TOPIC: AGRONOMY #54
Subject: Michigan Cover Crop Management
Date: October 2010

Bio Fumigants for Orchards and Vegetable Crops

For vegetable crops a combination of cover crops such as: rye and vetch; rye, hairy vetch, brassicas, or other combinations can be seeded. See the following Michigan State University Extension (MSUE) publications:

- Brassica & Mustards for Cover Cropping in Organic Farming, 2010 or electronic link at: www.extension.org/article/18643
- Mustards-A Brassica Cover Crop for Michigan, MSUE Bulletin E-2956

To reduce nematode damage to crops, cover crops that manipulate soil structure, soil water potential, and soil humus content are beneficial. Pacific Gold Oriental mustard is the recommended brassica before planting an orchard or potatoes to reduce damage from root lesion, dagger, or other herbivore nematodes. Cover crops should be allowed to grow to the green pod stage then incorporated to obtain herbivore nematode control. When brassicas are seeded as bio-fumigants, a mixture of brown, white and yellow mustard should be planted and allowed to reach green pod stage before incorporation. The goal is to prevent the brassicas from producing viable seed and the soil should be sealed after incorporation to increase the effectiveness of the glucosinolates bio-fumigation.

Trap Crops

Sugar Beet Cyst Nematodes can be fooled to lay eggs into oil seed radish if planted after wheat harvest as a trap cover crop. The larvae hatch out and die over winter before they complete their life cycle. Currently, only Colonel and Adagio oil seed radish varieties are recommended for this purpose.

Weed Seed Control

Ground beetles are common predators of weed seeds in many agricultural crops. Cover crops increase the habitat available to support larger ground beetle populations in no-till fields. See Natural Resources Conservation Service (NRCS) Michigan electronic Field Office Technical Guide (eFOTG) Agronomy Conservation Sheet, Conservation Buffers and Beneficial Insects, Mites, and Spiders.

Grazing Precaution

There is potential to kill livestock with prussic acid poisoning and nitrate poisoning from the young growth of Sudan grass and sorghum-Sudan grass hybrids used in rotational grazing or supplemental feeding. Follow proper grazing protocol to prevent poisoning.

Herbicide Carryover Issues

Consider potential herbicide carryover when selecting the species of the cover/green manure crop. Of the cover crops, rye is most tolerant of triazine carryover, followed by wheat, then oats, and lastly legumes. Legumes are extremely sensitive to triazine carryover released by liming low pH soils. Delay seeding legumes for one year if more than 1 pound of triazine was used the previous year and lime was recently applied. See the Herbicide Crop Rotation Restriction table in the latest MSUE Bulletin E-434, Weed Control Guide for Field Crops, or consult the latest herbicide label for rotation restriction information.

Aerial Seeding

Aerial seeding of cover crops into soybeans, especially wheat, rye, and oats, are best if seeded prior to soybean leaf drop. Aerial seeding of oats into soybeans (seeded prior to harvest) can add additional residue cover without the need to kill the cover crop the following spring. Aerial seeded wheat or cereal rye into corn is best if seeded during the early dent stage. This generally occurs the last week of August to mid-September. Aerial seeded or early no-till established cover crops provide more erosion control the year sown. Caution must be used when broadcasting or aerial seeding treated seed into a crop that is standing (to yet be harvested). Treated seed could show up in the harvested grain and result in rejection.

Crop Rotation

A grass cover crop is preferable when a legume, like soybeans, is planned following the cover crop. A legume cover or a green manure crop is preferable when a grass crop, like corn, is planned the following year. Consider sowing cover crops after the following crops: corn silage, dry beans, cucumbers, early soybeans, early corn, beets, spinach, carrots, lettuce, and potatoes.

Alternate Hosts for Pests or Pest Considerations

Hairy vetch and clovers can serve as a host to the Soybean Cyst Nematode (SCN). Consider alternative cover crops when SCN is a concern in the rotation. Other SCN host plants include henbit, common Mullen, wild mustard, chickweed, pokeweed, and canola. Hairy Vetch can be a weed in future wheat crops.

Small grain cover crops sown followed by No till corn or soybeans are grown can attract seed corn maggot and armyworm. Use an insecticide seed treatment to control seed corn maggot. Scout often for armyworm and corn stalk borer as these two pests are attracted to feed when both corn and cover crops are present.

Control weeds in cover crops by mowing or by using other pest management techniques.

Erosion Control

A cover crop sown using conventional tillage for seedbed preparation after mid-October can cause more erosion during the establishment year than if a cover crop was not planted.

Consider cover crops after corn silage to reduce soil erosion, replace organic matter losses, and capture nitrogen where manure is fall applied. To obtain maximum erosion control from cover crops after soybeans or corn, allow them to mature to the specified height per the criteria for erosion control. No-till and mulch-till compliment the use of cover crops for controlling erosion.

Early planted crops such as carrots, beets, direct seeded cabbage, and early potatoes do not allow sufficient growth of cover crops in spring. Crops planted late enough in spring to allow sufficient growth of cover crops prior to tillage are dry beans, soybeans, sweet corn, snap beans, cabbage, cucumbers, tomatoes, and late potatoes.

Interseeding of cover crops can be used with chemical suppression to reduce wind erosion and plant loss on sand or muck soils especially for onions, carrots, etc. Inter-seed cover crops at the last weed control cultivation in corn, cabbage, cauliflower, peppers, or eggplant. Inter-seed into snap beans 10 days before the first harvest of beans, or drill in cover crops and sow primary crop then kill cover with herbicides.

To increase surface residue cover in no-till, ridge till, or strip till residue management systems seeded with legumes as the cover crop, delay killing the cover until it reaches a height of 6-8 inches. In mulch-till systems, limit tillage to two passes (one primary tillage-chisel or deep disking and a secondary tillage pass), or two other trips. Cereal rye will grow longer in the fall and begin growth earlier in the spring than wheat.

Nutrient Management

To best synchronize the use of a cover crop as a green manure and the cycling of nutrients, factors such as carbon/nitrogen ratios may be considered. An early kill of a cover crop usually facilitates faster nutrient mineralization allowing nutrients to become available to the growing crop. If the primary objective for the cover crop is a bio-fumigant or to maximize the addition of organic matter, a late kill may be used. The right moment to kill the cover crop will depend on the specific rotation, weather, and farming objective.

Fertilize a green manure/cover crop in the spring with a high nitrogen fertilizer to maximize growth ahead of high nitrogen demanding vegetable crops. The recovery of the nitrogen applied to a green manure crop will amount to about 40 percent for the first vegetable crop. Some vegetables require much more Nitrogen (N) during their growth than others. See the attached Appendix for a list of vegetable crops that might benefit from a fall cover crop.

Reduce N loss below the root zone.

Residual N is likely to be present after a dry season of below normal rainfall. A fall soil nitrate test or stalk nitrate test is recommended to determine the availability of N, as excess nitrates, can be flushed from the soil into tile systems or groundwater. Rye, oil seed radish, or other small grains can capture about 50 percent of the available nitrates and prevent N losses.

To prevent nitrate leaching after corn/seed corn maturation on sandy soil, especially under irrigation, aerial seed ryegrass/rye in standing corn or broadcast after harvest. Nitrate leaching can occur after winter wheat. Frost seed red clover or red/sweet clover mixes in mid-March or mid-April to alleviate this problem. See Table 1 in the NRCS Michigan Cover Crop Standard (340) for seeding criteria found in the NRCS Michigan eFOTG, Section IV, or on the web at http://efotg.sc.egov.usda.gov/treemenuFS.aspx

To reduce nitrate leaching and phosphorus runoff from fall manure applications, aerial seed rye/ryegrass or apply rye with liquid manure or oil seed radish. Direct drill rye/ryegrass after harvest. To reduce nitrate leaching and phosphorus runoff from vegetable crops, broadcast or direct drill oil seed radish, ryegrass, or rye. For N recommendations, see the Appendix table taken from MSUE Bulletin E-2904 Nutrient Recommendations for Vegetable Crops in Michigan; or use MSU Nutrient Management 3.0 (or later) software to see which vegetables use the most N and/or have the greatest risk for nitrate leaching, especially from sandy irrigated soils.

To reduce potassium leaching on muck and sandy soils, plant rye or ryegrass cover. Aerial seed cover crops into standing row crops; broadcast seed, and till 2-3 inches deep after harvest; or direct drill into crop residue.

N credits from legume cover crops will be accounted for in the nutrient management plan. Credit for N produced by legumes is to be included in crop nutrient budgets.

Crown vetch can be living mulch in crop rotations with corn, hay, and small grain. See the Penn State University Bulletin, Crownvetch and No-Tillage Crop Production for Soil Erosion Control.

Alleopathic Effects

Burn-down, chop, mow, or till to kill cover crops when planting corn prior to corn emergence. Cover crops such as rye can produce an alleopathic effect that can slow the germination and growth of corn and other competition. It may be best to kill some grass cover about a week prior to planting the corn to reduce alleopathic effects. Control growth of the cover crops early to reduce competition from volunteer plants and shading especially in a dry spring.

Cereal rye and annual ryegrass have alleopathic effects on weed seedlings. Allow rye or ryegrass to reach a minimum 8-inch height before killing with herbicides or tillage to encourage alleopathic effect.

Soil Quality and Soil Organic Matter Maintenance

To maintain organic matter in low residue producing crop systems like vegetables, sow Sorghum, Sorghum-Sudan hybrids, Sudan grass, or corn to produce a high level of biomass. Use a rate of nitrogen (100 lbs/ac) to get maximum growth. Kill the cover crop in late summer/early fall with herbicides or shallow tillage and drill a rye cover to increase organic matter and improve soil tilth. See Table 1 in the NRCS Michigan 340 Standard for seeding rates and dates. Alfalfa, sweet clover, rye, ryegrass, and clovers in the crop rotation are excellent choices to help build or maintain organic matter in the soil.

To improve soil quality and increase soil organic matter, frost-seed legumes into small grain crops, from mid-March to mid-April or drill into small grain stubble after grain harvest.

To enhance carbon sequestration, use crop rotations with high residue producing crops such as corn, small grain, or alfalfa; plus no-till or mulch till; plus cover crops; plus straw bedded manure.

In row crops, over-seeding of legumes or small grains can improve soil tilth. In corn, spray an herbicide in a 10-inch band over the row and then follow by two cultivations. Over-seed cover crops at the second row cultivation. Timing is very important to successfully establishing a cover crop by over-seeding. Sow legumes between corn growth stages V-4 and V-6 (four to six leaves). Annual ryegrass should be seeded at V-6 to V-8. Small grains (rye) can be aerial seeded just prior to senescence (leaf drop) in soybeans and corn. See MSUE Bulletin E-2646 Michigan Field Crop Ecology for more information.

REFERENCES

Cavigelli, M. A., S.R. Deming, L. K. Probyn and R. R. Harwood (Eds.). 1998. Michigan Field Crop Ecology: Managing biological processes for productivity and environmental quality. Michigan State University Extension Bulletin E-2646, 92pp.

Clark A. 2007. Managing Cover Crops Profitably. 3rd. ed., Brassicas and Mustard for cover cropping on Organic Farming, Sustainable Agricultural Network Handbook series Book 9. National Agricultural Library, Beltsville, MD

Hargrove, W.L., ed. Cover Crops for Clean Water. SWCS. 1991.

Harrigan, T. M., D.R. Mutch, S.S. Snapp. 2005. Manure Slurry-Enriched Micro-Site Seeding of Biosuppressive Cover Crops. ASAE Meeting Presentation. Paper Number 051059.

Hartwig, N.L., Crownvetch. No-tillage Crop Production for Soil Erosion Control, Penn State University, Cooperative Extension Service, University Park, PA, 8 pp.0

Magdoff, F. and H. van Es. Cover Crops. 2000. p. 87-96. In Building soils for better crops. 2nd Ed. Sustainable Agriculture Network Handbook Series; Bk 4. National Agriculture Library. Beltsville, MD.

Mutch D., K. D. Thelen, 2003. No-till Drilling Cover Crops after Wheat Harvest and Their Influence on Next Season's Corn. MSU/KBS MSUE Bulletin, E-2897.

Much D., 1988. Cover Crops. MSU/KBS MSUE fact sheets, 24 pp.

Ngouajio, M. and D. R. Mutch, 2004. Oilseed Radish: A New Cover Crop for Michigan, E-2907, MSUE, East Lansing, MI.

NRCS Michigan Agronomy Technical Note 45, 2010, Cover Crops for Orchards.

NRCS MI Agronomy Technical Note 52, 2010, Aerial Seeding of Cover Crops.

NRCS Conservation Standard, 2010, Cover Crops 340.

NRCS Conservation Information Sheet, 1998. Conservation Buffers and Beneficial Insects, Mites, and Spiders.

http://efotg.sc.egov.usda.gov/treemenuFS.aspx See Section IV Michigan Conservation Sheets, Agronomy.

Rust S.R., H.D. Ritchie, O. B. Hesterman, and J.J. Kells, 1988. Annual Summer Forage Production in Michigan, MSUE Bulletin, E-2126, 8 pp.

Reeves, D.W. 1994. Cover crops and erosion. p. 125-172 in J.L. Hatfield and B.A. Stewart (eds.) Crops Residue Management. CRC Press, Boca Raton, FL

Snapp S., K. Date, K. Cichy and K.O'Neil 2006. Mustards a Brassica Cover Crop for Michigan.

Snapp, S., and D.R. Mutch, 2003. Cover Crop Choices for Michigan Vegetables. MSUE Bulletin, E-2896.

Stringer, J. W., W. Clatterbuck, and J. Seifert. Site Preparation and Competition Control Guidelines for Hardwood Tree Plantings, the University of Tennessee Extension Bulletin PB1783.

Warncke, D.D., J. Dahl, and B. Zandstra. 2004. Nutrient Recommendations for Vegetable Crops in Michigan. MSUE Bulletin, E-2904, 31 pp.

Warncke, D.D., J. Dahl, L. Jacobs, and C. Laboski, 2004. Nutrient Recommendations for Field Crops in Michigan. MSUE Bulletin, E-2904, 30 pp.

Free pdf copies of MSUE Bulletins and other references are available at the following Web sites:

- Web2.msue.msu.edu/bulletins/Bulletin/PDF/E-2897.pdf
- Web2.msue.msu.edu/bulletins/Bulletin/PDF/E-2896.pdf
- http//www.covercrops.msu.edu/pdffiles/extension bulletin E-2907.pdf. (Verified March 31, 2010)
- http//www.sare.org/publications/covercrops.htm. (Verified 24 March 2010)
- http//web2.msue.msu.edu/bulletins/Bulletin/pdf/E-2956

Appendix: Nitrogen recommendations for vegetable crops Grown on mineral & organic soils

Crop	Mineral soil (lbs/ac)	Organic soil (lbs/ac)
Asparagus Crowns	80	40
Asparagus, new planting	80	-
Asparagus , established	50	-
Beans, snap	40	20
Beets, red	100	40
Broccoli	140	90
Brussel Sprouts	140	90
Cabbage, Fresh Marked	140	90
Cabbage processing	140	90
Cabbage, Chinese	120	90
Carrots fresh market	100	60
Carrots processing	120	60
Cauliflower	140	90
Celeriac	150	100
Celery, fresh market	200	150
Celery, processing	200	150
Cucumber, pickling		
-Hand harvested	100	60
-Machine harvested	60	20
Cucumbers slicers	80	40
Dill	60	20
Eggplant	120	-
Endive	100	60
Escarole	100	60
Garden, home	140	90
Garlic	120	70
Ginseng	50	-
Greens, Leafy	100	50
Horseradish	100	50
Kohlrabi	140	90
Leek	150	100
Lettuce, Boston, bib	100	60
Lettuce, leaf	100	60
Lettuce, head	140	90
Lettuce, romaine	140	90
Market Garden	140	90
Muskmelon	100	-
Onion, dry Bulb	190	140
Onion, green	130	80
Pak choi	120	70
Parsley	100	
Parsnip	100	50
Peas	40	20
Pepper, bell	100	-
Pepper, banana	100	-
Pepper, hot	100	-
Potato	180	120
Pumpkin	80	40
Radish	50	20
Rhubarb	100	-
Rutabaga	100	50
Spinach	170	120
Squash, hard	80	40
Squash, summer	80	40
Sweet corn	120	70
Sweet potato	60	-
Swiss chard	100	50
Tomato, fresh market	120	-
Tomato, processing	80	-
Turnip	90	40
Watermelon	100	-
Zucchini	80	40

Source: E2934, table 4, pg 10.