practice
Floating row cover is the most useful tool	One roll covers brassica transplant pest exclusion, cold protection for greens, carrot rust fly prevention, and wind protection. Buy quality once.
Rotation breaks pest cycles	No brassica family member in the same bed for 4 years (see Ch. 7); no root crop in the same bed 2 years running.
Trap crops are underused	A row of mustard or radish let flower draws harlequins off cabbage; nasturtiums hold aphids off everything.
Time of day matters for spraying	Bt and pyrethrin both break down in UV — spray at dusk. Hard-water sprays are most effective on bright dry mornings.
Beneficials matter	Dill, cilantro, fennel, alyssum let flower in adjacent rows feed parasitic wasps and predatory flies that handle most caterpillar control invisibly.
Cull infected material aggressively	Aphid-heavy leaves, harlequin-infested mustard, nematode-galled root — into the trash, not the compost.

WARNING

Do **not** spray pyrethrin or neem when bees are active and avoid spraying anything blooming. Brassicas in flower (bolted, or seed crops) are major late-fall and early-spring pollinator forage in the Dragoons. If you must spray, do it at dusk and only on plants not in flower.

7 · Crop rotation handoff with peppers

What comes out, what goes in, when to bed-prep

7.1 The handoff — October

The pepper-to-brassica bed handoff is one of the most useful timing events in the Dragoons garden calendar. Peppers come out late September through October as nights drop and fruit set stops; the cool-season anchor crops — brassicas first, alliums second — go in immediately after, while the soil is still warm enough for root establishment but cool enough for the new crops to thrive.

Date	Pepper bed activity	Cool-season bed activity
Late September	Last harvest; let plants finish	Brassica transplants growing in pots
Early October	Pull plants; remove stakes; pull mulch	Brassica transplants going out in <i>other</i> beds
Mid-October	Broadfork former pepper bed; spread 2 in compost	Garlic and shallots being separated for planting
Late October	Bed rests 2 weeks; cover crop sown if not replanting	Garlic and shallot cloves planted in former pepper beds
Early November	Mulch new allium plantings 3-4 in deep	Spinach and mâche sown in shoulder beds

The reason this sequence works: **peppers are heavy feeders that draw down nitrogen.** Brassicas (also heavy feeders) want a fresh compost amendment but can use what's left of the pepper-bed nutrient profile. Garlic and onions (light-to-moderate feeders) actually *prefer* the lower-N residue of a finished pepper bed. By the time spring peppers go back in (next April), the alliums will be coming out (next June-July), and the bed has had a full cycle to rebuild structure.

7.2 The recommended 4-year rotation

A working 4-year rotation for a Dragoons bed that wants to grow both warm-season and cool-season crops:

Year	Spring/Summer (Apr-Sep)	Fall/Winter (Oct-Mar)
Year 1	Peppers + tomatoes (heavy feeders, deep roots)	Brassicas (heavy feeders, moderate roots)

Year	Spring/Summer (Apr-Sep)	Fall/Winter (Oct-Mar)
Year 2	Squash + cucumbers (heavy feeders, shallow roots)	Alliums (light feeders, fall-planted, finish next July)
Year 3	(Alliums finishing → mid-July) → cover crop (cowpeas + buckwheat)	Greens + root crops (light feeders, fine tilth)
Year 4	Beans + corn (legume builders)	Cover crop only — cereal rye + crimson clover · soil rebuilding year

The bed cycles through four families plus two cover-crop phases. By Year 5, the bed is back to peppers in a fresh-built soil with no carry-over disease, no nematode buildup, and excellent structure.

Notes on this rotation

- **Year 2 is the longest single-crop year** — alliums in fall through following summer, then cover crop. Plan accordingly.
- **Year 3's spring slot is a cover crop, not a cash crop** — cowpeas + buckwheat fix nitrogen, suppress weeds, and break the disease cycle. Mow at flowering, leave on the bed.
- **Year 4 is the legume + grass building year** — corn and beans together (or sequenced) put nitrogen back. Cereal rye + crimson clover overwinter to build root biomass through the cool season.
- **You can compress this to a 3-year rotation** if bed space is limited — drop the Year 4 cover-crop year and accept slower soil rebuilding.

The brassica → allium → light-feeder cycle is the cool-season backbone. Heavy feeders (brassicas) → light feeders that build sulfur compounds in the soil (alliums) → light feeders that rebuild tilth (greens, roots). This sequence runs across years 1, 2, and 3 of the cool-season slots and improves the bed every cycle.

7.3 Bed handoff timing — practical sequence

The exact dates that make this work in the Dragoons:

Sep 20 | Last meaningful pepper harvest; assess remaining green fruit |

Oct 1 | Pull peppers; clear stakes, drip line, mulch |

Oct 5 | Broadfork bed; remove largest weeds |

Oct 10 | Spread 2 in finished compost + 1 lb/100 sq ft bone meal + 1/2 cup wood ash

per 10 sq ft |

Oct 12 | Rake smooth; water deeply once |

Oct 15 | Plant garlic / shallots / overwintering onions |

Oct 25 | Mulch 3-4 in straw or shredded leaves |

Nov 1 | Walk away — alliums need almost no attention until March |

Nov 15 | Confirm mulch has settled and is intact after first wind events |

If you're going from peppers to brassicas instead of alliums:

Sep 1 | Brassica transplants sized up in pots, ready to go |

Sep 15 | Pull oldest pepper plants in beds where brassicas will land |

Sep 18 | Broadfork; amend with 2 in compost |

Sep 25 | Soil temp probe — wait for < 75 °F at 4-in depth |

Sep 28 | Transplant brassicas in evening; water in |

Oct 1 | Floating row cover for first 4 weeks (cabbage whites + cutworms) |

LOCAL TIP

The clearest signal that pepper season is genuinely over and brassica season can begin: the first morning where overnight low was below 45 °F. That's a hard threshold — at 45 °F or below, pepper fruit set stops, brassicas and lettuce thrive. In a typical Dragoons year this happens around Sept 25; in cold years as early as Sept 15; rarely later than Oct 5. Use it as a clearer-than-calendar cue.

Sources & references

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

Local resources

- **UA Cooperative Extension — Cochise County office (Sierra Vista)** — soil testing, harlequin-bug identification, brassica clubroot diagnosis, and the *Vegetable Variety Recommendations for Arizona* bulletin. Phone 520-458-8278.
- **UA Cooperative Extension Master Gardener program** — Cochise County volunteer help desk; the right place to walk in a sample of a sick plant or a soft-spotted garlic bulb.
- **Native Seeds/SEARCH (Tucson)** — heritage Southwest-adapted seed; carries several brassica and allium lines selected for hot-dry climates that outperform off-the-shelf catalog varieties at Dragoon elevation.
- **Salt Spring Seeds (Canada — mail order)** — heritage brassicas, particularly the open-pollinated kale and cabbage lines, well-suited to a mild cool-winter climate.
- **Sulphur Springs Valley feed and farm supply** — bulk straw mulch, elemental sulfur, bone meal, and the floating row cover that this guide refers to constantly.

Books & references

- *The Winter Harvest Handbook* by Eliot Coleman — the canonical cool-season-growing reference; the succession-sowing logic, row-cover protocol, and four-family pacing in this guide all lean on Coleman's framework.
- *Four-Season Harvest* by Eliot Coleman — the more accessible companion volume; recommended for a first-time cool-season grower.
- *Growing Food in a Hotter, Drier Land* by Gary Paul Nabhan — Sonoran-Desert context for the brassica → allium → root rotation and the heritage-variety selections.
- *The New Organic Grower* by Eliot Coleman — bed preparation, soil structure, and rotation logic that translate directly to the Dragoon cool season.
- *Hydroponic Food Production* by Howard Resh — the system selection chapter behind the \$2.6, \$3.10, \$4.8 hydroponic sections.

Online resources

- **UA Cooperative Extension publications** (extension.arizona.edu) — *Vegetable Variety Recommendations for Arizona*, alkalinity-management bulletins, and the SE Arizona IPM series.
- **PennState Extension — Cole Crops and Brassica IPM** (extension.psu.edu) — the most thorough free reference for cabbage white, cabbage looper, harlequin bug, and aphid identification and control.
- **OMRI (Organic Materials Review Institute)** (omri.org) — verify *Bt*, iron phosphate slug bait, *Sluggo*, and any other input intended as organic before applying.

- **Johnny's Selected Seeds growing guides** (johnnyseeds.com) — variety-specific cultivation notes for nearly every crop in this guide; particularly strong on brassica head-formation and lettuce variety selection for cold tolerance.
- **Cornell Vegetable MD Online** (vegetablemdonline.ppath.cornell.edu) — disease identification photos and IPM logic for brassicas, alliums, and roots.

Closing

The Dragoons cool season is generous. From late August through April, there is always a crop in the ground, always something to harvest, and always less pest pressure than the summer. The trade-off is timing discipline: a brassica transplanted in 80 °F soil, a garlic clove pushed in in December, a parsnip pulled before frost — each of these is a small mistake that compounds into a missed crop.

The four families in this guide knit together cleanly. Brassicas anchor the major fall and spring crops. Alliums occupy beds nearly the entire window and ask almost nothing in return. Greens fill the gaps with continuous succession sowings, especially in hydroponic systems where they outperform soil by a wide margin. Roots use the deep cool soil to make the sweetest crops of the year.

What this guide doesn't replace: trial and error in your own beds. A north-facing slope behaves differently from a south-facing one; a clay pocket sets carrots differently from a sandy one; the years where October stays warm change everything. Keep notes on dates, varieties, soil temperatures, and harvest weights. Three seasons in, you'll have a calendar that beats this one for your specific spot.

RELATED GUIDES

The 14 guides: - **Guide 1 — Hydroponic Primer & Library Map** · front door of the library - **Guide 2 — Peppers in the Dragoons** · the warm-season anchor - **Guide 3 — Bato Bucket Hydroponic Systems** · build, water, daily operations - **Guide 4 — Hydroponic Nutrients** · Masterblend + DIY + pH + Indoor/LED - **Guide 5 — Grapes in the Dragoons** · Cochise County viticulture - **Guide 6 — Cool-Season Crops** (this guide) · brassicas + alliums + greens + roots - **Guide 7 — Warm-Season Companions** · tomatoes + cucurbits + beans + corn + sweet potatoes - **Guide 8 — Herbs in the Dragoons** · annual + perennial · soil & hydroponic - **Guide 9 — Backyard Orchard in the Dragoons** · figs, pomegranates, jujubes, stone fruits - **Guide 10 — Pest, Disease & Wildlife** · IPM + Cochise wildlife exclusion - **Guide 11 — Foundations: Soil & Seed** · soil-building, composting, seed-starting, propagation - **Guide 12 — Harvest, Preservation & Storage** · canning, fermenting, drying, cellaring - **Guide 13 — Water in Cochise County** · sourcing, testing, treatment, rainwater, conservation - **Guide 14 — Season Extension Structures** · cold frames, low tunnels, hoop houses, high tunnels - **Guide 15 — Native Food Crops of the Sonoran-Madrean Region** · the indigenous food complex of the Dragoons and the wider sky-island region - **Guide 16 — Companion Plantings & Polycultures** · the design layer — companion matrix, anti-companions, cover crops, 9 Dragoons-specific guild designs - **Guide 17 — Recipes & Kitchen Integration** · what to cook with what came out of the garden this morning ·

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