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Introduction to Cover Crops for Vegetable Production in Utah

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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 confusing. A cover crop is often grown to prevent erosion by protecting the soil with living plants and roots that stabilize the soil. A green manure is typically grown to help maintain soil organic matter and increase nitrogen availability. A catch crop is used to scavenge nutrients following the economic crop and prevent nutrient leaching during the winter. In this bulletin we will use the term, cover crop (CC), but it is important to remember the different benefits these crops provide and what goals for the farm you what to accomplish.

Vegetable production is intensive and often removes large amounts of biomass and nutrients without returning much to the soil. Additionally, adequate crop rotations are difficult to achieve and high tillage is often used. These factors contribute to a general decline in soil health and over time, vegetable vigor and yield may decrease if proactive practices like cover cropping are not used. Cover cropping is an excellent way to maintain and improve the soils used for vegetable production.

There are many benefits to growing a CC including reducing soil erosion, increasing water infiltration, improving soil health, and breaking the life cycle of diseases and weeds. This factsheet provides a brief overview of CCs for vegetable production and will 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 plant, at what time of year, in which fields, and how often the CC should be worked into the farm rotation. You need to figure out the specific cultural considerations of the CC such as seeding rates, irrigation requirements, how long to grow the CC, and how to incorporate it. Begin by identifying your farm's specific needs. What is the primary reason you are considering planting a CC? Some possible reasons include:

- Cut fertilizer costs by adding nitrogen and decreasing nutrient losses
- Increase soil organic matter
- Suppress weeds or pathogens and reduce the need for herbicides
- Improve water infiltration and conserve soil moisture
- Reduce compaction
- Prevent erosion

Although your farm may benefit from all of these, choose a primary and secondary goal to focus on. Since some CC do somethings better than others and having well defined goals helps narrow down which crop(s) would be best for your situation. Having set some goals, determine the timing and field location of the CC(s) you want to plant. Consider the life cycles of the vegetables you typically grow. Ideally, plant and grow the CC during times when you do not normally have a

vegetable crop in the field. Matching the CC to the open period in your field minimizes interruptions to cash crops. This is one of the biggest challenges to cover cropping, particularly in areas with short growing seasons. Create a timeline of crop production that is 12 to 36 months long and then fill in your current crop rotations. Note other factors that affect your rotation such as when the fields are too wet to operate equipment, when your labor and equipment are busy (planting time for other fields/heavy harvest periods) as well as frost-free periods needed to grow the vegetable or the CC. Identify those widows where cover cropping is possible and keep these in mind during the CC selection process.

Seasonal Niches

Some of the common seasonal cover cropping niches include: winter fallow, summer fallow, or full-year improvement fallow. **Winter fallow** is when a CC is seeded in time for establishment before a hard fall frost, left over the winter, and then incorporated in the spring before planting the vegetable crop. Winter wheat, barley, annual rye, sweet clover, some vetches, and radishes are some CCs that may work well for the winter fallow niche. In areas with longer growing periods where double cropping vegetables is possible, there may be a summer period where the field is open for a short window. Planting a CC during the **summer fallow** may be a good option to control weeds, scavenge nutrients, and add some organic matter. Buckwheat, sorghum-sudangrass, millets, beans, or cowpeas are summer annuals that can fill this niche. If your soil is very low in organic matter and/or fertility, a **full-year** of cover cropping may be an excellent option for building the soil and controlling difficult weeds. Perennial CC's (alfalfa, clovers), biennials, or mixtures of different crops can provide numerous benefits. One option is to use sequential cover cropping. An example rotation could be to plant a summer annual (sorghum-sudangrass) and mow and incorporate it in the fall, then plant hairy vetch which is terminated in spring before growing a vegetable crop. A perennial CC could be left the whole year. CCs can also be used as a **living mulch**. Living mulches are typically planted between rows and around field edges. They typically need to be maintained by mowing and occasional side tilling to keep from spreading depending on crop used. White clover and perennial ryegrass are good options for a living mulch in vegetable production. While harder to adapt, there are instances when living mulches help reduce erosion, harbor beneficial insects, and reduce soil compaction.

Cover Crop Types

There are three main groups of cover crops: grasses, legumes, and broadleaf crops. The fibrous root systems of **grasses** are good for preventing erosion and capturing nutrients. Grass CCs have fast initial growth rates, relatively low seed costs, and produce a lot of biomass. As grasses mature their lignin content increases, making incorporation and breakdown more difficult. As is true for all CCs, be sure to incorporate the crop before seeds are set.

Legumes are primarily grown for their nitrogen fixation potential. They do this through association with rhizobia, a soil bacteria that form root nodules. These bacteria convert atmospheric nitrogen into a nitrogen form that plants can use. Legume seed should be inoculated with the correct rhizobia for the CC. In addition to the nitrogen fixation, legume biomass is high in nitrogen, they break down fairly quickly in the soil, and attract beneficial insects.

Broadleaf CCs have vigorous seedling growth and are a good option for outcompeting weeds. Their roots are good at absorbing nitrates from deep in the soil. Once incorporated into the soil they break down faster than grasses but slower than most legumes. Some of the broadleaf CCs are alternative hosts for insects and diseases, others have disease

Mustard cover crop at bloom, ready to be incorporated.

control properties, and alleviate compaction. Table 1 contains a list of CCs suited to Utah's climate and detailed information on each one.


Buckwheat cover crop at bloom, ready to be incorporated.

Field Management

How you manage the cover crop greatly influences the benefits derived from planting one. Careful management will increase your chance of success and maximize benefits both for the CC and for the vegetables grown later. Time planting the CC to match when it will establish well and to allow adequate time for sufficient growth. For example, cool-season legume CCs like peas do not germinate well and grow poorly if planted too late in the spring. Trying to grow a warm-season grass like sorghum-sudangrass in the fall often results in poor establishment and low biomass accumulation. Field preparation typically follows standard practices used for cash crops. Seed can be broadcast over the soil and then incorporated with harrows or ring rollers. Seed can also be drilled into the soil with a grain drill, or if the seed size is appropriate with bean or corn planters. No-till drills are commonly used for conservation tillage rotations. Seedbeds should be firm and level so planting depths are optimum for crop establishment. Table 1 includes seeding rates for broadcast planting. Seeding rate can be reduced if using a drill or planter. Use the high value of the recommended seeding rate if conditions are poor (very early planting date, very short planting window, high weed pressure).

Depending on the CC planted and time of year, irrigation may be necessary. Summer annuals typically require irrigation and fall planted CCs establish better if irrigated pre- or post-seeding. In-season irrigation of cool-season CCs is typically not needed.

There are several factors to consider needed when terminating the growth of the CC. Termination timing is important to meet your goals and achieve desired CC benefits. Once a crop flowers, biomass accumulation and nutrient uptake dramatically decreases. Since biomass accumulation is one of the main goals of planting a CC, termination just prior to flowering ensures maximum nutrient cycling and rapid tissue breakdown when incorporated. In addition, CCs allowed to form seeds can become a weed problem. CCs, especially grasses that are terminated after the stems become woody, tie up nitrogen during decomposition. To avoid this, consider incorporating grasses before they reach full vegetative growth. Timing is also determined by the upcoming vegetable crop. Early termination may be necessary to allow time to prepare the field, decompose the CC, and plant the following cash crop.

Crops that survive tillage, such as white clover, should be sprayed with a killing herbicide prior to incorporation. To aid in residue breakdown, it is a good idea to mow CC's before incorporation. When disking and tilling the CC, think about what crop will follow. Generally, allow two weeks between CC incorporation and planting the desired vegetable crop. If possible, prepare the beds for the upcoming crop at this same time.

Careful planning and management greatly improve success with CCs. Deciding to invest additional time and money into planting a CC can be difficult but remember that the benefits realized often outweigh costs. A year of a cover cropping will not magically fix all soil problems but if CCs are regularly included in a long-term farm management system most, if not all, of the benefits of cover cropping can be realized.

Additional Resources

Smith, R., R. L. Bugg, M. Gaskell, O. Daugovish and M. V. Horn. 2011. Cover cropping for vegetable production: A grower's handbook. University of California Agriculture and Natural Resources Publication 3517

SARE. 2012. Managing cover crops profitably, Third edition. Sustainable Agriculture Research and Education (SARE). Handbook 9

Table 1. Cover crops suited for Utah vegetable production systems.

Crop	Type[1]	Best Established[2]	Min Germ Temp	Broadcast Seeding (lbs/acre)	Erosion Control	Dry matter[3]	Total N (lbs./A)	Characteristics
Grasses								
Annual-Ryegrass	CSA	ESp, LSu, EF,F	40	20-30	Medium-High	4000-6000	-	Good at outcompeting weeds, fast-growing, non-spreading bunchgrass. Captures leftover N to reduce nitrate leaching. High weed potential if seed heads allowed to form.
Barley	CSA	F,W,Sp	38	80-150	High	4000-8000	-	Rapid seedling growth and early maturity. Good for short rotation. Salt tolerant, low water needs. Harder to incorporate when mature than other grasses.
Cereal Rye	CSA	LSu, F	34	60-120	High	3000-4000	-	Very hardy, good for late fall seeding. Spring planted will not set seed. Excellent option for absorbing excess N. Inexpensive seed, good for infertile or poorly prepared land. Good option as a windbreak. Weed potential if tilled at wrong stage.
Millet	SA	ES, S	60	30-40	Medium-High	4000-8000	-	Tall, erect grass with extensive root system. Low-input crop, dies with hard frost. High weed potential if tilled at wrong stage.
Oats	CSA	LSu, ESp	38	120-175	Medium-High	2000-8000	-	Late maturing, needs at least 6 to 10 weeks of cool-season growth. Doesn't do well in hot, dry weather. Reliable winter kill. Fall planted has more dry matter.
Sorghum-Sudangrass	SA	LSp, ES	65	40-50	High	8000-10000	-	Excellent for smothering weeds in summer. Roots secrete allelopathic compounds. Medium seed cost. Good at breaking up compacted soil, particularly if mowed once. May need supplemental N for best growth. Heat and drought tolerant. Mature, frost-killed plants become woody.
Winter Wheat	WA	LSu, F	38	60-150	Medium-High	3000-8000	-	Late maturing makes it a good option for areas where wet springs delay tilling. Lower-cost seed than rye. Can scavenge N from deep in the soil. Spring planted will not set seed.

Table 1. Continued

Crop	Type[1]	Best Established[2]	Min Germ. Temp	Broadcast Seeding (lbs/acre)	Erosion Control	Dry matter[3]	Total N (lbs/A)	Characteristics
Legumes								
Alfalfa	Per	S,EF	48	15-20	Medium	6000-8000	70-100	Does not establish well in nutrient-poor soils. Usually left for several years. Deep taproot breaks up compaction layer. Does well with a small-grain nurse crop.
Cowpeas	SA	S	58	70-120	High	2500-4500	100-150	Most productive heat-adapted legume. Once established, very drought-tolerant. Excellent for smothering weeds. Some cultivars are nematode resistant. Incorporate while still green.
Hairy Vetch	WA	EF, Esp	41	25-75	Medium	2300-5000	90-200	Hairy Vetch tolerates cold or fluctuating winter temps fairly well. Needs to be planted earlier in the fall than cereal crops for good winter survival. Good at breaking up subsoil compaction. Other vetches (Common, Smooth, and Purple) are similar to Hairy but need warmer temperatures.
Medics	Per	EF, Esp, ES	45	15-30	Medium	1500-4000	50-120	Good at choking out weeds but can easily become weedy itself. Great option for short windows.
Peas (field/winter)	WA	ESp,F	41	90-100	Medium-High	4000-5000	90-150	Rapid spring growth helps peas out-compete weeds. Excellent N contributors. Can also be harvested for forage or seed.
Red Clover	Per	LSu, ESp	41	10-12	Medium	2000-5000	70-150	Does not tolerate mowing. Breaks up subsoil compaction.
Sweetclover	Bi	Sp, S	42	10-20	Medium-High	3000-5000	90-170	Do not mow the first growing year. Breaks up topsoil and subsoil compaction.
White Clover	Per	LW,Sp, EF	40	5-15	Medium	2000-6000	80-200	Excellent at choking out weeds. Survives tillage, can be invasive.
Broadleaf								
Buckwheat	SA	Sp to LSu	50	50-90	Low	2000-4000	-	Very fast grower, chokes out weeds and great for short windows. Weed potential if tilled at wrong stage.
Mustards/ kales	WA	SP, LSu	40	10-20	Medium-High	3000-9000	30-120	Reduces topsoil compaction, good control of nematodes, diseases and weeds. High allelopathic potential. May over-winter.
Radish	CSA	SP, LSu, EF	45	10-20	Medium-High	4000-7000	50-200	Reduces subsoil compaction, chokes out weeds, and has some allelopathic qualities. Good for short windows.
Rapeseed/ canola	A/Bi	F, Sp	41	10-20	Medium-High	2000-5000	40-160	Some nematode control and allelopathic qualities. Two different species: *Brassica napus* (annual) and *B. rapa* (biennial).

1: CSA=Cool Season Annual; SA=Summer Annual; WA=Winter Annual; Bi=Biennial; Per=Perennial
2: NFT=Not Frost Tolerant; EF=Early Fall; F=Fall; LF=Late Fall; W=Winter, ESp=Early Spring, LSp=Late Spring, Sp=Spring, ESu=Early Summer, S=Summer, LSu=Late Summer, EF=Early Fall, F=Fall, LF=Late Fall
3: Assuming full season, moisture and fertility

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