

# COVER CROPS FOR VEGETABLE GROWERS

BY  
 CHARLES W. MARR  
 RHONDA JANKE  
 PAUL CONWAY



Cover crops are not grown for harvest; rather, they are grown to protect and improve soils. Cover crops can improve soil tilth, control erosion and weeds, and maintain soil organic matter content. Soil compaction can be reduced and water infiltration, which may leach soil nutrients (especially nitrogen) can be reduced. Thus, cover crops can be used to retain and recycle plant nutrients—especially nitrogen—between cropping cycles. Cover crops also provide a habitat for beneficial insects, as well as provide rotations to break plant disease cycles.

This production guide is intended for organic vegetable growers that rely on alternative fertilizer sources and soil improvement systems; however, all vegetable growers can implement soil improvement potential from the use of cover crops.

## Cover Crops and Vegetables

Cover crops are used in large scale field crop production systems for similar reasons as vegetable production. However, there are some special situations that vegetable producers face when trying to implement cover crops into vegetable cropping systems.

1. Many vegetable producers—especially market gardeners—may not have livestock to utilize the cover crops for forage or pasture. Thus, value of the cover crop for livestock grazing does not exist as it would in a diversified farming operation.

2. Most vegetable crops have a shorter season than agronomic crops; thus, more possibilities for establishing and terminating cover crops exist, and may be quite different.
3. Vegetables are traditionally grown on small tracts of well drained, fertile, high valued land. Rotations in and among vegetables on small tracts may become difficult.
4. Because of the smaller sized land areas that many market gardeners deal with and the complexity of vegetable rotations on that small tract, establishing cover crops may become difficult. Traditional tillage and seeding equipment may not be suitable for these small areas.
5. Terminating and tilling in cover crops may be more difficult for a small market gardener without access to larger scale tillage equipment. The “chopping and tilling” capabilities of a large tandem disk, for example, may be difficult to duplicate with small scale, lighter equipment.

## Using Cover Crops in Vegetable Production Systems

Cover crops can be used in a variety of ways with vegetable rotations. The selection of a crop and vegetable rotation may vary depending on the grower operation, site, availability of irrigation, vegetables involved, and locale. Cover crops can be used in several ways in vegetable operations.

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1. As a main crop used during the primary growing season. This may provide a full season for optimum growth and nitrogen fixing capacity of the crop. However, used as a rotational crop, it will exclude the production of a cash vegetable crop.
  2. As a companion crop where the cover crop is planted between rows of the vegetable crop. In eastern states, where rainfall is greater, this system of living mulch or companion cropping is more practical. In Kansas, competition for water is greater; thus, irrigation may be necessary to implement an aggressive cover crop growing near a shallow rooted vegetable crop.
  3. As a catch crop where the cover crop is planted before or after the vegetable crop growing season to trap and hold nutrients, or to reduce soil erosion in fields.
  4. As an off-season crop where the cover crop is established after the growing season of the vegetable and is left in place during the winter months to protect soils and hold nutrients. This is, by definition, a cover crop used to cover the soil in winter months.

In some instances, the use of cover crops may be planned and implemented as part of a seasonal rotation of crops. However, a vegetable producer may also have an opportunity to establish some cover crops in an opportunistic manner—when a particular situation may develop in a particular season. This may come from a sudden freeze, hail-storm, or loss of market where a planned vegetable crop is terminated prematurely. These situations occur more frequently in vegetable operations than other agronomic situations. A grower may need to be prepared to establish a cover crop quickly—whenever the opportunity presents itself.

### **Cover Crop Management**

The advantage of the cover crop may differ depending on the type of cover crop, season, and site situations. The ability of the cover crop to significantly contribute to soil organic matter increases, fixation of nitrogen in the soil, and soil tilth is usually reserved to sequential use of cover crops in long-term use situations. A short-term

planting and termination of a cover crop may contribute little, but may be useful in holding nutrients from leaching, soil from eroding, or weeds from taking over a field.

Grasses (or small grains) used as cover crops usually germinate quickly and cover the ground rapidly. However, they do not fix nitrogen from the atmosphere to contribute to a total nitrogen gain in the soil; only legumes have this characteristic. Legumes are usually slower to germinate and establish in the autumn season; but, their subsequent growth in the following spring season can be substantial.

**Establishing Cover Crops.** Cover crops require minimal soil conditions for establishment. A soil test will indicate any soil problems that prevent adequate soil fertility for establishing a sufficient cover crop. Due to the precision placement of seed and a mechanism that ensures good seed-soil contact, using a seed drill will usually result in a better stand and use less seed than broadcasting or scattering seed over the soil surface followed by a light tillage. An adequate plant stand is important to ensure good biomass (crop volume) and weed suppression. A seed drill can often be rented from local co-ops, rental equipment suppliers, or garden equipment dealers.

**Terminating and Incorporating the Cover Crop.** In addition to proper establishment, it is also important to pay attention to termination and incorporation of the cover crop. Terminating the cover crop before it blooms usually results in easier termination and incorporation since the organic material begins to decompose quickly and easily—resulting in a short ‘dead time’ before establishing the next crop. In this situation, planting a subsequent crop 2 weeks after termination and incorporation can be accomplished. After the crop begins to bloom, more biomass is produced but plant material may be less succulent and slower to deteriorate. Also, significant water utilization by the cover crop may make soil tillage and subsequent crop establishment difficult (unless irrigation is available). After the crop blooms, allow 3 to 4 weeks after termination and incorporation before planting a vegetable crop.

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It is important that the cover crop be completely killed so that it does not re-establish and become a weed crop in the following vegetable planting. If there is a large amount of top growth on the cover crop, chop/shred or mow the crop first. Use a heavy disk or rotary tiller for complete incorporation of the cover. The use of a moldboard plow may result in a layer of material that is not adequately blended with the surrounding soil unless the material is chopped and/or shredded first (blending encourages rapid decomposition).

## Types of Cover Crops

There are 3 main categories of cover crops based on their season of growth.

1. **Perennials**—Live for many or a few years without replanting. Perennials can be used as forage crops for several years or used as a cover for a single season. It is critical that the perennial crop be killed with termination and incorporation so that it will not return as a weed crop in the vegetable crop.
2. **Summer annuals**—Crops that are seeded in the spring or summer season and grown for a short time that season are classified as summer annuals. They will usually not survive a cold winter so they cannot be relied upon for an overwinter cover that will resume growth the next spring. However, the crop residue may remain as a dead winter cover.
3. **Winter annuals**—Crops that are usually fall seeded, begin some growth in the autumn season, and regrow rapidly the next spring are referred to as winter annuals. This includes many small grain crops as well as some legume crops.

The following is a listing of some common cover crops. Those that are legumes (capable of fixing nitrogen) are noted.

### Perennials

**Alfalfa** (Legume)—Alfalfa is a widely available, commonly grown forage in Kansas. It has value as a hay crop as well having a deep, penetrating root system, and is drought tolerant. It is usually fall seeded so that some growth develops before overwintering for winter survival.

**Red Clover** (Legume)—Red clover is a short-lived perennial that is not as drought tolerant or as deep rooted as alfalfa. It can be seeded in late summer to early autumn or ‘over seeded’ into vegetable crops late in their growth cycle (in sweet-corn, squash or pumpkins). Overseeding may be accomplished by sowing the seed and lightly cultivating or raking to incorporate the seed.

### Summer Annuals

**Annual Lespedeza** (Legume)—Korean and striate lespedeza are examples of annual lespedeza that have good drought tolerance but are cold sensitive. They grow well in hot weather and can be used as grazing crops for livestock in the summer season. They grow well on low fertility soils.

**Sweetclover** (Annual)—Annual sweetclover is a cold sensitive legume with high nitrogen fixation capability. It establishes quickly and well and grows rapidly. It could be established up to 2 months before the first killing freeze.

**Berseem Clover** (Legume)—Berseem clover is a cold sensitive legume that has moderate nitrogen fixation capability and establishes very rapidly.

**Cowpea** (Legume)—Cowpeas are cold sensitive and moderately drought tolerant but have high nitrogen fixation capability. They grow especially well in hot weather. Cowpeas have some value as a vegetable crop if allowed to mature to the podding stage.

**Garden Pea** (Legume)—Peas have low nitrogen fixation capability and are cold sensitive. However, they can be used as a spring seeded annual—followed by other vegetables in a rotation.

**Soybean** (Legume)—Soybeans are sensitive to cold but have high nitrogen fixation capability and are widely available for planting. They establish rapidly and will shade out weeds when used as a summer annual (drilled or broadcast seeded).

**Buckwheat** (Non-Legume)—Buckwheat is very sensitive to cold but is fairly drought tolerant. It establishes very rapidly in warm weather and is probably best used as a ‘smother crop’ for weeds. Several crops may be planted in succession during the summer season.

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**Mustard or Turnip** (Non-Legume)—These crops can be used as a cash vegetable crop but serve as a trap crop for nutrients when fall seeded (after crops are harvested for autumn winter marketing). They are cold tolerant and will remain green for an extended period in the winter for livestock grazing.

**Sorghum–Sudangrass** (Grass)—Sorghum/sudangrass is a hybrid of sorghum and sudangrass that has good drought tolerance, grows rapidly, and produces a huge biomass (crop volume). It has been reported to have a suppressing effect on subsequent growth of some weed species such as redroot pigweed, purslane, and foxtail. It is normally planted 2 weeks after corn planting for best results or anytime during the summer season.

**Spring Oats** (Grass)—Oats are widely available and can be used as a late season crop that is usually grown 6 to 12 inches tall before winter killing temperatures kill the crop. It makes an excellent winter cover residue that is easily incorporated in the spring.

#### **Winter Annuals**

**Black Medic** (Legume)—Black medic is an expensive seeded cover crop that establishes quickly but has fairly good cold tolerance. It needs to be well established in the fall to overwinter well.

**Crimson Clover** (Legume)—Crimson clover is usually grown as a winter cover but can be used as a summer annual as well. It has good cold tolerance and nitrogen fixing capability and is moderately drought tolerant. It does not grow well in soils with a neutral or higher pH. Close mowing will kill the crop (if done before full bloom to prevent reseeding).

**Hairy Vetch** (Legume)—Hairy vetch is one of the best known and widely used legume winter covers for vegetable production. It has excellent cold tolerance and is moderate in its ability to fix nitrogen and withstand drought. It tolerates a wide range of soil pH and fertility levels. If left after blooming, it will reseed for a subsequent crop. It should be planted 40 days before the first freeze to ensure that it is well established and able to survive the winter. Other vetches include wollypod, common, and purple types.

**Austrian Winter Pea** (Legume)—This large seeded legume is moderately cold tolerant and has good nitrogen fixing capability. It establishes rapidly. It is usually planted in mid- to late September for overwintering purposes.

**Annual Ryegrass** (Grass)—Annual ryegrass (often called Italian ryegrass) is fairly drought tolerant and has good cold tolerance. It can provide a good means of trapping nutrients when established in late summer and is easy to till/incorporate the following spring season.

**Winter Wheat or Rye** (Grass)—Rye is often not used in many areas of Kansas when rotations include wheat as a grain crop; however, rye is a tall growing grass that overwinters well and can be established late in the season. It provides excellent winter erosion control. Most wheat varieties are smaller, shorter plants but the cold tolerance is good and seed is inexpensive and readily available.

#### **Using Cover Crops in Vegetable Rotations**

Matching the characteristics of cover crops with the seasons of production of vegetable crops can be a difficult task. Early planted vegetables such as potatoes, onions, lettuce, cabbage, broccoli, radishes, beets and carrots need to be planted early so that the harvest period occurs before hot weather. Thus, winter annuals used to improve soil organic matter content or nitrogen fixation usually are not an option because of the early planting date required. In these crops, a summer annual or winter annual may be considered after the harvest season.

Winter annuals or perennials work best with warm season vegetables such as tomatoes, peppers, sweetcorn, cucumbers, melons, squash and pumpkins, or sweet potatoes. Melons and sweet potatoes are planted late enough that some spring growth of winter annuals or perennials can occur before tillage is required—thus, improving the organic matter and nitrogen content of soils.

**Soil improvement**—the addition of organic matter and nitrogen to improve soil fertility and tilth—can best be achieved by using a full-season legume in a vegetable rotation. However, this means one or more lost income crop year unless a market for the hay (forage) from the legume crop is available. Use of summer annuals or winter annuals is a good way of maintaining nutrients and

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gradually improving soil organic matter content and tilth; however, a slower response is to be expected. The addition of supplemental sources of organic materials such as compost or manure should be investigated as a 'quick fix' for immediate organic matter and nutrient improvement, followed by rotations of vegetables with summer annuals and/or winter annuals.

### **Conversion of Pasture/Cropland to Vegetables**

Cover crops are an excellent way of making a transition to vegetable production from pasture or cropland. Tilling of pastures usually requires a year to breakdown sod and ensure that no soil insect problems are encountered (this is especially true for wireworms in root crops such as potatoes or carrots). Cropland is often unknown in terms of weed problems to be encountered, differential soil areas in a field, or fertility variation in the field. A cover crop will allow a grower to observe these situations while adding fertility and organic matter to fields. This also eliminates any herbicide or chemical carryover for growers in transition from conventional to organic production. A summer annual crop followed by a winter annual crop (or an early seeded winter annual crop) will allow the grower to observe weedy, droughty, or infertile areas in the field through its entire cropping sequence.

Be especially alert for weedy hayfields. Check the field borders for weed problems, as these will probably be present in the field. Fall tillage is suggested—followed by a summer annual crop then planted to a winter annual prior to use the following season.

### **Cover Crops and Soil Improvement**

The addition of organic matter and nitrogen to improve soil fertility and tilth can best be achieved by using a full season legume in a vegetable rotation. However, this can mean one or more years of lost crop income, unless the farmer has a market for legume hay. Ways to minimize this income loss follow. In some cases, growers may have no choice. Years of continuous crop production with little attention to organic matter maintenance requires a period of cover cropping to stop the decline of soil fertility and tilth. In many cases, however, use of summer annuals or winter annuals is a good way

of maintaining nutrients and gradually improving soil organic matter content and tilth; a slower response, however, is to be expected. The addition of supplemental sources of organic matter should be investigated as a "quick fix" for immediate organic matter and nutrient improvement. These sources are compost or manure, followed by rotations of vegetables with summer annuals and/or winter annuals.

There are two ways to get the soil building benefits of legume vegetable rotations with minimal or no loss of cash crop revenue. The first is strip-cropping cover crops, primarily legumes, and vegetables. The second is to interplant vegetables into newly established legume seedings or seed cover crops into established vegetable crops. As mentioned before, interseeding into established crops is risky under Kansas conditions unless irrigation is available.

1. **Strip-Cropping:** Growers plant strips of legumes or legume/grass/grain mixes and strips of vegetables across fields. Cover crop strips are left for 1 to 3 years then rotated back to vegetables. Strip widths can be adjusted to equipment width; a 2-row planter set for 3-foot rows means strip widths in multiples of 6 feet. Strips can also be adjusted to accommodate changes in slope or other field characteristics. Strip-cropping is best suited to fairly rectangular fields larger than  $\frac{1}{2}$  acre. The legume strips are mowed as needed. This method has advantages over whole field growing of both vegetables and legumes. Traffic and compaction are limited to those strips best suited to handle it—legume sod strips. Traffic on vegetable strips is reduced to tillage and cultivation. This is a very low cost and efficient way to fix nitrogen, suppress weeds and build soil tilth. The "border effect" improves yields on some crops, especially sweet corn. The legume strips provide a handy source of mulch or compost material conveniently located next to the cash crop. The grower can concentrate manure, compost or fertilizer on cash crop strips opening up more opportunities for double cropping if water is available. The grower has more time to do timely cultivation and harvest. Strips allow cropping of more sloping ground than prudent under whole field conditions. The legume

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strips not only hold soil from washing but can be effective windbreaks and hosts for beneficial insects. Finally, rotations are simplified once the initial planning and strip establishment is done. The grower has less need to seed winter annual green manure during often narrow weather windows. Farmers can also limit income loss by planting vegetables into new legume strips (described below in paragraph 2).

There are disadvantages to this technique other than the obvious—loss of income. The grower must do detailed planning in advance, sometimes one year out. He or she must measure and mark strips precisely enough to match his or her equipment. Cover crops may have to be replanted; lime and phosphorus may be needed to get the field in shape for legume crops. The switchover year must be thought through; otherwise, all strips will be bare going into winter. A phased rotation with some strips being converted each year will work best.

2. **Interplanting:** In this method, the cover crop legume is planted in early spring. Several weeks after germination, a strip is tilled out; vegetables are planted in this tilled strip. The cover crop between the strips is managed just as it would be if the whole strip was in legumes. This method is especially adapted to transplanted crops such as brassicas or tomatoes. Selecting the right cover crop is important. Considerations are fast growing versus slow growing legumes. Fast growing legumes will provide a lot of mulch but may interfere

with the cash crop. The distance between vegetable strips is based primarily on the mowing width of the grower's mower unless the crop will be harvested before the cover crop starts rapid growth. Interplanting is not suited for frequently hilled crops (potatoes) or crops traditionally planted in narrow rows. This method is probably best suited to small fields or plots where the grower cannot sacrifice much ground for a season-long cover crop but still wants the soil building benefits of a lengthy cover crop without the work of planting a summer annual.

Interplanting cover crops between rows of established vegetable crops can be done in Kansas but with marginal odds of success. Timing and moisture levels are critical. The grower must plant the cover crop after the cash crop is well established but before it is tall enough to shade out the cover crop, usually 3 to 4 weeks after the vegetable crop is planted. Clovers usually don't do well if planted after late April; the large seeded legumes such as soybeans or cowpeas do better. These legumes must be planted deep enough to be in moisture. Hairy vetch can also be used but it is very sensitive to shade. Clovers do better if planted from late August through mid-September. They benefit from the shading effect of tall cash crops at this time. Late seeding isn't practical if the rows are weedy, as the extra tillage required will use up too much moisture. Interplanting cover crops works best with wide rows.

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## COMMENTS ON SPECIFIC COVER CROPS—MANAGEMENT GUIDE

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(In this guide, N=nitrogen; P=phosphorus; K=potassium)

### ***Perennial Crops***

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#### **Alfalfa**

Characteristics:	A deep-rooted legume that can last at least 3 to 4 years. Excellent N fixer, very drought tolerant and tolerates frequent mowing. Does not tolerate wet soils or frequent flooding. Can be straight seeded or sown in mixes usually with a grass such as brome.
Adapted to:	Throughout Kansas. Soil pH must be above 6. It requires at least medium levels of P (40 to 60 PPM) and K.
Sowing Dates:	Early April to mid-May and mid-August to late September.
Seeding Rates and Methods:	15 to 20 pounds per acre straight seeded. (½ to 2 pounds per 1000 square feet), less if seeded with a grass. Alfalfa does best when drilled but can be broadcast and harrowed in on a firm seedbed. Use higher rate for broadcast. Use alfalfa inoculant.
Management:	There are two kinds of alfalfas—dormant and nondormant. The dormants, which stop growing in mid-autumn, are the most common in Kansas because they are very winter hardy. The nondormants grow much faster but are much less winter hardy. One nondormant variety, Nitro, will overwinter in eastern Kansas. The non-dormants can be cut 3 times in the seeding year, the dormants once. Dormants should be sown with a nurse crop such as oats to protect young seedlings. The nondormants have lesser need for a nurse crop. Moisture permitting, a cutting of nondormant alfalfa is possible in early June from an April sowing. Alfalfa can be mown or turned under when it reaches 12 inches.
Suitable for Intercropping:	Yes, but the expense of seeding alfalfa and value as a forage crop make it a poor choice.
Suitable for Mixes:	Usually sown straight but often mixed with a grass such as brome.
Suitable for Small Growers:	Alfalfa is not suitable for small growers as it can only be incorporated with heavy equipment such as plows or chisels.
General Comments on Use:	Alfalfa, while an excellent forage crop and soil builder, is a poor choice as a cover crop. It is expensive to establish. It is suited to strip cropping but only if the grower has livestock, a market for hay and hay equipment. If grown, Nitro is the best choice for market growers.
Source/Cost:	Readily available from feed dealers or wholesales. Public varieties usually cost \$2 per pound, private varieties can run as high as \$3 per pound. Farmers occasionally have seed for sale at a cheaper price. Nitro alfalfa can be purchased in less than 50-pound quantities from Albert Lea Seedhouse (see Seed Sources).

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#### **Red and White Clover**

Variety:	Red—Medium, Mammoth, Alsike. White—Dutch, New Zealand, Ladino.
Characteristics:	Medium red clover is the most common red clover; Mammoth is a slightly later and coarser red clover that is usually cheaper; and Alsike is a small fine stemmed clover very tolerant of wet locations. Dutch white clover is the common low growing white clover found in pastures and lawns; New Zealand is a taller more drought tolerant white clover; Ladino is a fine-stemmed clover adapted for wet locations. All white clovers are shorter than the red clovers; the whites are long perennials while reds last two years unless allowed to reseed themselves. All are slow growing. Reds are tall enough to cut for hay in August of the seeding year. All grow fast in the second year. All clover is relatively shallow rooted with fair drought tolerance. They will grow on almost all soils as long as the pH is above 5.8 and P levels are above 35 PPM. They do well on soils too wet for alfalfa.

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### **Perennial Crops con't.**

#### **Red and White Clover con't.**

Adapted to:	Eastern Kansas in both the northern and southern regions of the state. Clover production is marginal west of Manhattan due to low rainfall.
Sowing Dates:	Late February through mid-April. Clovers can be sown mid-August through mid-September although these plantings can fail if moisture is short. Early spring seeding rarely fails as clovers are frost tolerant. Use alfalfa/clover inoculant.
Seeding Rates and Methods:	Red clovers are sown at 8 to 15 pounds per acre (½ to 1 pound per 1000 square feet) or white clovers at 5 to 10 pounds per acre (seed is slightly smaller). Use the higher rates for straight seeding the lower rates for seeding with grasses. If using oats as a nurse crop, don't plant the oats too thick (1 to 2 bushel/acre). Red and white clover can be mixed together. Seed can be drilled or broadcast and harrowed.
Management:	Clovers grow slowly in the seeding year but should be 12 to 15 inches tall by mid-August. Red Clovers are good nitrogen fixers, around 80 pounds per acre the first year and 100 pounds per acre the second year. Growth is rapid during the second year. Mow as needed to control broadleaf weeds especially during the seeding year. Alsike and Dutch white are moderate nitrogen fixers (50 pounds per acre). New Zealand White can fix as much N as the taller red clovers.
Suitable for Mixes:	Clovers mix well with oats. A clover/oat mix produces large amounts of mulch or biomass for soil improvement. Mow to control oat growth. Annual ryegrass can be a good companion for clovers.
Suitable for Small Growers:	Red clovers are best incorporated by plows, chisels or heavy rototillers. White clovers, due to their lower growth, can be rototilled with several passes.
General Comments:	Clovers or clover mixes are well suited as cover crops both in the rotation or intertilled. Clovers can be maintained for years if a grower is willing to 'frost' seed them after 2 years. Considering seed cost, availability and use of establishment, clovers are a good choice as a rotation cover crop in eastern Kansas. If straight seeded, however, clovers don't produce much mulch in the first year.
Source/Cost:	Red clovers are readily available from feed dealers. Costs vary but will be approximately \$1.60 per pound commercially. Farmers often have clover seed for sale for \$0.80 to \$1 per pound. White Dutch clovers are also very available but more expensive. The other white clovers usually have to be special ordered and will cost at least \$2 per pound. Several feed dealers in Kansas sell clover mixes, usually Medium and Alsike red clovers, which are often economically priced.

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#### **Yellow Blossom Sweetclover** (also used as a winter annual)

Variety:	Usually not stated on seed bags.
Characteristics:	Yellow blossom sweetclover is a biennial. If planted in the spring, it grows fairly rapidly, goes dormant in autumn and will grow aggressively the next spring, flowering in late May. When fall seeded, it grows slowly, overwinters, and then grows rapidly and flowers—completing its life cycle. Sweetclover is deep taprooted and drought tolerant; it can deplete soil moisture if left too long during a dry late spring. It is an excellent N fixer (100 pounds per acre) and is adapted to all soils except wet. Its deep taproot can bring up minerals from the subsoil. It needs a pH of 6 and moderate levels of P (40 PPM).
Adapted to:	Throughout Kansas.
Sowing Dates:	Late February (frost seeding) through early May and August to early September. Seed at least 40 days before the average date for killing frost. Sweetclover is the only clover that can be seeded throughout the summer with a reasonable chance of establishment.



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## ***Perennial Crops con't.***

### **Yellow Blossom Sweetclover con't.**

Seeding Rates and Methods:	Seed at 9 to 15 pounds per acre ( $\frac{1}{2}$ to 1 pound/100 square feet). Use the higher rates for straight seeding. Sweetclover can be frost-seeded, drilled or broadcast and harrowed in. Use alfalfa/clover inoculant.
Management:	Sweetclover should be about 10 inches tall by late May through early June from a spring seeding. Mow as needed to control weeds and growth if growth threatens the cash crop after interseeding. Mow high, as sweetclover is intolerant of close mowing. Plow under in late October or early November if planting an early vegetable crop the next spring. If left to overwinter, plow under before flowering or at least before seed set. Mature sweetclover is very fibrous and will break down slowly. The seed is hard and will survive many years in the soil becoming a weed.
Suitable for Intercropping:	Sweetclover is a good choice for an intercropping legume especially if planted before the vegetable crop. It will produce plenty of mulch by mid-June. It is an excellent choice for a one year cover and soil building crop.
Suitable for Mixes:	Best choice is oats if heavy biomass production is the goal. Mow to control oat growth. Sweetclover can be sown with the small grains in the fall. Oats are the best choice because they winter-kill. A wet spring can result in too much grain growth and incorporation problems.
Suitable for Small Growers:	No. It requires plowing to incorporate.
General Comments:	Sweetclover seed is cheap. The crop is easy to plant. These factors alone make it an excellent choice for a one year cover especially if intercropped.
Source/Cost:	Seed dealers can readily order sweetclover. Costs are around \$0.50 to \$7.70 per pound and will vary yearly. This is by far the cheapest clover.

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## ***Summer Annuals***

### **Berseem Clover**

Varieties:	Most common is Bigbee, occasionally Multicut is available.
Characteristics:	Berseem clover is an extremely vigorous, tall growing (up to 24 to 27 inches) white clover. It will be tall enough to mow by late May through early June from a March seeding. It is slow to flower before the first cutting but later flowering is rapid especially if moisture stressed. Berseem clover does best under hot, moist conditions. Many cuttings are possible under these conditions. It tolerates wet soils. Under Kansas conditions, growers can expect one heavy cutting, followed by a lighter cutting in early July. Regrowth after the second cutting is usually sparse. Once Berseem flowers, its life cycle is complete. If the blossoms are left undisturbed, Berseem will reseed itself. Under ideal conditions the new seeding can grow up to 15 inches tall before winter kill which occurs at 18°F. Berseem has the same fertility and pH requirements as red clover. N fixation may be 80 to 100 pounds/A.
Sowing Dates:	Early March through mid-April. Berseem can be sown mid-August to early September but success is marginal unless moisture is adequate or the seedings are shaded.
Seeding Rates and Methods:	Plant at 15 to 25 pounds per acre ( $\frac{1}{2}$ to 2 pounds per 1000 square feet). Use the higher rates if seeding alone. Best drilled but can be harrowed in. Frost seeding is usually not successful. Once established, Berseem can survive temperatures to 22°F. Use alfalfa/clover inoculant.

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## Summer Annuals con't.

### Berseem Clover con't.

Management:	Management is influenced by time of cutting. Berseem makes excellent hay or heavy quantities of mulch. The first cutting should be made when the berseem is 7 to 20 inches tall, later cuttings will be difficult because it gets tall and can fall over. The second cutting should be made before heavy flowering, usually one month after the first cut. Don't mow close. Try to leave 1 to 3 inches of stubble. Any regrowth should be left alone. Either incorporate if planting a fall catch (to trap fixed N) or let reseed. Berseem leaves a very mellow friable seedbed so spring tillage requirements are minimal. Transplants can be put right into the seedbed. Berseem is one of the best weed suppressors because it is so aggressive.
Suitable for Intercropping:	Yes, because of heavy biomass production and slower mid-summer growth. Make sure that the tilled in strips stay clean. Berseem too close to vegetables will overwhelm young plants.
Suitable for Mixes:	Yes, if even heavier biomass is desired. Mix with oats. An oat-berseem clover mix is an excellent soil builder if left in for a full season.
Suitable for Small Growers:	Yes, Berseem works well for small growers because it is controlled by mowing. No heavy tillage is needed.
General Comments:	Berseem's growth characteristics make it the best choice of the one season soil builders for small growers, especially if used as part of an intercropped system.
Source/Cost:	Berseem clover is now much more available than it was several years ago. Feed dealers can order it from their wholesale suppliers. The price is less than red clover, usually \$1.25 to \$1.35 per pound.

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### Lespedeza

Variety:	Usually not stated. Most common are Korean annual lespedeza and Striate Annual Lespedeza. Marion is a new striate lespedeza developed for intensive grazing—it is too expensive to use solely as a cover crop.
Characteristics:	The annual lespedezas are cold sensitive, slow growing and drought tolerant legumes. Lespedezas grow slowly from an early spring seeding, starting rapid growth in mid-summer. The Korean lespedezas reach 1 foot in height by late August. This slow spring growth means that lespedezas benefit from a companion crop such as small grains or annual ryegrass. If allowed to reach full bloom, lespedezas are moderate nitrogen fixers (40 to 60 pounds/acre) but tolerate more infertile and acid soils than clovers or alfalfa. Lespedeza often volunteers itself in fields when chemical weed control is stopped or growers control broadleaf weeds by mowing. Lespedezas are good forage and hay crops but biomass production is light.
Adapted to:	Lespedezas thrive throughout eastern Kansas. The Korean strain is more common in the north. The striates do better in the southern part of the state. If seeding Lespedeza for the first time, use Korean as it grows well throughout.
Sowing Dates:	Late February (frost seeded) through late April.
Seeding Rates and Methods:	Seed at 15 to 25 pounds per acre (1 to 2 pounds per 1000 square feet). Use higher rates if seeding alone. Lespedezas can be frost seeded, drilled or broadcast and harrowed in. Use lespedeza/cowpea/peanut inoculant.
Management:	Lespedezas do better if sown with a nurse crop, unless the field is clean. Mow high initially to control weeds. If no reseeding is desired, mow in late August. Lespedeza does not need to be fall tilled to kill it unless a grower wants to establish a winter annual cover crop. Lespedezas do respond to P and manure applications if the field is very low in P.

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### Summer Annuals con't.

#### Lespedeza con't.

Suitable for Intercropping:	Lespedezas are a good choice for an intercropping system since their slow spring growth causes little competition with the tilled in vegetable crop. Rapid summer growth covers the soil and suppresses weeds. Lespedeza leaves a friable seedbed for the next crop. Lespedeza sod seems to hold moisture so it is a good cover crop for droughty soils.
Suitable for Mixes:	Oats and annual ryegrass are good companion crops.
Suitable for Small Growers:	No heavy equipment is needed to kill it. Its slow early growth allow the grower to harvest early vegetables. The lespedeza's rapid summer growth effectively protects soil and fixes enough N for following crops needing low amounts of N. Lespedeza is an excellent choice if the grower wants to prepare marginal land for vegetable production. Seed is cheaper than clover.
General Comments:	Other legumes are better N fixers than the lespedezas. Lespedeza, however, is an almost no-fail cover crop. If frost seeded with clover, it acts as a safety net if the clovers fail. An oat-Korean lespedeza mix is the best choice for a one year cover if converting marginal land to vegetable production or for improving soil that a grower eventually wants to cultivate. A lespedeza-grass mix is also ideal for covering corroded ditches and waterways after their repair. Lespedezas, once called the "Poor Man's Alfalfa," can also provide excellent forage for all classes of livestock.
Source/Cost:	Feed dealers can readily special order lespedezas from their wholesalers. Lespedeza seed is commonly sold as unhulled or hulled. The unhulled is cheaper and is quite suitable for early spring seeding. Prices vary from year to year but the average cost is \$0.80 per pound.

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#### Soybean

Variety:	Many available. Public varieties (developed by land-grant colleges) are cheaper than private varieties. Any locally adapted variety for grain harvest will be satisfactory as a cover crop.
Characteristics:	Soybeans are upright bushy legumes. They must be planted in warm soil. Strong N fixers, they will grow on most soils but prefer fertile deep loams. They are moderately drought tolerant. Inoculate with soybean inoculant. Soybeans are grouped by maturity. Later varieties generally are taller. Planting after late June usually results in shorter plants but still has acceptable growth. Soybeans prefer a neutral pH but tolerate acid soil.
Adapted to:	Soybeans do well throughout eastern and central Kansas.
Sowing Dates:	From mid-May through late July. Sowings in early August can make acceptable growth with moisture if September stays warm.
Seeding Rates and Methods:	For green manure, sow soybeans at 50 to 100 pounds per acre (2 to 3 pounds per 1000 square feet). Soybeans can be planted thicker but no more than 200 pounds per acre. Drill soybeans or broadcast and disk/harrow in. Planting in rows defeats the purpose of growing soybeans as a cover crop.
Management:	The keys to getting the best out of soybeans are timing of planting and weed control. While soybeans can be planted in May, they will have passed their prime value as a green manure by late September. This is fine if the grower intends to incorporate in late summer, otherwise plant from mid-June through late July. If the field is new or weedy, plant a fast growing smother crop like buckwheat first. Plant soybeans thick. Their fast growth will smother weeds if weeds were controlled before soybean planting. The longer soybeans are left alone before pod formation, the more biomass is produced. Let soybeans grow at least 80 to 100 days. Soybeans can be plowed or disked but can also be mowed, leave the residue on the surface.

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### **Summer Annuals con't.**

#### **Soybean con't.**

Suitable for Intercropping:	Yes, but must be planted after early crops are established; the clovers are better choices especially for vining crops. Soybeans, however, are fairly shade tolerant and are one of a few cover crops that will grow under sweet corn if planted before corn is 2 feet tall.
Suitable for Mixes:	In general, no. It can be mixed with rape which has similar growth habits. If mixed with buckwheat, the buckwheat will mature and set seed before soybeans are ready for plowing.
Suitable for Small Growers:	Soybeans are an excellent cover crop for small growers especially if planted after harvest of early vegetables. Mowed soybean residue leaves a very friable seedbed for the next spring.
General Comments:	The soybean nitrogen fixing ability, rapid growth, cheap seed cost and widespread availability make it an excellent cover crop choice for following early vegetables.
Source/Cost:	Widely available. Public varieties usually cost \$11 to \$13 per 50-pound bag.

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#### **Cowpea**

Variety:	Many varieties are available. Red Ripper grows fast and is fairly slow to vine.
Characteristics:	Cowpeas must be planted in warm soil. They are drought tolerant and do better in poor and acid soil than soybeans. They fix high amounts of nitrogen (130 pounds per acre) and produce large amounts of biomass. Inoculate with cowpea/lespedeza/peanut inoculant. All cowpea varieties tend to vine as they mature. Viney cowpeas are very difficult to mow or incorporate. Cowpeas do not tolerate frost.
Adapted to:	Cowpeas thrive throughout eastern and central Kansas. In general, they outgrow soybeans in southern and south-central Kansas especially in droughty, poor soils.
Sowing Dates:	Anytime between mid-May and late August. Cowpeas are not daylight sensitive. Late plantings grow just as tall as early plantings. Cooler days after late September slow growth considerably.
Seeding Rates and Methods:	Seed at 50 to 100 pounds per acre( 2 to 3 pounds per square feet). Drill, plant in narrow rows or broadcast and disk in.
Management:	Sow cowpeas thick to get maximum ground cover quickly. If the field is very weedy, plant a quick smother crop such as buckwheat. Cowpeas are well adapted to sowing after harvest of early vegetables. As a rule of thumb, allow 60 days of growth before mowing or turning under. Although Red Ripper is relatively slow to vine, all cowpeas will vine eventually. Vined cowpeas clog mowers and all tillage implements. If planted late enough, mow cowpeas and leave the residue of the surface for a friable seedbed next spring.
Suitable for Intercropping:	Marginal at best since it needs warm soil. It is one of the few cover crops that can be planted between sweet corn rows. Plant before corn is 2 feet tall and if the field is at least fairly free of weeds.
Suitable for Mixes:	No. Unless planted with a crop such as rape, that has the same growth habits, cowpeas don't recover from early mowing.
Suitable for Small Growers:	Yes, especially for soil building on poor ground and after early or mid-summer harvested crops. Cowpeas lack of frost tolerance and fast growth make it a good choice where it can't be turned under.
General Comments:	Cowpea's adaptability helps it fill a niche in the summer annual cover crop family. Growers must balance its excellent performance with the difficulty of finding it in northeast Kansas.

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### ***Summer Annuals con't.***

#### **Cowpea con't.**

Source/Cost: Feed dealers can special order most cowpeas. Growers in northeast Kansas, however, must order Red Rippers from a wholesaler. Cowpeas are more available in southern and central Kansas. Commercially available seed costs between \$0.25 to \$0.50 per pound depending on the year.

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#### **Canadian Field Pea**

Variety: Many varieties are available, the most common is Trapper. This variety is so common that field peas are sometimes called Trapper peas.

Characteristics: Field peas are primarily used in Canada, Great Lakes states and the Northeast as a high protein, silage forage. They grow like garden peas only taller. Field peas are very cold tolerant and grow quickly in May. Field peas are good nitrogen fixers with most N fixed by the time they bloom, usually late May. Inoculate with pea/vetch inoculant. Peas do well in most soils except heavy clays. Peas can also be planted from mid-August to early September, but don't germinate well in hot dry soil. If they come up they can grow into December—only the blooms are particularly frost sensitive.

Adapted to: All of eastern Kansas.

Sowing Dates: Late February (if the ground is dry enough to work) through mid-April. March is the ideal time.

Sowing Rates and Methods: Minimum 50 pounds per acre (2 pounds/1000 square feet). Can seed up to 200 pounds per acre for increased weed suppression. Drill or broadcast and till in.

Management: For maximum biomass, N fixation and weed control, a thick stand is important. Peas are succulent enough to be incorporated by disking; in most cases the stand will need to be mowed. Mow after blooming but before pods are set. A thick stand of mature peas and headed out oats will clog a sickle bar mower. Peas produce so much biomass that small seeded crops cannot be sown into the incorporated residue. Stick to transplants or large seeded vegetables.

Suitable for Intercropping: Yes, especially for small plots and if the grower wants plenty of mulch. Mowing at the bloom stage usually kills the peas so late season coverage could be a problem.

Suitable for Mixes: Peas mix well with oats. Seeding rates can be adjusted to favor the cheaper oats but still produce good biomass and nitrogen fixation. In the northeast, a field pea/oats/hairy vetch mix (60 percent pea, 25 percent oats, 15 percent vetch by weight) is an excellent full season soil builder. Under Kansas conditions (hotter and drier), decrease the amount of peas and increase the amount of vetch, and be prepared to mow the mix several times. A heavy fall disking will probably result in vetch winterkill.

Suitable for Small Growers: Yes. As the peas are killed by mowing. Future tilling is easier if the peas rot for 1 to 2 weeks or are used as mulch.

General Comments: The best use of field peas is as a spring cover crop on ground planned for June crops or July planted vegetables for fall harvest. The pea/oat/vetch mix will work if biomass production is the overwhelming consideration. Cheaper alternatives exist.

Source/Cost: Feed dealers can special order field peas from their suppliers. Sometimes wholesales list field peas under game or wildlife plot mixes. Make sure the dealer doesn't order Austrian Winter Peas instead of field peas. Prices vary year by year. Normally a 50-pound bag costs around \$17.

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**Summer Annuals con't.**

**Annual White Sweetclover**

Variety:	Most common variety is Hubam—a variety developed by Iowa State University in the 1940s. Annual white clover is hard to find. Most sweetclovers are biennial so make sure you are getting annual sweetclover.
Characteristics:	Annual white has the same soil requirements as yellow blossom sweetclover, a pH of 6 and medium levels of P and K. It also requires alfalfa/clover inoculant. It tolerates wetter soil and is reputed to grow more rapidly in the seeding year. It winterkills at 18 to 20°F. It is deep taprooted and a strong N fixer.
Adapted to:	Eastern Kansas, particularly east of Manhattan.
Sowing Rates and Methods:	Seed 15 to 30 pounds per acre (1 to 2) pounds per square foot. Drill or broadcast and harrow in.
Sowing Dates:	Seed March through mid- to late April. Annual Sweetclover can also be planted mid-August to early September.
Management:	Annual Sweetclover generally grows rapidly. If allowed to grow to full maturity it will become woody, coarse and difficult to incorporate. Mow as needed to control growth. Under Kansas conditions, annual white appears to have only fair drought tolerance, but experience in Kansas is limited.
Suitable for Intercropping:	Probably, if planted so that early vegetables are harvested before it starts rapid growth. Presently the expense of the seed limits its usefulness.
Suitable for Mixes:	Oats are recommended as a nurse crop; mow to control oat growth.
Suitable for Small Growers:	Annual sweetclover should work for small growers due to its rapid warm season growth, propensity to winterkill and its ability to make good growth from a late summer seeding.
General Comments:	There is little grower experience with this cover crop in Kansas. Reports from Pennsylvania indicate that Hubam Sweetclover planted in May, grew to 6 feet in July. Whether this is likely or even possible in Kansas is unknown. One year's experience suggests that annual sweetclover grows about the same as yellow blossom sweetclover. Considering the cost and difficulty finding seed, small scale experimentation is advised.
Source/Cost:	Annual sweetclover must be mail ordered. Seed is expensive, averaging \$2.20 to \$2.50 per pound.

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**Oats**

Variety:	Many different varieties are available. "Feed" oats are the most available oats year round but are not sold by variety. "Seed" oats are sold by feed dealers in the spring for grain harvest and are sold by variety such as Don. Feed oats are acceptable for cover crop use.
Characteristics:	Oats are a fast growing, frost tolerant, tall (up to 3 feet) small grain. Oats have a fibrous and extensive root system that holds soil. Oats produce good biomass. They tolerate low pH and wet soils and will grow adequately on most Kansas soils. If allowed to mature, oats will reseed themselves; the new oat seedings will winterkill. Oats respond to manure applications and will suppress early weed growth.
Adapted to:	All of eastern Kansas.
Sowing Dates:	Late February through mid-April with March being the ideal planting month. Oats can also be seeded from early August through mid-September. The earlier summer seedings generally make the best fall growth.

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### **Summer Annuals con't.**

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#### **Oats, con't.**

Seedings Rates and Methods:	If used as a nurse crop for clovers and other legumes, seed oats at 1 to 2 bushels (bags) per acre. If seeding alone, use up to 4 bushels/acre. Fall seedings should be at least 2 bushels per acre, more is better. Drill or broadcast and disk or harrow in. For small plots, seed at 2 to 4 pounds per 1000 square feet.
Management:	Oats need little care. Management depends on crop intent. For a mulch, oats should be mowed when mulch is needed. In crop mixes, don't seed the oats too thick. If there is any doubt, mow the oats. Oat straw, especially when a legume is grown with it, is a soil builder in its own right. The straw decomposes rapidly, the effect is much like leaf mulch in a forest. Oats are an efficient trap crop. A late summer oat seeding will trap nutrients from manure applications. Summer oat plantings can also provide good grazing and erosion control in winter. Finally, oats are a good nurse crop for winter annual legumes. The winterkilled oats protect the legume from frost heaving and don't interfere with spring incorporation.
Suitable for Intercropping:	Yes, if sown with clovers, lespedeza or field peas.
Suitable for Mixes:	Probably the best nurse crop for legumes. It can also be mixed with brassicas for fall grazing or ground cover and for trapping manure nutrients.
Suitable for Small Growers:	Yes, as a mulch source for summer crops and a fall trap crop.
General Comments:	Oats are very versatile, readily available and cheap. Their greatest value to vegetable growers is biomass production, weed suppression and erosion control. An oat/clover combination is hard to beat as a full season soil builder either strip planted or intercropped.
Source/Cost:	Oats, especially feed oats, are available year round from feed dealers or farmers. Commercial cost will vary but will average \$5 to \$6 a bag.

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#### **Buckwheat**

Variety:	Many available. Most buckwheat sold is labeled as variety not stated.
Characteristics:	Buckwheat grows rapidly in warm conditions. It matures in about 40 to 50 days. It does not fix nitrogen. It grows on most soils but does best on fertile, light soils. It is not drought tolerant and, thus, can limit its use in Kansas. Normally, its fast growth enables it to smother weeds. Fast growth means that several plantings can be made in sequence. Once mowed, buckwheat decomposes rapidly due to its hollow stem. Buckwheat creates a very friable soil. It has poor frost tolerance but reseeds itself readily if the flowers mature to seed.
Adapted to:	All of eastern Kansas. Buckwheat may thrive in central Kansas if planted early.
Sowing Dates:	Late April to early September.
Sowing Rates and Methods:	Seed 30 to 60 pounds per acre (1 to 2 pounds per 1000 square feet). Use higher rates on poorer ground. Drill or broadcast and harrow or shallowly till in.
Management:	The key to using buckwheat is to mow before the flowers set seed if you intend to follow with another crop. This includes reseeding buckwheat. Conversely, buckwheat can be allowed to reseed itself all through the growing season. The last crop, however, must be killed before it sets seed since they will sprout next spring. Buckwheat can be disked under. If mowed and left on the surface, little tillage will be needed to plant the next crop. This will save soil moisture. Buckwheat residue is a good winter cover if planted thick enough and early fall growth is satisfactory.

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### **Summer Annuals con't.**

#### **Buckwheat, con't.**

Suitable for Intercropping:	Buckwheat is planted too late to use as an established cover crop for strip tilling in vegetables. It can be planted after vegetables are established but management will be difficult since it grows so fast.
Suitable for Mixes:	In general no. Since it must be mowed and most late-planted legumes, such as soybeans, don't tolerate mowing. It can be reseeded with soybeans and, even better, vetch, and allowed to reseed itself. When the legume is incorporated or mowed, the buckwheat will die out unless it sets seed just before incorporation. Spring-sprouted buckwheat is annoying but easily cultivated out.
Suitable for Small Growers:	Yes. Refer to comments above. Buckwheat is an excellent follow on cover crop after harvest of early vegetables, especially if the grower wants to clean up a weedy plot.
General Comments:	Buckwheat has two primary uses. Use it as a smother crop before sowing a summer-long season legume such as soybean. This is especially advisable when converting weedy pasture to vegetable production. The second use is as a smother crop before planting small-seeded vegetables or transplants for fall harvest. This is especially true of vegetables that are not heavy N feeders.
Source/Cost:	Buckwheat can be special ordered by feed dealers. Sometimes, farmers have buckwheat seed for sale. Prices vary year to year. The average is \$0.25 to 0.40 per pound. Buckwheat seed loses germination rapidly. Don't plant seed that is more than 2 years old.

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#### **Japanese Millet**

Variety:	No named varieties.
Characteristics:	Japanese millet is a fast growing summer annual grass. It must be planted in warm soil. It has limited frost tolerance and will winterkill. Its fast growth and fibrous root system make it an excellent smother crop, erosion protector and trap crop. It needs nitrogen for rapid growth so should be manured or fertilized heavily. It tolerates frequent cuttings and makes excellent forage or hay. Japanese millet is fairly drought tolerant once established and is very tolerant of wet soil.
Adapted to:	Eastern Kansas. It may do well in Central Kansas on moist areas.
Sowing Dates:	Late May through July. It can be planted in August to the first week of September. Under good conditions, it will grow 6 to 12 inches, if moisture is available.
Sowing Rates and Methods:	Seed 25 to 30 pounds per acre (1 to 1½ pounds per 1000 square feet). Drill or broadcast and till shallow.
Management:	When intended to use as a summer long trap crop, proper mowing is important. Mow before it heads with about 3 inches of stubble. Two to 4 feet of growth can be expected with 60 days to first cutting and 40 days to subsequent cuttings. Residue production is high if left uncut in September.
Suitable for Intercropping:	In general, no, because it doesn't mix well with summer legumes and may well smother clovers and vetch if seeded with them. Too fast growing to plant into vegetables.
Suitable for Mixes:	No; unless the grower is prepared to sacrifice a summer annual by mowing it with the millet. It can be mixed with rape for greater biomass production but there is little benefit from this if the millet grows well.
Suitable for Small Growers:	Yes. If the grower wants a full-season smother crop after harvest of early vegetables. The soil must be fertile enough to support multiple cuttings.



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**Summer Annuals con't.**

**Japanese Millet, con't.**

General Comments: Japanese millet is most useful as a long season cover and smother crop when the grower has access to plentiful manure and needs the forage for feed or mulch. It is a good choice for cleaning up weedy fields or converting cropland to vegetable production.

Source/Cost: Feed dealers can order Japanese millet from the wholesale suppliers. Costs vary year to year but will average \$0.40 per pound.

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**Sorghum–Sudangrass**

Variety: Many varieties available.

Characteristics: Sorghum–sudangrass is a fast growing, drought tolerant annual grass. Left uncut it can grow over 6 feet tall. It is a good N trap crop and a very good smother crop. It needs warm soil to germinate and adequate moisture to grow to its full potential. The plant will, however, survive drought well. It is not frost tolerant. It will grow on most soils but responds best to fertile soils.

Adapted to: Adapted to all of Kansas.

Sowing Dates: May through July.

Sowing Dates and Methods: Seed at 15 to 40 pounds per acre. Higher rates on better ground. Drill or broadcast and harrow in.

Management: Correct mowing is key to managing sorghum-sudan. It will produce tremendous amounts of biomass even if mowed. If left alone it will become unmanageable. It ties up considerable nitrogen and must be allowed to decompose a month or more before planting another crop.

Suitable for Intercropping: No. Due to its late planting date and rapid growth.

Suitable for Mixes: Livestock producers can mix it with soybeans for silage but it is not suited for mixes as a cover crop.

Suitable for Small Growers: While it will winterkill, it is too rank in growth habit for small growers. Even field crop farmers need heavy duty mowers to cut sorghum-sudan for hay or silage.

General Comments: There are better choices for a full season cover than sorghum-sudan. Growers with cattle, access to manure and who plant it for forage can use it as a cover crop. It needs plentiful manure to reach its full potential as a cover crop.

Source/Cost: Readily available. Should cost between \$0.30 to \$0.40 per pound.

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**Forage Brassicas (Cabbage family crops)**

Variety: The most common varieties are turnip, rape (Dwarf Essex Rape, in particular) and kale. Both hybrid and open pollinated turnips are available. Use a readily available cheap variety such as Purple Top if the sole purpose is green manure. Hybrid rapes and kales are available but their high price makes them uneconomical for green manure. A mustard/Chinese cabbage cross—Tyfon—is usually grown for fresh greens or forage but has some value as a cover crop.

Characteristics: Forage brassicas are fast growing, drought tolerant, once established, and efficient producers of biomass. They do not fix nitrogen but will trap it and other soil nutrients. They persist into early winter with kale being the most hardy. They eventually winterkill. Rape has a long taproot so it can loosen heavy soils. They grow best in fertile soils or when manured. They are tolerant of fairly acid soils.

Adapted to: All of eastern Kansas.

Sowing Dates: Plant after late March or early April. They can be sown throughout the summer but are usually seeded in August through early September for late fall grazing. They grow fine in cool weather.

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### **Summer Annuals con't.**

#### **Forage Brassicas (*Cabbage family crops*), con't.**

Seeding Rates and Methods:	Sow turnips thinly, 5 to 7 pounds per acre or ¼ pound per 1000 square feet. Sow rape or kale at 8 to 15 pounds per acre (⅓ pound/1000 square feet). They can be drilled or broadcast with light incorporation. In some situations, incorporation may not be necessary.
Management:	Don't plant forage brassicas when vegetable brassicas will be grown the same season. Forage brassicas tolerate mowing and grazing. While the brassicas will grow on low fertility soil, they do best under fertile conditions. They can provide significant ground cover after winter killing.
Suitable for Intercropping:	Best suited for planting after an early vegetable. They can, however, be drilled into sweet corn or spread after the last cultivation.
Suitable for Mixes:	Best suited for mixes with summer legumes, such as soybeans, sown as part of a season long cover crop (pea, oat, vetch or vetch/buckwheat) or with oats for fall pasture.
Suitable for Small Growers:	While their growth habits don't require heavy equipment to manage, their value to small growers is limited unless livestock forage is needed.
General Comments:	Forage brassicas were developed for intensive grazing. Only Dwarf Essex rape and turnips are easily available and cheap. Use forage brassicas if late pasture is a primary requirement.
Source/Cost:	Feed dealers can order Dwarf Essex rape. Occasionally it is sold as birdfeed. Purple top turnips are available anywhere. Rape costs about \$0.50 to \$0.60 per pound, turnips between \$1.00 to \$1.50 per pound.

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#### **Oilseed Radish and Agricultural Mustard**

Variety:	No separate varieties of these two crops are available yet.
Characteristics:	Both these plants are fast growing trap crops. Oilseed radish grows rapidly. It can reach 3 feet after 6 weeks. It has a deep taproot, breaks up heavy soils and is reported to have some nematocidal effect. It winterkills at 20°F. Agricultural mustard tolerates low fertility soils but oilseed radish does not. Both are excellent trap crops, preventing nutrient leaching and providing cover over winter. Neither fix nitrogen.
Adapted to:	These are new crops for Kansas but they have been grown successfully in eastern Kansas.
Sowing Dates:	Agricultural mustard can be seeded in early spring (up to mid-April) and in August through early October. While oilseed radish can be sown in April or May, it is normally seeded in late August through late September (refer to comments section).
Seeding Dates and Methods:	Seed Oilseed radish at 15 to 25 pounds per acre (2 pounds per 1000 square feet). Seed mustard at 15 to 20 pounds per acre (1 pound per 1000 square feet). Both can be drilled or broadcast and harrowed in. Mustard can be broadcast without incorporation. Oilseed radish seed is larger and must be covered.

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### **Summer Annuals con't.**

#### **Oilseed Radish and Agricultural Mustard, con't.**

Management:	Oilseed Radish needs special attention. It grows best on ground that has been heavily manured in mid-summer or after a legume crop (such as Berseem Clover) has been killed. Plant between late August (after August 20) through mid-September. Under good fertility and moisture conditions, the radish will grow to 3 feet and flower. The resulting winterkilled residue may be heavy enough to interfere with small seed vegetable planting in the spring. The roots can be quite large. Later plantings, to early October, will produce 6 to 8 inches of top growth. Spring plantings can also grow rapidly. On poor soils, oilseed radish will make limited growth. Mow as needed to control growth. Mustard is much easier to manage. Spring growth will be rapid. Expect 2 to 3 feet of growth and flowering in 6 weeks. There is little growth after mowing flowering plants. In the fall, growth depends on the weather. Several inches of growth can be expected, most of it early. Mustard should winterkill with below 10°F temperatures.
Suitable for Intercropping:	No, unless sown just before early vegetables reach maturity.
Suitable for Mixes:	Oilseed radish is probably not suited to mixing with grasses. Mustard mixes with legumes and grasses, especially when fall sown.
Suitable for Small Growers:	Both could be of use to small growers. The mustard seems to have the most promise as a soil builder on heavy soils. Cheaper, more available cover crops make oilseed radish less useful as a trap crop.
General Comments:	Very little work with these crops has been done in Kansas. Oilseed radish needs special conditions for maximum performance. Mustard seems more useful for more situations. Experiment with small trial plots before planting on a larger scale.
Source/Cost:	Mail order sources are usually required. Check with local dealers first.

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### **Winter Annuals**

#### **Hairy Vetch**

Varieties:	Many are available. Usually sold as variety not stated.
Characteristics:	Hairy vetch is a versatile, strong nitrogen fixing (100 pounds per acre), cold tolerant legume. It will survive Kansas winters. Growth is affected by time of planting and subsequent weather. If sown in late summer or early fall, vetch will grow several inches before going dormant. Up to 8- to 10-inch growth is possible if the fall is mild and vetch is planted in August. Vetch is susceptible to damage from frost heaving unless planted with a small grain nurse crop. Once the weather warms up in the spring, hairy vetch makes rapid, almost explosive growth. Cool weather in March will delay rapid growth until April. Dense, viney growth will easily form a surface mat. Growth can reach 5 to 6 feet if stretched out. After flowering, vetch growth slows and the plant dies. If spring sown, vetch grows slower but steady. Growth is also viney and it wilts in midsummer. Mowing retards flowering. Vetch can also be planted in June; growth is slow in the summer heat but rapid growth resumes when the weather cools in September. Hairy vetch needs a pH of 6 to 7 for best growth and responds to phosphorus if the soil is low in P. It tolerates most soils but prefers good drainage. It won't survive flooding. It is fairly drought tolerant once established. It is intolerant of shade especially if the shading crop is tall and fast growing. Use pea/vetch inoculant.
Adapted to:	All of eastern Kansas and most of central and southern Kansas. West of Salina vetch planting should be on moist areas only. If winter wheat will grow, fall-sown vetch will, too, but earlier spring incorporation is necessary to reduce moisture depletion in drier regions.

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## **Winter Annuals con't.**

### **Hairy Vetch, con't.**

Sowing Dates:	For overwintering, plant between mid-August to late September in north-east Kansas. Farther south, mid-October plantings will likely survive winter cold. As a rule of thumb, vetch should be planted 3 to 4 weeks before a killing or hard freeze. In the spring, plant vetch from March through mid-April and again in June (June plantings are susceptible to drought). Fall and spring plantings should include a small grain as a nurse crop.
Sowing Rates and Methods:	Seed hairy vetch at 25 to 50 pounds per acre (1 to 2 pounds per 1000 square feet). Sow with a nurse crop of small grains. Seeding rates can be adjusted to meet specific grower requirements (more N fixing, etc). A rule of thumb is a 1:1 or 1:2 ratio of vetch to small grain (by volume). Vetch is best drilled but it can be broadcast and drilled or harrowed in. The seed is large so light disking could work.
Management:	<p>A grower must decide which small grain to use in fall seedings. Oats will winterkill but will provide enough residue to protect the vetch from frost heaving. Winter wheat, fall barley (where adapted) and rye will survive the winter and provide a scaffold to support vetch's viney growth. On the other hand, a wet spring can result in delayed incorporation. Small grains may have matured enough to hinder breakdown of the cover crop when it is finally turned under. If possible, mow the small grain/vetch mix if it can't be incorporated due to wet conditions. When to turn under is a second critical decision. A general rule is to incorporate vetch any time after April 15 if it is to be followed by a May-planted cash crop. Maximum N fixation will not have occurred but May windows for tillage may be few. Also, in a dry spring, rapidly growing vetch may use too much soil moisture and, thus, hinder germination of the following cash crop. Maximum N production is good but not critical if the grower has a systematic soil building and fertility program in place.</p> <p>Vetch is probably best plowed unless the grower has heavy or hydraulic tandem disks and chisel plows. Multiple passes are required if using a standard light disk. Unmown vetch will clog rototillers. Spring-sown vetch mixes are easier to manage; mow as needed to control growth and incorporate in late summer or fall. The dead vetch can be left alone until the next spring. June-seeded vetch can be disked in the fall. This will weaken the stand enough to allow easy incorporation the next spring.</p>
Suitable for Intercropping:	Yes, but again difficult to manage. If seeded before vegetables, the tilled out strip must be thoroughly worked to ensure vetch kill. Frequent mowings may be needed to keep vetch from overwhelming the cash crop. Interseeding into established vegetables can work if done at the right time, here the problem is keeping the vetch alive. Use wide rows especially if interseeding in a vine crop. Vetch tolerates some shading from low growing crops but won't survive under growing sweet corn. Wait until the corn stalks are drying. The corn provides enough shade to keep the rows moist and cool but not enough to block out too much light.
Suitable for Mixes:	Yes, due to its tolerance to mowing. Other than small grains, use buckwheat, field peas or rape. It can also be mixed with Austrian Winter Peas where adapted.

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**Winter Annuals con't.**

**Hairy Vetch, con't.**

Suitable for Small Growers:	In general, no. While it can be mowed until it eventually dies, other cover crops are easier to manage. There has been interest in using hairy vetch as a living mulch due to trials in the USDA farm in Beltsville, MD. Hairy vetch was planted in the fall and flail mowed in the spring. The mowed residue was piled into rows and tomatoes were transplanted into these piles. Reported results were excellent. This has been tried in Kansas in 1995. Unfortunately, this was a wet spring. The mulch held in moisture which delayed plant growth and fruit maturity. Foxtail overwhelmed the trial plot in late summer. The main difficulty, however, was the extreme difficulty in cutting the vetch low enough to ensure it would die. Some vetch regrew in the rows although this did not really affect tomato growth. This method has not been proven to work in Kansas. Growers should try a trial small plot only before converting to this system.
General Comments:	Hairy vetch is a versatile cover crop with year round usefulness. Growers must deal with its rather exacting management requirements for best results.
Sources/Costs:	Hairy vetch is readily available from feed dealers if special ordered. Occasionally, farmers have vetch seed for sale. Commercial prices can vary year to year but average \$0.85 per pound.

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**Other Vetches**

Varieties:	Lana Woolypod, Purple and Common.
Characteristics:	Other vetches are less winter hardy than hairy. Lana woolypod winterkills at 10°F as does purple vetch. Common vetch will survive down to 15°F. Lana and purple vetches tend to grow more vigorously than hairy vetch, common vetch is about the same. All require pea/vetch inoculant. Nurse crops not needed for fall plantings.
Adapted to:	Same as hairy vetch.
Sowing Dates:	Same as hairy vetch.
Sowing Rates and Methods:	Same as hairy vetch
Management:	Similar to hairy vetch but not as exacting. Lana will grow vigorously into the winter before winter killing in January. It acts like a very cold tolerant summer annual leaving a dead mulch for spring crops, especially early transplants. If spring planted, treat like hairy vetch.
Suitable for Intercropping:	Yes, if the grower can control fast growth. Currently, the seed is expensive so other cover crops may be more suitable for the present.
Suitable for Mixes:	Same as Hairy Vetch but pick cold intolerant small grains if fall seeded.
Suitable for Small Growers:	Lana woolypod has been grown in Kansas as a winter killed cover crop before spring cabbage. Its rapid fall growth and good N fixation make it a good substitute for hairy vetch doing the same job for growers without heavy equipment.
General Comments:	These vetches have seen little use in Kansas because of their cost and lack of local sources. They are potentially useful especially for small growers.
Source/Cost:	These vetches must be mail ordered. Cost varies year to year but averages \$1.10 per pound.

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## **Winter Annuals con't.**

### **Austrian Winter Pea**

Varieties:	Separate varieties exist but mostly sold as variety not stated. When purchasing winter peas commercially make sure that you are not buying Canadian field peas ( Trapper Peas) which have a different growth habit.
Characteristics:	Austrian field peas are good nitrogen fixers (70 to 100 pounds per acre) with good cold tolerance (see below). They do well in heavier soil but grow in most soils. They tolerate somewhat acid soil. Use pea/vetch inoculant. Once the weather warms up in early spring, pea growth is rapid. Winter peas will mature before hairy vetch. Maximum N fixation occurs when flowering. Austrian winter peas are not tolerant of spring cold periods. Do not plant these in the spring as they need a dormant period for full growth. Spring-planted peas will only grow a few inches before flowering.
Adapted to:	Kansas is the northern part of the winter pea's range. A week of 18°F or less with no snow cover will degrade or kill the stand outright (based on research in Pennsylvania). Winter peas always do better with a nurse crop to provide some frost protection. In general, winter peas have a 50/50 chance of surviving north of I-70. Odds are better south of I-70. Winter peas are well adapted in southeast and south central Kansas where they are a common cover crop for row crop farmers. Winter peas do well along the Kansas/Oklahoma border as far west as Wichita.
Sowing Dates:	Late August through late September. In extreme southern Kansas, October seedings are possible. As a rule of thumb, allow 30 to 40 days between planting and the average first hard freeze.
Sowing Rates and Methods:	Austrian winter peas are large seeded so seeding rates are high—70 to 120 pounds per acre. When seeding with a small grain, rates can be adjusted to favor the peas or the small grains based on the growers needs or local conditions. Winter peas are best drilled but can be broadcast and disked in. For small growers, sow at 2 to 4 pounds per 1000 square feet.
Management:	Seeding during the optimum window is important. Seed with a small grain, either oats (which will winterkill but still protect the peas) or a winter hardy grain. As extra insurance against winterkill, vetch can be added to the mix. In the spring, winter peas can be killed by disking, as they are succulent. Mow first if the stand is rank. Mowing will kill the stand if done at bloom stage.
Suitable for Intercropping:	No, unless sown between rows of vegetables during the optimum planting window.
Suitable for Mixes:	Yes, mix with small grains.
Suitable for Small Growers:	Yes. Any seeder that can plant garden peas can plant winter peas. Small growers should investigate using Austrian winter peas instead of hairy vetch, if they live in an area adapted to the winter pea. Use oats as a nurse crop to avoid the problems of incorporating a winter hardy small grain the following spring. Austrian winter peas are especially suited as green manure before transplanted warm season vegetables.
General Comments:	The winter pea is probably the best over wintering legume for vegetable production in those regions of Kansas where it consistently overwinters.
Source/Cost:	Austrian winter peas are readily available in southern and central Kansas. Some farm-raised seed may be available. Prices should range from \$0.45 to \$0.60 per pound.

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## Winter Annuals con't.

### Crimson Clover

Varieties:	Many varieties exist but crimson clover is generally sold as variety not stated.
Characteristics:	Crimson clover is a rapid growing, moderate N fixing (70 to 80 pounds per acre) legume. It grows rapidly in cool weather, faster than the red clover. It is fairly tolerant of a semi-acid soil and grows in low fertility soil although it responds to P. Inoculate with alfalfa/clover inoculant. It has fair cold tolerance. Spring growth is rapid, with flowering by mid-May in most years. Flowering completes its life cycle although it readily reseeds itself. If spring planted, crimson clover grows a few inches and then flowers.
Adapted to:	Winter survivability is enhanced by using a small grain nurse crop. Survival north of I-70 is doubtful. South of I-70, crimson clover does better but winterkill is still possible. Crimson clover is best adapted to southeast Kansas.
Sowing Dates:	Mid-August to mid/late September. Expect rapid fall growth if moisture is available.
Sowing Rates and Methods:	Seed at 20 to 40 pounds per acre (½ to 2 pounds per 1,000 square feet). Crimson clover is the largest seeded of the clovers. Drill or broadcast/shallow till.
Management:	Management is easy with the most critical decision being time to incorporate. Crimson clover is low growing (18 inches) so disking is possible but multiple diskings will probably be needed. It can be mowed before incorporation.
Suitable for Intercropping:	Generally no. It can be sown into existing vegetables in August through September for late fall cover and grazing.
Suitable for Mixes:	Small grains, if the grower intends for it to survive the winter and regrow in the spring.
Suitable for Small Growers:	Small scale growers could use crimson clover for its rapid fall growth, but better choices exist.
General Comments:	Crimson clover could be a good cover crop choice for southeastern Kansas, if the grower can find a source for economical seed.
Source/Cost:	Crimson clover is hard to find. Feed dealers may be able to special order. It is available from several mail order sources.

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### Grain Rye

Varieties:	Many varieties exist but rye is usually sown as variety not stated.
Characteristics:	Grain rye is a very hardy small grain. It grows longer into the fall than other small grains and resumes growth earlier in the spring. It is the tallest of the small grains. It will grow on most soils but does best in sandy soils. It is an extremely efficient nutrient scavenger, better than the other small grains. It is an excellent trap crop for nitrogen. Its dense and fibrous root system is a significant builder of organic matter and makes heavy soil more friable. If planted early enough in the fall it provides good grazing and it is often spring grazed as well. It has been shown to have weed suppressor (allelopathic) characteristics—better than other overwintering grains. Its rapid spring growth produces a lot of biomass. This biomass will be a significant problem if a wet spring delays incorporation. Even if turned under in time, the bulk will cause planting and germination problems for small seeded vegetables.
Adapted to:	All of Kansas. Growers planning to use rye should be aware that it is a serious weed in wheat fields. Growers in major wheat growing areas should be sure of their ability to manage rye before they plant it or avoid using rye in any area where wheat may be a rotated crop.

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**Winter Annuals con't.**

**Grain Rye, con't.**

Sowing Dates:	Seed from late August through late October. November plantings are feasible in southern Kansas. Grain rye can be spring seeded and grow well but it will die before flowering.
Sowing Rates and Methods:	If rye is seeded with a legume such as vetch, use 50 pounds per acre or less depending on the vetch rate. For straight seeding, use 60 to 200 pounds per acre. The higher rates are recommended for late plantings. Rye can be broadcast and disked or tilled in but is best drilled. Rye can germinate on the soil surface if moisture is available.
Management:	Rye takes attention to detail to manage properly. In the spring, till in when the rye is 8 to 16 inches tall or wait until it flowers to kill it by mowing. Rye is a very effective windbreak; till out strips early then let the remaining rye grow until the vegetables are well established. Rye straw itself may be allelopathic and mown straw has been shown to suppress weeds for some time. Incorporation of the straw induces its weed suppressing effect. If planting into turned under rye, wait several weeks to allow the roots and other residue time to rot. Two diskings may be needed before planting.
Suitable for Intercropping:	If fall sown, strips can be tilled out as mentioned above. Spring sown rye can provide cover but cheaper options are available.
Suitable for Mixes:	Rye is usually sown with a hardy legume such as hairy vetch. The rye acts as a scaffold for the vetch, preventing some vetch matting. Clovers can be sown with the rye if sown before late September. Frost seeding clovers or lespedeza into rye in early spring is risky because of ryes allelopathic effect.
Suitable for Small Growers:	In some cases. If they can incorporate it early enough, rye can be managed without plows or heavy disks. Its best use for small scale growers is as a weed suppressor in weedy plots. Let it flower, mow it, wait several weeks to let it decompose and plant a summer legume or a large seeded vegetable or transplant for fall harvest.
General Comments:	Rye is very versatile and can be very useful if managed properly. Traditionally sown with hairy vetch, these combinations can get away from a grower if the weather does not cooperate. Growers with sandy land can probably get away with it. Avoid this mix for bottom ground or soils that dry slowly. Rye is especially useful if the grower has access to manure and needs to clean up a weedy field or improve soil structure in clay soils. It is an excellent choice for growers who want an occasional cover crop and those who rely on chemical fertilizers for nutrients as it is so efficient as a trap crop. There is some evidence that using rye to clean up a field one year prior to planting onions significantly reduces the cultivation needed to grow onions from seed or any other weed-sensitive vegetable.
Source/Cost:	Feed dealers can special order grain rye from their wholesalers. There is renewed interest among farmers in using rye for temporary grazing so it should be easier to buy seed. Prices will vary but will average \$9 per 50-pound bag.

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## Winter Annuals con't.

### Other Overwintering Small Grains—Winter Wheat and Barley

Varieties:	Many varieties are available, use what is available. Feed wheat is perfectly acceptable as a cover crop.
Characteristics:	Winter wheat grows much like grain rye but is less vigorous in the fall. Winter wheat overwinters well in Kansas and resumes growth in the spring. Growth is rapid after March with seed heads forming in late May. Winter wheat does not have as dense a root system as rye nor does it suppress weeds or trap nutrients as well as rye. It is as an effective nurse crop as rye. Modern wheats are nearly all short stalked—averaging 30 inches tall. Wheat is drought tolerant and does best in deep, well drained soil. Barley is grown in parts of Kansas and has the same characteristics as wheat.
Adapted to:	Wheat is grown throughout Kansas. Some barley is grown in Kansas.
Sowing Dates:	Generally seeded between mid-September to late October.
Sowing Rates and Methods:	Rates vary in different regions; 25 to 50 pounds per acre is a rule of thumb. When seeded with a legume, adjust rates to favor the legume. Wheat is best drilled but can be broadcast and disked or harrowed in.
Management:	Manage wheat like rye. Wheat grows slower in the spring than rye. Growers have much time to incorporate wheat. It can get too mature for rapid decomposition in a wet spring.
Suitable for Intercropping:	Generally no. Strips can be tilled into standing wheat in early spring for seeding vegetables. Wheat is an acceptable windbreak, but not as good as rye.
Suitable for Mixes:	Wheat is often planted with hairy vetch for which it is a good nurse crop. Unlike rye, wheat is good for frost seeding clovers and lespedeza. Sweetclover can be planted with wheat in the fall or frost seeded into it early spring. If fall seeded, the sweetclover/wheat mix can produce excellent biomass for spring incorporation. If sweetclover is frost seeded, the wheat must be killed by mowing (after flowering). The sweetclover will not grow enough to justify turning under until the late summer, fall, or best of all, the following spring.
Suitable for Small Growers:	Not really suited. A wheat/Austrian winter pea mix can be controlled by mowing. This mix is best suited for transplants. Wheat alone is a poor choice. Use rye alone for weed suppression or soil building or oats for cover and residue.
General Comments:	Wheat is a good choice as a nurse crop for winter legumes. The mix is easier to manage in the spring than a rye mix. There is generally no advantage to seeding wheat alone unless the grower plans to frost seed a clover in the spring.
Source/Cost:	Wheat is available and cheap everywhere in Kansas. These facts alone often are the major reason growers use wheat. Feed wheat usually costs between \$5 to \$6 per 50-pound bag. Farm raised wheat may be considerably cheaper.

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### Annual Ryegrass (not to be confused with Grain Rye and/or Perennial Ryegrass)

Varieties:	When buying annual ryegrass, be sure that you are not purchasing perennial ryegrass by mistake.
Characteristics:	Annual ryegrass is a fast growing, cool season grass. It is used for quick grazing and erosion control. It tolerates almost all soils but does best on deep fertile soils. It is very tolerant of wet ground and temporary flooding. It will grow on acid soil and has a dense root system, so it is excellent for nitrogen trapping and holds soil well. Its growth habit complements clovers and lespedeza so it is a good nurse crop. It is not drought tolerant. It forms seed in mid-June, after that, growth is minimal. If seedheads establish, it can self-seed and regrow. If fall planted, winter killing is not guaranteed in Kansas. Annual ryegrass will grow well if spring planted.
Adapted to:	Eastern Kansas.

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**Winter Annuals con't.**

**Annual Ryegrass (not to be confused with Grain Rye and/or Perennial Ryegrass), con't.**

Sowing Dates:	From mid-August to late-September. Fall growth is heavily influenced by fall weather. In spring, plant from late February to mid-April.
Sowing Rates and Methods:	Seed at 18 to 40 pounds per acre (1 to 2 pounds per 1000 square feet). Seeding rates can be adjusted to include legumes or for a thicker stand. Best drilled but can be tilled in. Shallow coverage is all that is needed. Annual ryegrass has been sown mixed with manure in a spreader and covered with a thin layer of mulch.
Management:	Annual ryegrass is easy to establish and quick growing. Mowing is not needed unless the grass has gone to seed. Unlike mature small grains, annual ryegrass stays green and is easier to incorporate when mature. Its dense root system takes time to decompose; avoid planting small seeded vegetables in old ryegrass sod. This doesn't apply if the sod has had several months to break down.
Suitable for Intercropping:	Annual ryegrass is an excellent choice as a nurse crop for legumes when establishing legume strips in a vegetable/legume stripcrop rotation. Annual ryegrass can be established in late August for vegetables.
Suitable for Mixes:	Well suited to plant with clovers, lespedeza and even nondormant alfalfa (use light rate). This mix will not provide the same amount of biomass as a clover/oat mix. Ryegrass can be mixed with vetch.
Suitable for Small Growers:	Annual ryegrass can be easily incorporated if tilled early enough in the spring. It is an excellent choice for pathways. If the grower has access to manure, use ryegrass as a fall seeded trap crop.
General Comments:	Annual Ryegrass has several unique characteristics that give it a niche. As a trap crop it is equal to grain rye but not as strong a weed suppressor. It is an ideal companion crop for establishing perennial legumes. It is also good in mixes for either early or fall grazing. Finally, it is an excellent grass for halting erosion and loosening up heavy soils.
Source/Cost:	Annual Ryegrass is usually carried by feed dealers. Seed costs vary year by year but it is usually the cheapest grass seed available. Costs average \$0.40 to \$0.60 per pound.

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**Some Mail Order Sources of Cover Crops**

Albert Lea Seedhouse, P.O. Box 127, Albert Lea, MN 56007.

Peaceful Valley Farm Supply, P.O. Box 2209, Grass Valley, CA 95945.

Kaufman Seeds, P.O. Box 398, Ashdown, AR 71822.

Snow Pone Farm Supply, RR2, Box 1009, Belgrade, ME 04917.



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Brand names appearing in this publication are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned.

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