NRCS	**Michigan Technical Note** **USDA-Natural Resources Conservation Service**

AGRONOMY #45
Subject: Cover Crops for Orchards
Date: June 2010

General Information

Planting cover crops between rows of trees is recommended when the soil is sandy and low in organic matter *and where the tree spacing allows access for tillage and planting*. *In high density plantings, however*, cover crops are often replaced by permanent sod strips, such as tall fescue, between rows and chemical weed control within the rows.

Cover crops have these advantages in orchards:

- **Add organic material and help maintain soil humus content.**
- Improve structure, *which can improve drainage* of clay soils and retain more moisture in sandy soils
- Capture leachable nutrients like nitrogen and potassium in sandy soils
- Absorb water and nutrients in late summer, helping tree wood mature for less winter injury
- Protect the soil from wind and water erosion
- Moderate soil temperature, retain snow, and reduce winter injury to tree roots
- Decomposition of cover crops in the spring *releases* the nutrients tied up in the *plants*.
- Small grain cover can improve drainage on wet soils
- Encourage pollinators
- Provide weed suppression
- Control dust on fruit and in the air

Cover crops for orchards can be either legumes, forbs, grasses or brassicas. Legumes decompose rapidly and release nitrogen and other nutrients in the soil for the trees. Grass cover crops, however, decompose more slowly, and tie up nitrogen in the residue. Nitrogen fertilizer or a readily available nitrogen source may be needed to speed up residue decomposition and avoid a depressing effect on tree growth. Brassicas can provide suppression of nematodes.

SOIL SAMPLING

Pre Establishment soil sampling: According to Michigan State University Extension (MSUE) bulletin E-852, *Fertilizing Fruit Crops*, soil samples should be *taken* for all new orchards one year before planting. Two composite soil samples should be taken: 0-8 inch depth and 8-16 inches depth, to help identify acidic or high calcium subsoil horizons. If any land smoothing or leveling operation exposes *large areas of* subsoil, these should be identified with Global Positioning (GPS) mapping tool or on a hand-drawn map. These exposed subsoil areas often vary considerably in soil test levels and pH compared to the rest of the field.

Before planting trees *apply agricultural limestone* to *increase* the pH to 6.5-6.8. Incorporate the lime prior to planting trees or sowing cover crops. If the soil test phosphorus (P) exceeds 50 ppm or 100 lbs./ac or the soil test potassium (K) exceeds 125 ppm or 250 lbs/ac no additional P or K is needed for apples, pears, stone fruits,

grapes, strawberries and raspberries. Follow the fertilizer recommendations in tables 1 & 2 in E852 or per the MSUE soil test recommendations available from the MSU soil test lab or MSU Nutrient Management Fertilizer Program (MSUNM).

Established plantings soil sampling: In established orchards and vineyards, *soil tests are needed primarily for monitoring soil* pH. Soil pH should be maintained between 6.0 and 7.0 to prevent nutrient imbalances which are more likely when the soil pH is outside this range. However, soil tests alone are not a good indicator of nutrient needs because *established* trees are deep rooted and often obtain adequate nutrients even when soil tests may indicate that nutrient levels in the topsoil are low. Soils should be sampled every 3-5 years to monitor established plantings. Each sample should be at least 20 cores and be 10 acres or less for a composite sample For areas with different soil types, lime or fertilizer history takes separate soil samples. Cover crops can be selected to tolerate existing pH levels.

Summer Cover Crops

Tilled Orchards: In a clean tilled seedbed shortly after rainfall or if a recent soil test is not available:

- Sow cover crops 2-3 weeks after tree blooms.
- Use 250-300 lbs/ac of a low nitrogen blend fertilizer (maximum 30 lbs/ac N) or approved equivalent organic fertilizer prior to planting a cover crop.

Summer cover crops include: (See Table 1 for rate and timing)

- **Soybeans** *(Glycine max)* sow in orchards under 10 years old. Soybeans are tolerant of a soil pH range of 6-7.
- **Sudangrass** (*Sorghum vulgare* var. *sudanense*)–Where water is not limiting, this is a valuable cover crop which can improve soil organic matter and aeration. Grows rapidly in hot weather. Apply 300 lbs/ac 19-19-19 or equivalent to obtain 4-6 feet of growth on the Sudangrass.
- **Millet** *(Setaria italica)* A summer or winter cover crop for orchards where shading of young trees is not a factor. Millet is very competitive for water on drought soils. Sow millet a minimum of 5 feet from young trees. On wet soils, consider sowing Siberian millet. Where soils are dry, Crown, Hog and Red Turghai are better varieties because these varieties are shallow rooted and compete less for water. Pearl millet is a poor host for the root –lesion nematode.
- **Buckwheat** *(Fagopyrum esculentum)* Thrives on a wide range of soil types. Seed is inexpensive and the plant matures in about 60 days. After maturity a light disking can establish a second buckwheat crop that overwinters the following spring. This cycle can be repeated for about 3 years after the original seeding. Buckwheat *residue has a low C*: N *ratio and decomposes* easily. Because of this, it does not tie up soil nitrogen like Sudangrass residue. Buckwheat is a good Phosphorus foraging plant especially where soil test P is low.

Winter Cover Crops

Sown in late summer and tilled the following spring before they compete for water and nutrients.
Winter cover crops include:

- **Winter Rye** *(Secale cereale)* **–** widely used on *low fertility* or acid soils as it tolerates winter cold and is effective in preventing soil erosion during winter. In spring, rye should be disked down when about knee high to minimize competition for moisture and nitrogen with trees. It can also be controlled with a burn-down herbicide if it is too wet to till. In organic orchards it can be crimped and rolled at anthesis. Rye cover not controlled in young orchards *can stunt the growth of trees* 1-5 year old.
- **Wheat** *(Triticum vulgare)* **–** similar to rye but grows more slowly. Consider a mix of rye and wheat as a cover crop to reduce moisture loss but still increase soil organic matter. Seed mix rates, however, may depend on the price and availability of rye seed.

- **Annual ryegrass - (***Lolium florum***)** provides organic matter with its prolific roots. Can be sown in mid-August and makes enough growth to protect topsoil from water erosion over winter. Generally has less growth than cereal rye and doesn't require mowing ahead of apple harvest the year of seeding. Annual ryegrass can overwinter and require disking the following spring like cereal rye.
- **Hairy vetch *(Vicia villosa)* and cereal rye-** This is an excellent winter cover crop mixture, since a good stand of both produces heavy growth that is higher in nitrogen compared to rye alone. This combination does well where the soil is too acid or dry for clover or alfalfa.
- **Oats** (Avena sativa) **– Sow** by August 15 to attain good growth before the first fall freeze. Oats are generally killed by a heavy frost so the first frost in Michigan may not completely stop growth. Dead oat cover can furnish good protection over winter.
- **Crimson** *(Trifolium incarnate)* **and red clover** *(Trifolium pretense)* **–** Crimson clover tends to kill badly if winter freezing conditions are severe. The earlier it is seeded in mid summer the better it can survive a cold winter. Red and mammoth clovers are good cover crops in a high pH soil and good stands can be made with frost seeding or direct seeded.
- **Sweet clover (***Melilotus alba)* – The deep rooting characteristics of this clover make it a valuable cover crop in a young orchard, but it can compete for water during a dry spell. Sweet clover should be kept a good distance from trees (tree canopy drip line edge). It can be frost seeded in the spring and allowed to grow one season before it is controlled by tillage the following spring.
- **Alfalfa (**Medicago sativa) - The price of seed has discouraged widespread use of alfalfa as an annual cover crop. It is more valuable as a permanent cover with other grasses to form a sod. Alfalfa tolerates rough treatment with machinery. Because alfalfa is deep rooted, trickle irrigation for trees may be needed in dry periods to compete for water.

Cover Crops for Nematode Suppression Prior to Planting New Orchards:

Prior to sowing cover crops in orchards for nematode control see soil sampling procedures to determine the type of nematodes present. See MSUE Bulletin E-2419, Avoidance and Management in Tree Fruit Production in Michigan 1993. Develop a bio-fumigation cover crop plan to reduce numbers of harmful nematodes present before planting new trees. MSU research by Dr. Bird has shown varietal sensitivity to nematodes species controlled according to the crop being protected.

- **Pacific Gold Oriental Mustard (***Brassica junica)* *Pacific Gold Oriental Mustard has shown good suppression of the Herbivore (Root Lesion nematode)* prior to planting new orchards. This variety of mustard is commercially available as seed for cover crops. It produces high levels of glucosinolates, which are allelopathic chemicals that occur throughout the Brassica family. Glucosinolate degradation produces *isothiocyanates, which are* biologically active bio-fumigation compounds that have broad-spectrum activity on soil microorganisms. Some commercial soil fumigants use methyl isothiocyanate as the active ingredient produced from the degradation of other constituents for a nematicide.) Not all brassicas produce the same effect for other crops Best control has been observed when the mustard is disked in at the green pod stage prior to maturity. Sprinkler irrigation may be beneficial in a dry year to improve the stand and biomass produced hence impacting the amount of Glucosinolate available from residue decomposition.
- **NRCS MI 2005/2006 Field trial report recommends that:**
  "A mixture of brown, white and yellow mustard should be planted and allowed to reach green pod stage before incorporation to prevent the (mustards) form becoming a weed. The soil should be sealed after incorporation to increase the effectiveness of the glucosinolates. Sealing can be accomplished by rolling with a crow-foot cultipacker or by application of ¼ inch or more of irrigation water."
- **Dwarf Essex Rape (***Brassica Napus Hort. Var. Dwarf Essex*) *Dwarf Essex rape has shown good suppression of the Herbivore (Dagger Nematode)* prior to planting a new orchard. Dwarf Essex Rape produces a large stem like common mustard and can be used as a winter or spring annual. Rape plants prefer well drained soil with a pH of 5.5-8.3. Rape has high drought tolerance, can break up plow pans, and suppress weeds.

Prior to developing a cover crop plan for established orchards consider providing supplemental drip irrigation to reduce orchard tree water stress. Also, consider what fruit pest (insect or disease) that could be an alternate host and potentially cause crop production yield loss.

Table 1: Cover Crops for Soil Building and Bio-fumigation for orchard land[1/]

Purpose	Species	Planting Date	Seeding Rate (lb/ac)	Seed Depth (inches)
Root Lesion nematode control	Pacific Gold Oriental Mustard*	May	15	¼-1/2
Dagger nematode control	Dwarf Essex Rape	May	15	¼-1/2
Soil organic matter and soil erosion	Winter Cereal Rye	July 15-Sept 1	112	½-1
Nitrogen fixation	Field Pea &	May	40	1-2
Soil Quality	Oilseed Radish**	May	20	¼-1/2
Soil organic matter and soil erosion	Oats	Mid August	32	1-2
Herbivore nematode control	Pacific Gold Oriental Mustard**	Mid August	15	¼-1/2
Soil organic matter and soil erosion	Winter Rye	Mid October	112	½-1

Incorporate immediately after mowing at green pod stage with tillage to obtain bio-fumigation effect.

1/ Source: 2005/2006 NRCS MI Agronomy Field Trial cover crops used for bio-fumigation.

** Broadcast seed and cultipack after field peas or oats are sown with a drill

Table 2: Amount and time of seeding for Orchard Cover Crops/[1]

Cover Crop	Time of seeding	Nitrogen added before seeding	Seed Rate	Seed Rate Mix	Seed Depth inches
Legumes*			**Lbs/ac**		
Alfalfa	Early Spring August 1	no	20	6-10	¼-1/2
Alsike clover	July	no	6	2-4	¼-1/2
Crimsom clover	August 1-30	no	16	5-8	¼-1/2
Hairy Vetch	June 1-30 August 1-15	no	60	0	¼-1/2
Ladino clover	June 1-30 August 1-15	no	2	1-2	¼-1/2
Red clover	June 1-30 August 1-15	no	12	3-8	¼-1/2
June or mammoth clover	June 1-15	no	30	3-8	¼-1/2
Sweet clover	Early Spring August 1	no	15	5-10	¼-1/2
Grasses & Small grains					
Red Fescue	E. Spring/late Summer	yes	50	4-10	¼-1/2
Barley**	July 15-Sept 1	yes	72	36-72	1-2
Bluegrass Kentucky	June 1	yes	30	3-8	¼-1/2
Buckwheat	June or July	no	50	0	¼-1/2
Dwarf Essex Rape	June	no	2	0	¼-1/2
Millet	June 1	yes	25-40	10-15	¼-1/2
Oats**	July 15-Sept 1	yes	48	32-48	1-2
Rye**	Sept 1-15	yes	84	44-84	1-2
Rye Grass	Sept 1-15	yes	12-15	4-10	¼-1/2
Sudan Grass	June or July	yes	25-30	0	1-2
Timothy	June 1	yes	20	2-10	¼-1/2

1/ Source: Modern Fruit Science, Table 1, Pg. 109, MSUE Bulletin E-2107, and Northrup King FS 828-1.

*Legume seed needs to be inoculated with correct Nitrogen fixing bacteria just prior to planting

**Use with mixtures of other small grains

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