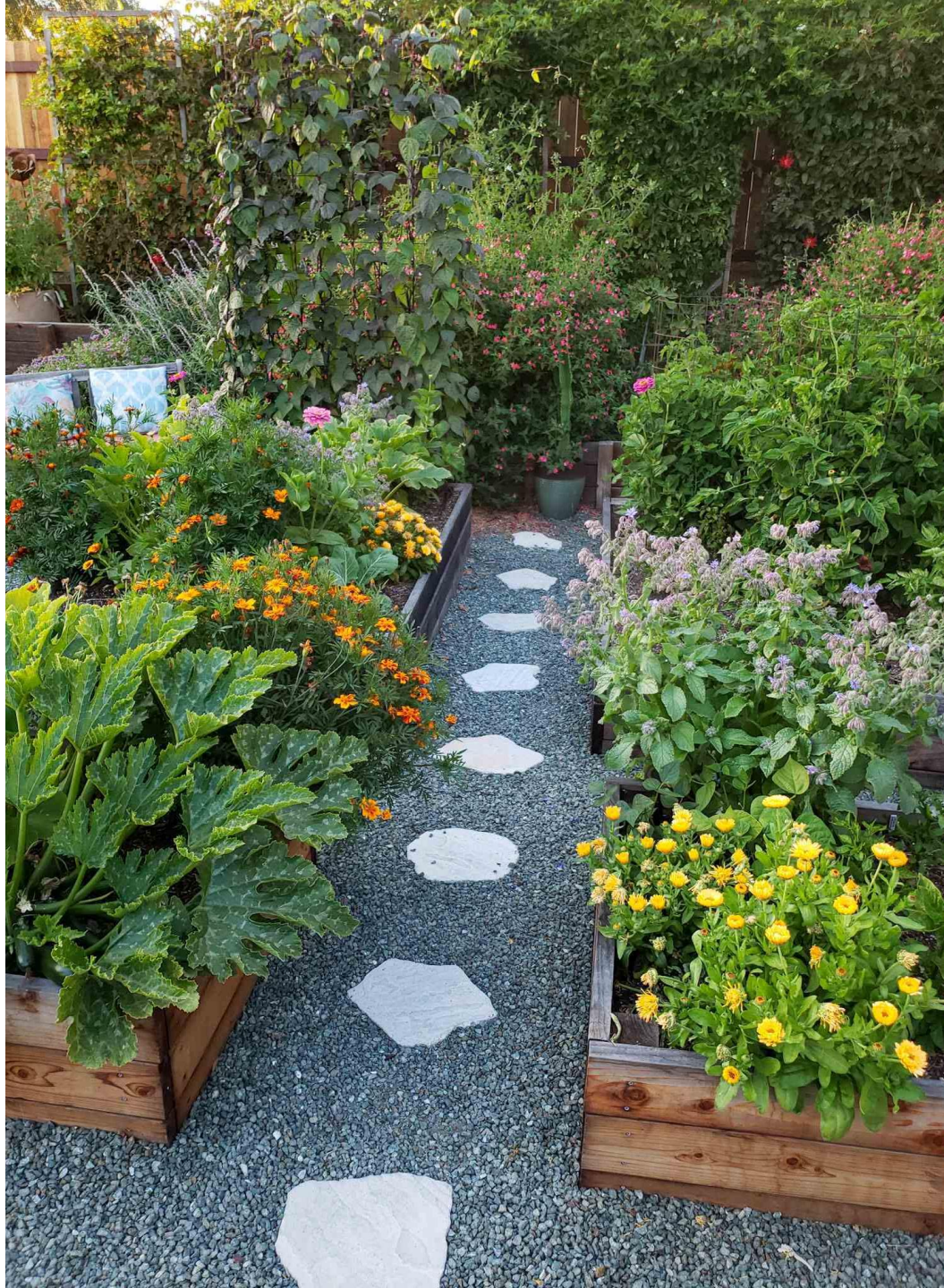
Making the Most out of your Veggie Garden with Companion Planting

Benefits of Companion Planting

1. Reduced Pest Pressure
2. Reduced Weed Pressure
3. Reduced Disease Pressure
4. Improve Soil Fertility and Structure
5. Improved Pollination
6. Improved Biological Control
7. Improve Aesthetics

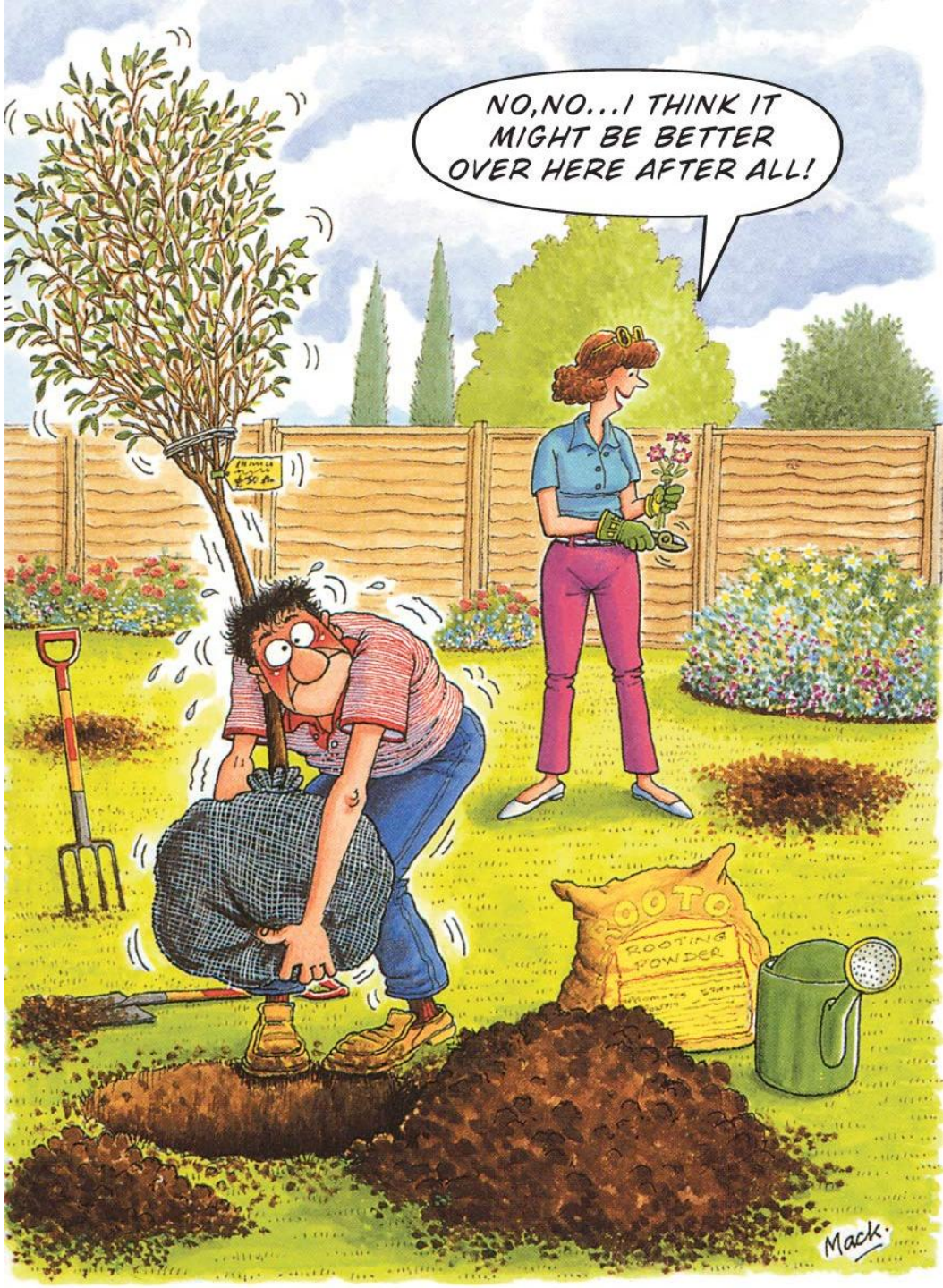


So… What is it, Exactly?

- Companion Planting, “Plant Partners” (Jessica Walliser)
- Polyculture
  - **in agriculture** is the practice of growing two or more different crops together in the same field at the same time, often to improve productivity, resilience, and ecological balance.
  - Pest and diseases don’t spread as easily as in a **monoculture**.
- Intercropping/Interplanting
  - The practice of growing multiple crops in one field to promote a more beneficial environment.
    - **Mixed** intercropping – different crops in the same field but not planted in formal rows.
    - **Row** intercropping – crops are planted together in alternate rows.
    - **Relay** intercropping – when crops are planted into existing crops just before the first crop is ready to harvest.
    - **Crop Rotation & Succession Planting** – a form of polyculture when crops are planted in different locations at different times.

How Close Together Should Companion Crops be Planted?

- It Depends.
- Physical proximity is factored based on the specific methodology and desired benefit of the plant partners.



Companion Planting - Garden Myth or Plant Lore?

- Companion Planting is research-based, with limitations:
  - Size and scale – field trials in much larger than home gardens
  - Scope – research facilities and demonstration farms
    - Environmentally controlled, or real farm conditions
  - Unpredictable climatic conditions
- Bottom line: avoidance of monocultures

Plants Effect on Each Other

- Shared Resources
  - Light, Water, Nutrients
  - Adaptation, Competition, Sharing
- Improved Nutrient Availability
  - Soil Structure
  - Nitrogen Fixation (legumes)
  - ~ Green Manure
- Chemical Messaging
  - Semiochemicals alert other plants or predatory insects
  - Herbivore-induced plant volatiles (HIPV)
- Fungal Associations
  - Mycorrhizae – colonize plant roots and move through soil
  - Bring nutrients to plants
  - Aid communication and nutrient transfer between plants
- Allelopathy
  - Chemicals released by plants to inhibit growth of other plants
  - Can be used to alleviate weed pressure (winter rye grass)

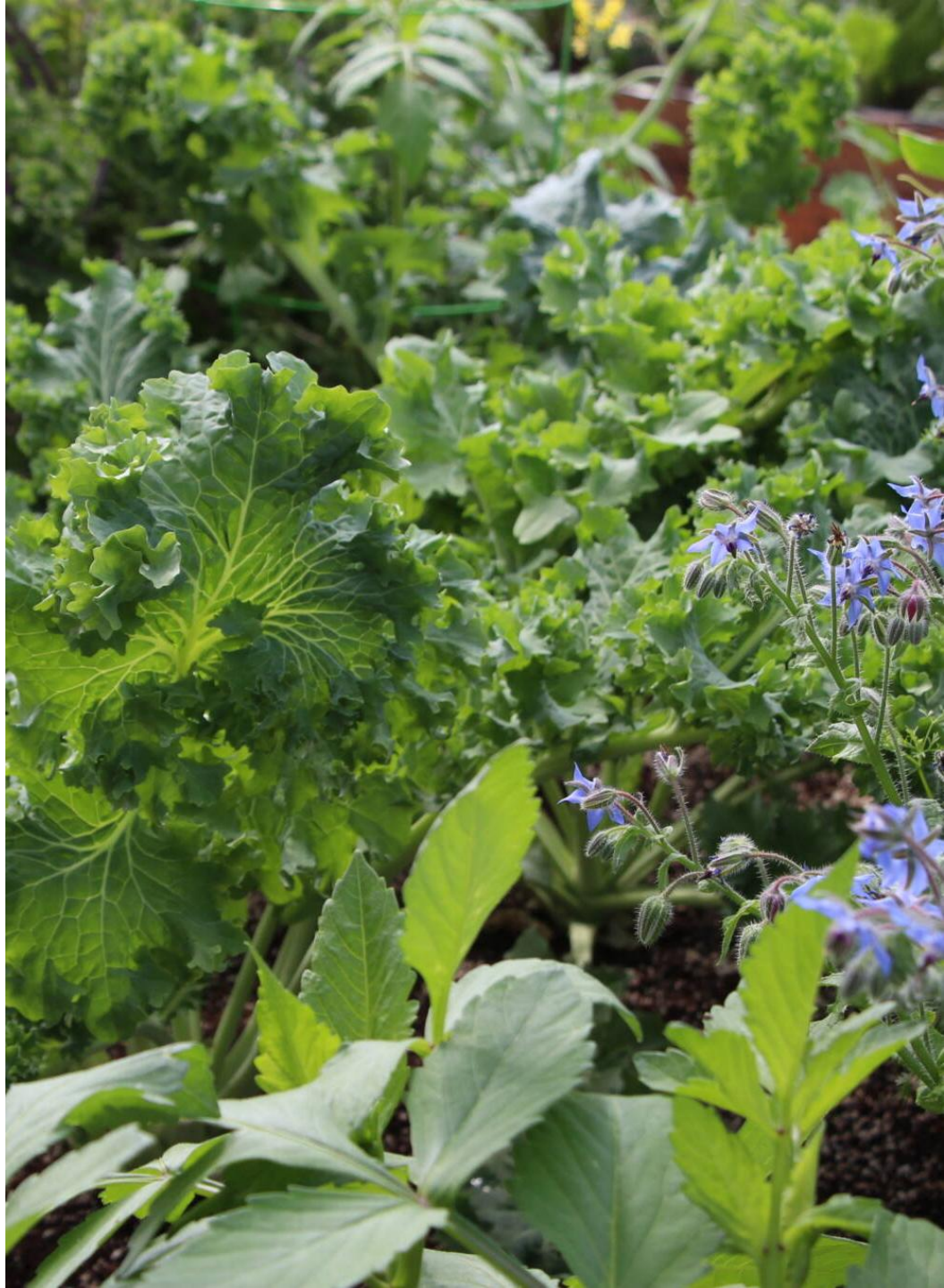
Diversity + Structural Complexity = Stability

- Diversity: # of different plants grown.
    - Crops & Flowers
- Structural Complexity: various growth habits and structure.

- Creating an ecosystem where many layers of organism interact in a myriad of ways

Companion Plants can be used for:

- Soil Health
- Weed Management
- Living Trellis/Support
- Pest Management
- Biological Control
- Pollinators



Soil Health

- Complex network of mycorrhizae (fungus), and beneficial soil-dwelling insects
- Holds resources for plants: nutrients, water, oxygen
- Texture and structure: determine permeability and water-holding capacity
- pH (acidity): nutrient availability
    - More alkaline (less acidic, higher pH), makes micronutrient less soluble (ex. Iron deficiency)

Companion Plants for Soil Conditioning - Cover Crops

- Reduce soil erosion
- Build soil structure
- Increase soil fertility
- Add organic matter
- Nitrogen fixation (legumes)
- Weed suppression
- Create habitat for beneficial insects
- Increase biodiversity in the garden

How To Use Cover Crops

- Crops not grown for harvest
- Direct seed in spring or fall / prior to or after vegetable crop
- Cool season and warm season varieties
- Mow down before flowering
  - Trimmings can be used as mulch, good source of OM
- Incorporate (till or dig) crop into soil a few weeks before planting vegetable crop
- *some cover crops can be invasive – spreading perennial crops not turned under deep enough
- - or re-seeding

Types of Cover Crops

- Oats
  - Cool-season & Winter-killed
  - Plant prior to early season crops
  - Limit weed growth, add OM, living mulch
- Buckwheat
  - Warm-season
  - Plant prior to warm-season crops
  - Must be trimmed before flowering
  - Add OM, benefits soil microbes
- Winter rye
  - Cool-season, does not winter kill
  - Plant prior to warm-season crops
  - Suppress weeds (allelopathic), add OM, feed microbes, fast soil builder
- Crimson clover
  - Cool and Warm-season & Winter-killed
  - Legume – boosts soil nitrogen
  - Improves soils health
  - Good for pollinators & beneficials
- Winter wheat
  - Cool-season, planted in fall
  - Covers & protects soil during winter
  - Does not winter kill in milder climates, but easy to kill
  - Mow in spring, grow vine crops (pumpkins, squash, cucumbers) in mowed debris
- Cowpeas
  - Warm-season, grown spring-summer
  - Germinate and grow quickly, drought tolerant, fix nitrogen
  - Till in a few weeks before growing fall crop of leafy greens (lettuce, spinach, kale)

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Introduction to Cover Crops for Vegetable Production in Utah

Tiffany Maughan, Research Associate, and ***Dan Drost***, Extension Vegetable Specialist

Crop plants have been used throughout history to improve soil fertility and crop productivity. Crops grown for these purposes are commonly called cover crops, green manures, or catch crops. The names are often used interchangeably which may be

help growers interested in figuring out what CCs will work best for their unique situations.

Deciding what CC will work best can be challenging. You need to determine which CC to

Companion Plants for Nitrogen (N)

Green Beans + Potatoes

- Increase size of potatoes
- Beans fix N and share it with neighboring plants
- Grow at a similar rate & can be planted simultaneously
- Can be grown together as Mix or Row intercropping

Companion Plants for Nitrogen (N)

Fava Beans + Sweet Corn

- Fava beans can fix up to 250 lbs. of N/acre & they transfer N to neighboring crops while the grow.
- Fava bean roots and foliage residue add nutrients to the soil when cut at the end of the season
- Tolerate frost
- Corn is a heavy N feeder and a warm-season crop.
- Plant beans a few weeks before last frost, then plant corn when threat of frost has passed
- Plant in “sandwich rows” for corn pollination

Companion Plants for Nitrogen

Peas + Lettuce

- Both are cool season crops best grown in spring and fall
- Peas grow tall (tendrils) to help shade the lettuce when temperatures rise (bolting)
- Peas provide lettuce with N
- Grow a row of peas flanked with rows of lettuce, or alternate them
- Use a trellis to support peas

Companion Plants for Nitrogen

Cowpeas + Peppers

- Both are warm season
- Cowpeas fix N, have deep roots that loosen soil and draw moisture closer to the surface, are somewhat allelopathic – preventing weed seed from germinating
- Plant cowpeas in spring after last frost then plant peppers (or other larger warm-season crops) as *transplants* after risk of frost
- ‘Black-eyed Peas’ are a variety good for eating

Companion Plants for Nitrogen

Edamame + Fall Greens

- Edamame are soybeans harvested at a young stage, among the best of N fixers (130 lbs. N/acre)
- Edamame are warm-season crops
- Plant in spring after last frost, then plant cool season crops for fall harvest when the edamame has fixed up lots of N
- Alternate plant rows with fall greens

Companion Plants for Heavy Soil

Buckwheat

- Adds organic matter (OM)
- Breaks up compacted soil through root exudate compounds
- Allelopathic for weed suppression
- *trim before flowering to keep from going to seed

Forage Radish

- Adds OM
- Bio-drilling: break up soil with long, thick roots and far-reaching root hairs.
- Winterkill (in hardiness zone 5b and below), and break down quickly (no tilling necessary)
- *these are not the garden Daikon radish varieties: var. *longipinnatus (Grounhog, 'Graza', 'Sodbuster', Tillage Radish, 'Eco-Till')*

Turnips

- Var. 'Appin'
- Bio-drilling, OM, may not winter kill (mow down to kill)

Weed Management – Living Mulch

- Grown in between rows or under actively growing crops
- Suppress weeds through resource competition and shading soil surface, making it more difficult for weed seeds to germinate
- Some also fix N & attract pollinators
- Increase biodiversity and OM

Where to Grow Living Mulch

- Row intercropping – alternate with vegetable crops
- Underneath or skirt taller row crops
- Walking paths
- As a mulch alternative beneath fruit trees in orchards & grape vines in vineyards

Living Mulch - Considerations

- Can be annual or perennial
  - In general perennials are paired with perennials (orchard), and annuals with annuals
- Manage spread & competition (perennial pathways)
- Size matters!
  - Mature height of mulch does not shade out crop
- Potential drawbacks:
  - Resource competition for crops
    - -thoughtful pairing
  - Spreading via roots or seeds
    - -vigilant mowing or trimming

Living Mulch – Companion Plants

Clovers

- **Crimson clover** (tall or mowed)
  - Cole crops (brassicas) recommended, many crops benefit, best between rows
  - Good for pollinators and beneficials, fix N, suppress weeds
- **Subterranean clover** (low growing)
  - Provide excellent weed control, allelopathic (do not plant if you are sowing crops from seed)
  - Winter killed, seeds underground like peanuts
  - Can be grown beneath or between several different crops
- **White clover** (medium height, short-lived perennial)
  - Grown between strawberry rows (do not plant as mix intercropping, or there is too much competition)
  - Mow white clover prior to strawberry harvest. Biomass breaks down rapidly, adding OM and N to the soil
  - Shown to improve blueberry production, but may benefit most perennial, shrubs and brambles.

Living Mulch – Companion Plants

- Oats
  - With various crops
  - Inexpensive, easy to grow, winter killed
  - Provide weed control and mulch when mowed (grow up to 4’ and must be mowed)
  - Row intercropping partnered with various crops grown as transplants
- Winter Rye
  - With asparagus, seeded in spring after harvest
  - Summer temperatures keeps winter rye from growing tall and competing with asparagus
  - Suppress weeds, particularly fall germinating (dandelion), but does require more watering
- Cowpeas
  - With peppers (study) improved yield in peppers
  - Dense canopy restricts weed growth, mildly allelopathic suppressing weeds seed germination
- Yellow Mustard
  - With summer squash (study), increase yields, and shown to decrease pest populations and the associated disorders (aphids, whiteflies, squash silverleaf)
  - Weeds suppression while growing, and if cut stems are left as mulch
  - Extensive root system breaks up heavy soils
  - Winter killed, must be mowed to prevent invasive re-seeding habit

Allelopathic Cover Crops

Winter rye

- Residue has shown to reduce foxtail, pigweed, ragweed, and purslane germination
- Sow in late summer-autumn, cut/mow in spring, leave residue as mulch
- Provides weed suppression for months
- Ideal for gardens with high annual weed pressure
- Not ideal for garden areas where seeds will be directly sowed

Oats

- Oats suppress weeds through allelopathy when grown before a crop and left as residue.
- In sweet potato systems, oat cover crops and stem mulch significantly reduce weed growth.

Allelopathic Companion Plants

- Cucumbers + Taller Vegetables
  - Cucumbers are allelopathic
  - Can be grown as a cover crop (plant late season starts 3-4 weeks after tilling in cucumber residue)
  - Can be grown as living mulch under corn, tomatoes, eggplant, etc. to suppress weeds
- Rapeseed + Potatoes
  - Rapeseed (canola) has allelopathic properties effective on weed control in potatoes
  - Similar management as yellow mustard (brassica)

Support & Structure - Living Trellis

Corn + Pole Bean

- Sow tall corn varieties (sweet corn, popcorn, ornamental corn) after danger of last frost
- Sow pole bean varieties (green, yellow, purple, bi-color) once corn in 4-5” tall.
- Corn serves as a trellis while beans climb vertically
- Beans can fix and provide N to corn

Sunflowers + Mini Pumpkins

- Use tall, multi-branched sunflower varieties
- Mini pumpkin varieties, ‘Jack-Be-Little’, ‘Baby Boo’, ‘Lil’ Pump- ke-mon’
- Start sunflower seeds indoors 4-6 weeks before average last frost
- Transplant sunflowers after danger of last frost has passed
- Seed mini pumpkins when sunflowers reach 1-2’ tall

Sunchokes + Cucamelons

- Sunchokes, or Jerusalem artichoke, is a tall, perennial flower that blooms yellow in late summer with edible tubers. They spread by underground roots, so best planted in a separate area where they can be divided and thinned.
- Cucamelons are climb somewhat aggressively and produce grape-sized fruits that resemble watermelons. Can reseed if fruits are left to drop.

Orach + Fall Peas

- Orach, or “Mountain Spinach” is a beautiful, tall growing leavy green
- Warm – season crop that can be harvested late spring through summer
- Acts as climbing support for a fall crop of snap or pod peas
- Leaves can be eaten fresh or cooked, like spinach

Tithonia + Malabar Spinach

- Tithonia (Mexican Sunflower), is a beautiful, warm-season annual, great for pollinators, easily grown from seed or as transplants
- Malabar spinach is a warm-season, vining crop. Leaves are harvested throughout the summer, used as a heat-tolerant spinach
- Both are slow to start in the spring, so they pair nicely together. Tithonia acts as a sturdy, branched trellis for Malabar spinach.

Broom Corn + Asparagus Beans

- Broom corn is a type of sorghum (a grain) that is a tall, warm-season, easy to grow crop. It's heigh and sturdiness makes it a great trellising plant.
- Asparagus beans (pole beans or yardlong beans) are vigorous climbers, pods can get up to 12" long, and taste like standard garden green beans.

Companion Plants for Pest Management

Backed by scientific research

Ways Companion Planting is Used for Pest Management:

- Luring pests away from crops through trap cropping
- Disrupting insect feeding through masking/hiding host plants
- Interfering with pest egg-laying
- Using plants to physically block migration of pests to host plants
- Polyculture approach to improve biodiversity (attracting beneficials)

How Do Pest Insects Find Their Host Plants?

- Appearance
  - Color
  - Size
- Chemical
  - Volatile
- Appropriate/inappropriate landing theory
  - Pests “taste” the plant using receptors on their feet
- Attracting beneficial insects

Goal for Pest *Management* in Companion Planting

- We want to confuse the pest
- Masking verses Repelling
  - Plants thought to repel pests (e.g. marigolds, peppermint, sage, thyme have a strong scent)
  - Strong scent doesn't *repel* pests, they *mask* the "smell" (volatile chemicals) of the host plant

Trap Cropping

- One method of pest management

- Lure pest away from crops using a sacrificial crop more attractive to the pest
- Selective pesticide use (treat the trap crop only)
  - Sacrificial crop varietal selection
  - Timing and location of planting
    - More mobile pests – plant several feet away from desired crop
    - Less mobile pests – plan close to desired crop, or in alternate rows

Trap Cropping for Specific Pests

- Squash Bugs – Blue Hubbard Squash
- Flea Beetles – Pak Choy, Radish, Chinese Mustard
- Lygus Bugs – Alfalfa
- Aphids – Radishes, Nasturtiums, Chinese Cabage

Companion Plants for *Masking*

Pepper + Alliums

- Grean Peach Aphid (peppers)
- Allium *family* (onions, scallions, garlic)
- Plant together (intercropping) around pepper crops

Companion Plants for *Masking*

Tomatoes + Basil

- Thrips
- Plant basil with tomatoes to mask smell from thrips
- Avoid planting onions with tomatoes – tomato spotted wilt virus (TSWV)

Companion Plants for *Masking*

Collards + Calendula

- Aphids
- Calendula masks collard greens (& other cole crops) from aphids
- Calendula (pot marigold) flowers also attract beneficial insects that prey on aphids
- Also has herbal uses (tea) & easy to grow from seed

Companion Plants for *Masking*

Potatoes + Tansy or Catmint

- Colorado Potato Beetle
- Tansies and catmint are perennial herbs that deter Colorado potato beetle
- Inter planting in the potato patch is more effective than planting in the periphery
- Transplant tansies or catmint in fall when potatoes are dug (they transplant well and tolerate root disturbance during potato digging)

Companion Plants that *Interfere with Egg Laying*

Cole Crops + Sage, Dill, Chamomile, Hyssop

- Cabbage Worms
- Sage (herbal) & Hyssop (medicinal) are perennials
- Dill & Chamomile are annuals with herbal & medicinal properties
- Produce flowers that attract beneficial insects

Companion Plants that *Interfere with Egg Laying*

Tomato + Basil

- Tomato & Tobacco Hornworms
- Intercrop basil with tomatoes to interfere with sphinx moth (adult hornworms) egg laying

Companion Plants that *Interfere with Egg Laying*

Cole Crops + Thyme

- Cabbageworm & Cabbage Loopers
- Thyme is a perennial herb shown to significantly reduce egg laying of cabbage worm moths
- Thyme flowers also attract pollinators and other beneficial insects

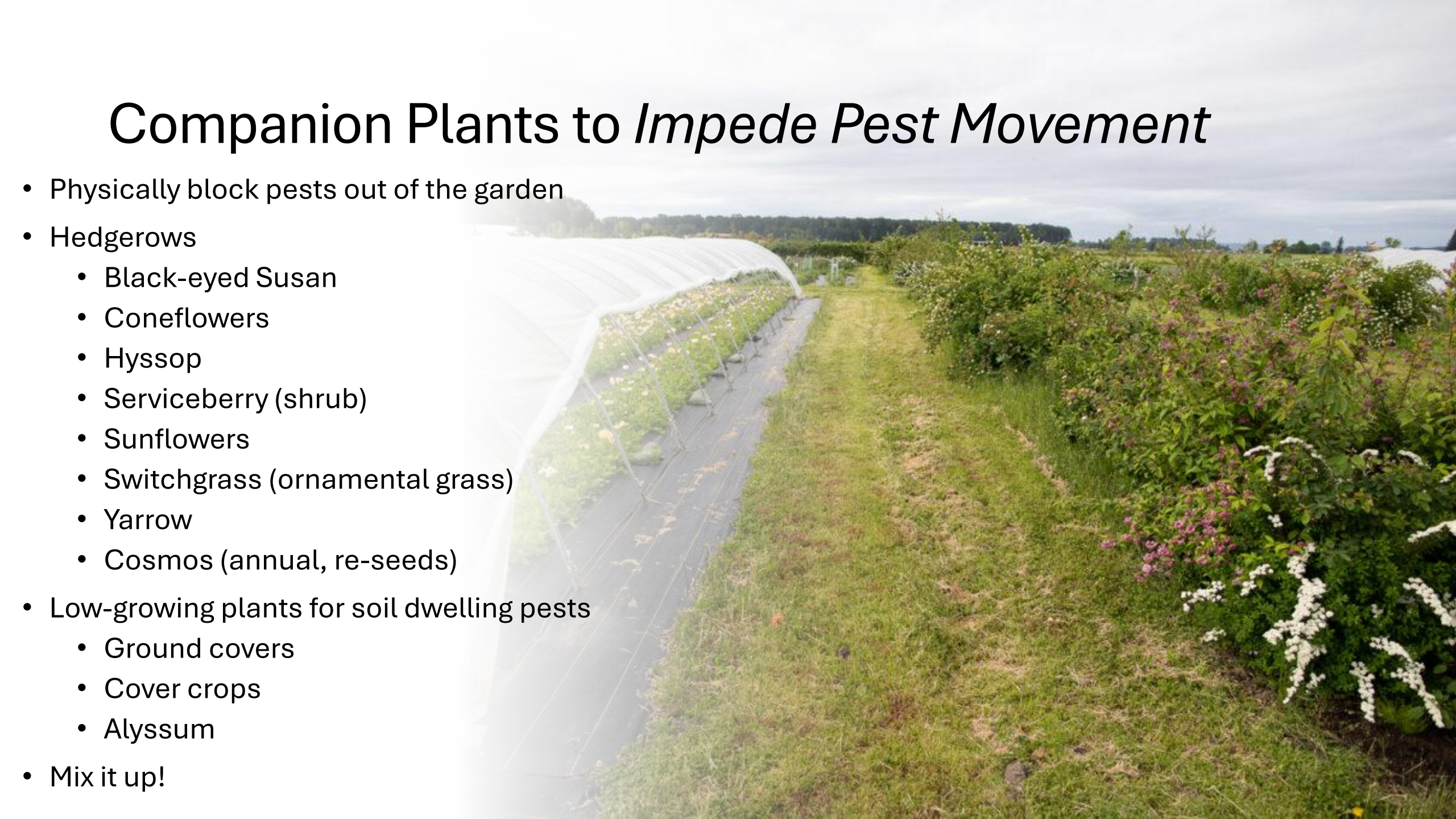
Companion Plants that *Interfere with Egg Laying*

Onion & Cole Crops + Marigolds

- Onion Maggot & Cabbage Maggot
- Mrigolds are commonly used as companion plants, but there are few studies backing this
- One study showed marigolds interfere with onion maggot & cabbage maggot adults (tiny fly) egg laying
- White clover has also shown to interfere with egg laying (more management – tilling)

Companion Plants to *Impede Pest Movement*

- Physically block pests out of the garden
- Hedgerows
  - Black-eyed Susan
  - Coneflowers
  - Hyssop
  - Serviceberry (shrub)
  - Sunflowers
  - Switchgrass (ornamental grass)
  - Yarrow
  - Cosmos (annual, re-seeds)
- Low-growing plants for soil dwelling pests
  - Ground covers
  - Cover crops
  - Alyssum
- Mix it up!



Biological Control

- Using natural enemies to reduce pest population for you
- Reduce or eliminate need for pesticides
- Natural enemies can be purchased from insectaries, online, or local businesses and release in the garden
- In companion planting, we use plant that provide food and habitat to for natural enemies to attract them to the garden

Companion Plants for *Biological Control*

Companion Pant	Pest Controlled
Dill	Aphids, caterpillar pests, Colorado potato beetle
Fennel	Aphids, caterpillar pests, Colorado potato beetle
Cilantro	Aphids, caterpillar pests
Cosmos	Aphids
Mint Family	Caterpillar pests
Sweet Alyssum	Aphids
Crimson Clover	Thrips and other insects (attracts spiders)

Companion Plants for *Attracting Pollinators*

- Flowers
  - Perennial & annual
  - Various flower sizes and structure
  - Variety of heights
  - Mixed bloom time for continual food source
- Grasses
  - Provide hiding places and overwintering habitat
- Mulches & Living Mulch
  - Provides habitat
- Maintenance
  - Leave perennials uncut through the winter
  - Deadheading for longer bloom time and reduce re-seeding

Companion Plants for *Native Bees*

- Utah represents 1/3 of total native bee population in US
- Layered habitat
- Nesting:
  - Shrubs with pithy stems
  - Undisturbed ground
  - Plant debris left on the ground
- Season-long blooming
  - Annuals, perennials, shrubs
- Dual benefits
  - WaterWise
  - Esthetically pleasing
  - Edible


Bottom Line – Biodiversity!

Thank You!

Class Feedback

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