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Montana State University Extension

MontGuide

From Conventional to Organic Cropping: What to Expect During the Transition Years

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Organic agriculture is one of the fastest growing agricultural sectors in Montana. This Montguide reviews the definition of organic agriculture and describes some of the economic, environmental, and biological challenges that a producer could face during the transition period from conventional to organic practices.

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What is organic agriculture?

Although the term "organic" may sound ambiguous, the USDA National Organic Standards Board (NOSB) provides useful guidelines. Specifically, the NOSB states that organic agriculture "is based on minimal use of off-farm inputs and on-farm management practices that restore, maintain, or enhance ecological harmony." In this context, "the primary goal of organic agriculture is to optimize the health and productivity of interdependent communities of soil life, plants, animals and people" and "the principal guidelines for organic production are to use materials and practices that enhance the ecological balance of natural systems and that integrate the parts of the farming system into an ecological whole."

How can I become a certified organic crop producer?

Organic producers interested in obtaining USDA certification in organic agriculture must comply with the National Organic Program (NOP). This program develops, implements and administers national production, handling and labeling standards for organic farming.

Specifically, the organic crop production certification standards require that:

- Land must have no prohibited substances (e.g., non-approved pesticides and synthetic fertilizers) applied to it for at least 3 years before the harvest of an organic crop.
- Soil fertility and crop nutrients should be managed through tillage and cultivation practices, crop rotations, and cover crops, supplemented with animal and crop waste materials and allowed synthetic materials.
- Crop pests, weeds and diseases should be controlled primarily through management practices including physical, mechanical and biological controls. When these practices are not sufficient, an approved biological, botanical or synthetic substance may be used.
- Preference will be given to the use of organic seeds and other planting stock, but a farmer may use non-organic seeds and planting stock under specified conditions.
- The use of genetic engineering, ionizing radiation and sewage sludge is prohibited.

More information on the USDA NOP can be found at www.ams.usda.gov/nop.

Organic Crops in Montana

According to recent data provided by the Montana Department of Agriculture, Montana ranks first among U.S. states in the production of certified organic wheat, and second in organic production of all grains, peas, lentils and flax. As of 2005, there were 145 USDA-certified organic pasture and cropland operations, representing a total of 103,433 and 126,450 acres respectively.

The Montana Department of Agriculture is accredited to certify organic producers and handlers. More information on the Montana Department of Agriculture Organic program, organic growers in the state and the organic certification process can be found at http://agr.mt.gov/organic/Program.asp.

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Is organic agriculture inherently sustainable?

The USDA NOSB requires that a certified organic farm and/or ranch should adopt "an ecological production management system that promotes and enhances biodiversity, biological cycles, and soil biological activity." However, like all agriculture, organic production involves the unavoidable challenges of sustaining the land and its people. Whether an organic grower achieves the ever-moving target of sustainability will ultimately come down to personal commitment.

For example, because organic growers can only use a handful of approved herbicides, they rely more heavily on tillage and cultivation than conventional and no-tillage farmers. However, in the dryland ecosystems of the Northern Great Plains, excessive reliance on soil cultivation could lead to soil erosion. Achieving the two-fold goal of weed management and soil conservation requires an ecological approach to weed management that combines multiple weed control tactics with knowledge of the ecology of crop-weed competition and an understanding of the economic threshold for control.

With the exception of nitrogen from legumes, large acreage organic grain farms in Montana generally do not add nutrients. In the long run, this approach to nutrient management will deplete the soil nutrient pool and become unsustainable. Although reduction in soil quality can be remediated with the addition of manure, it must be composted prior to application due to concerns about pathogens and weed seeds.

Sustainable Agriculture

The term sustainable agriculture has been used and interpreted in many ways. A common thread running through these definitions is that sustainable agriculture comprises site-specific ranching and farming practices designed to meet current and future needs for food, fiber, energy, and ecosystems services including but not limited to soil conservation, clean water and biodiversity. Sustainable agriculture emphasizes production and food systems that are profitable, environmentally sound, energy efficient, and that improve the quality of life for both farmers and the public.

Examples of successful approaches aimed at enhancing the sustainability of the farming enterprise in Montana can be found in Montguide *An Introduction to the Principles and Practices of Sustainable Farming* (MT200813AG).

What challenges may I face during the transition years?

It is difficult to predict the challenges that a producer may face during the transition period from conventional to organic agriculture. Decisions based on the best available knowledge will ease the pathway towards organic production.

Economic challenges

In addition to production challenges facing producers transitioning to organic agriculture, there are some important marketing, finance and risk management considerations that new organic producers should prepare for.

Years 1-3: Organic certification requires a 36-month transition period to organic production before crops can be sold as organic. This means that producers need to prepare for potentially lower yields without receiving the increased prices received by established organic producers. This most often means that one or two crop harvests must be sold into transitional non-organic markets. For example, if the last pesticide in conventional farming was used in a field in June of 2009, then a crop harvested in July 2012 or later would have surpassed the required 36-month interval for organic transition.

Producers undertaking an organic transition should consider the following economic strategies to prepare for the three-year certification period:

- Complete an extensive, realistic and multi-year farm budget
- Enhance your farm recordkeeping to support organic requirements and to support the additional management needs of your operation
- Include the potential for complete or partial crop losses during the transition
- Establish a multi-year enterprise plan with a lender who supports your organic efforts. Work with your lender to set this plan in writing
- Select a portion of your acreage based on good soil quality and low pest pressure for initial organic transition, with additional acreage brought into production later

Years 4 and Later: In 2008, organic premiums have been approximately 75 percent for wheat, 25 percent for feed barley, and 100 percent for lentils (above conventional prices). Selling organic products differs from selling conventional crops in that the pool of buyers is much smaller, buyers from longer distances need to be considered, and delivering high-quality products is vital. New organic producers need to develop relationships with buyers and should expect to devote considerable time toward attaining these premiums and in protecting their reputation as a reliable supplier of products that the processor, retailer and final consumer want to purchase.

Cropping systems challenges

Transitional rotations need to keep weed management, soil fertility and soil moisture goals firmly in mind from the outset. Crops must be grown competitively. In conjunction with crop rotation, routinely high seeding rates and narrow row spacing (6"-7") are critically important in organic management.

Research at Montana State University suggests that wheat is an effective starting point of a transitional crop rotation in semiarid regions as it is a relatively competitive crop that provides cultural opportunities such as increased seeding rate and narrow row spacing to minimize weed populations.

Following conventionally managed wheat, the transitional period will involve two additional crop years which can be managed to set up the first certified organic crop to be harvested 37 to 38 months after the last application of synthetic chemicals. Importantly, one of those crop years should be a legume green manure to begin the soil conditioning process whereby subsequent crop growth will be dependent on biological soil fertility. Legume green manure during the second year of the transitional crop sequence should result in a soil nitrogen (N) status capable of growing hard red winter or spring wheat with adequate protein. However, an annual legume such as pea in the first year may be followed by oilseed crops such flax or safflower, both of which can serve as effective nurse crops for sweet clover if the goal is to aggressively build soil fertility. Also, it may be possible to bridge directly to wheat or barley production on the oilseed stubbles if rainfall and soil fertility are sufficient.

Wheat stubble management is critical for conserving soil water. Tall standing wheat stubble acts as a snow trap in winter, allowing the establishment of Austrian winter pea (where winters are mild or snow cover is reliable), which can be terminated by June 1 to conserve soil water for the subsequent crop.

Soil water can also be managed by knowing crop rooting depth and alternating deep and shallow rooting to use soil water most effectively. A healthy pea crop effectively roots to a 30-inch soil depth; spring wheat to a 42-inch depth; winter wheat to 48-inches, and safflower to 60-inches or more where the soil depth and moisture permit deep rooting crops. Although knowing where crops forage for moisture reduces the risk of water stress, the yearly climate trumps all management decisions; a hot dry year may limit crop yields, while a wet cool year may increase weed and other pest pressures.

Organic Premiums

Economic analysis of organic crop rotations studied at MSU-Bozeman show that the average net returns per acre for an organic rotation are quite favorable when compared with those for conventional rotations. Two important components of this advantage are the lower input costs under organic production and the organic price premiums available after the three-year transition period. More information can be found in Miller et al. (2008). Survey analysis carried out in parallel with this project indicates that organic producers' labor and management requirements per acre are between 30 percent and 40 percent above those for conventional production. These higher costs include additional tillage, additional scouting for pests, and in particular, more time spent marketing organic crops.

Perhaps the only agronomic protection against uncertain climates is diversified crop rotation with different phases in different fields, and a flexible management approach to know when to abandon a bad cropping situation and try again next year.

In the dryland ecosystems of Montana, the role of perennial forages in organic agriculture is not fully understood. Some producers have advocated for the use of alfalfa or other forage mixtures to serve in the transition period as a bridge to immediate annual cropping under certified organic status. Unfortunately, the deep rooting nature of alfalfa and grasses result in a super-dry soil profile that may limit crop establishment and growth for multiple years. Further, forage removal is accompanied by large amounts of soil nutrients that are not easily replaced in organic systems. Lastly, our experience indicates that the breakup of perennial forage stands is typically accompanied by a severe invasion of both annual and perennial weeds, which can prove unmanageable when crop growth is water-limited.

Nutrient challenges

Highly soluble synthetic fertilizers are not allowed on organic farms, forcing organic growers to use legumes, livestock manure, crops that mobilize nutrients, or certified organic products such as rock phosphate, to maintain nutrient availability. If a farm has been well fertilized, the lack of synthetic inputs may not be a large obstacle for years, but if yields were already nutrient-limited prior to transition, this may substantially decrease yields, especially when combined with lack of pest controls.

Of the 14 mineral nutrients that have been found to be essential for crop growth, N most frequently limits crop yields in Montana on both conventional and organic farms. Fortunately for the organic farmer, N can be added to the soil by growing legume green manures. Legumes that have been used on organic farms in Montana include perennials (e.g., alfalfa and sainfoin), biennials (e.g., sweet clover), and annuals (e.g., pea, lentil and chickling vetch). Perennials and biennials generally fix more N on an annual basis because they have a longer growing season and a more established root system, yet use more water than annuals.

Research conducted in Montana on annual legumes has found that grain yields following winter pea are generally higher than following spring pea, winter lentil, or spring lentil. Peas produce more biomass and fix more N than lentils. The earlier growth habit and termination of winter pea compared to spring pea provides more stored soil water for the subsequent crop and more time for N to be released from the residue. To maximize yield in the year following a legume green manure, the legume should be terminated relatively early. Specifically, winter wheat grain yields are generally higher when the legume is terminated at bloom rather than at pod, because of stored water differences. However, to increase the N and organic matter content of the soil, it should prove beneficial to terminate later, realizing that next year's yield will likely not be optimized. Economics will likely dictate whether the grower needs to focus on next year's yields or can afford to build soil N and organic matter.

Manure is an excellent source of both plant-available N and organic N. The best approach to determine application rates based on N needs is to have the manure tested for total N and ammonium-N. Other nutrients, such as phosphorus (P) and potassium (K), should also be tested at this time. Your MSU County Extension office (www.msuextension.org) or the Natural Resources Conservation Service (www.mt.nrcs.usda.gov) can assist you with determining optimum application rates once the manure has been tested.

Supplying P to organic farms is more of a challenge than supplying N, because P, like all of the mineral nutrients except for N, can not be 'grown'. In addition, high levels of calcium (Ca) in most Montana soils reduce P availability by forming Ca-phosphate minerals. If manure is readily available, this will likely be your best P source. However, haul distances from large sources of manure in Montana are likely too long to make this economically viable for most large-acreage organic farms. Organic farmers can also consider adding certified organic P fertilizers, such as bone meal and rock phosphate (Table 1). Unfortunately, neither of these P products is very soluble in neutral to high pH soils. In Montana, rock phosphate increased P availability more in a crop planted a few months after fertilization than one planted at the same time as fertilization (Rick et al., 2007). Therefore, if rock phosphate is used, it should be well before the growing season, or alternatively, built up over time.

TABLE 1. Nutrient contents of common organic fertilizers.

Fertilizer	N (%)	P_2O_5 (%)[5]	K_2O (%)	S (%)
Rock Phospate[1]	0	3-16	0	0
Blood Meal[2]	12	1-2	0-1	
Bone Meal[2]	1-6	11-30	0	
Gypsum[3]	0	0	0	17
Greensand[3]	0	1	6	0
Manures[4]: Beef Cattle	1-2.5	0.9-1.6	2.4-3.6	
Dairy	0.6-2.1	0.7-1.1	2.4-3.6	
Horse	1.7-3	0.7-1.2	1.2-2.4	
Swine	3-4	0.4-0.6	0.5-1	
Poultry	2-4.5	4.5-5.5	1.2-2.4	
Sheep	3-4	1.2-1.6	3-4	

[1] Range of P_2O_5 from Havlin et al. (2005). Soil Fertility and Fertilizers. Prentice Hall.

[2] Blood and bone meal data from Koenig and Johnson, 1999. http://extension.usu.edu/files/publications/factsheet/HG-510.pdf

[3] Gypsum and greensand data from Gardener's Supply Col http://www.gardeners.com

[4] Manure nutrient content based on dry weight data from Knott's Handbook for Vegetable Growers. 1997. John Wiley & Sons, Inc.

[5] Only available P_2O_5 is noted, while dissolution and diffusion of P from apatite minerals will likely contribute more available P over time. For example, some rock phosphates are 3 percent available P_2O_5, but 20 percent total P_2O_5. All organic amendments have variable nutrient content.

Certified organic P fertilizers are generally much more expensive per pound of P_2O_5 than synthetic fertilizers. Therefore, it's recommended that these products be applied in only one or two strips and evaluated for yield increases compared to non-fertilized adjacent strips prior to large scale application.

Another potential strategy for increasing P availability is to seed green manures that have the ability to dissolve rock phosphates and soil P. Buckwheat, legumes, and certain mustards have the capability to access significant quantities of P from rock phosphate, unlike cereals. These crops acidify the root zone or secrete chemicals from their roots that make P more available. Although this effect has been documented in certain crops, the previous crop appears to have little to no effect on P availability in subsequent crops (Rick et al., 2008). However, legume green manures are still very important for adding N to the soil.

Other nutrients such as potassium (K), sulfur (S), and micronutrients generally do not limit crop growth as frequently as N or P. Greensand and gypsum are the most common organic fertilizers to supply K and S, respectively. Fortunately, there are relatively pure sources of gypsum that do not require any refining, and therefore the cost of organic gypsum is often not substantially higher than conventional gypsum.

The best way to determine if your organic farm is lacking in any nutrient is to have your soil tested. Even if you do not intend to add fertilizer, soil testing can greatly assist in determining your crop rotation. For example, a field with lower N could be planted with a legume or barley, whereas a field with higher N could be planted with wheat. An alternative method to evaluate N availability is to compare wheat protein levels with "critical levels". Specifically, if the winter wheat or spring wheat grain protein is less than 12.1 or 13.2 percent respectively, yields were likely limited by the lack of N and the grower should consider the worth of increasing the frequency of legumes in the rotation (For more information see Fertilizer Facts 21 and 34, http://landresources.montana.edu/fertilizerfacts).

Weed challenges

Managing weeds in organic systems requires a shift in the producer's attitude. Rather than aiming at eliminating all weeds from his/her fields, an organic grower goal should be to keep weeds below an economically damaging threshold level. This is particularly important since research and anecdotal evidences indicate that weed management may become a challenge for organic growers. For example, when comparing conventional no-tillage and organic small grain farms across Montana, we observed an increase in the abundance, percent cover, and species richness of weed communities occurring in organic fields. Moreover, we observed an increase in the relative abundance of annual and perennial dicotyledonous weed species including field pennycress, common sunflower, common lambsquarters, field bindweed, and Canada thistle.

Fortunately, not all weeds are equal and, if properly managed, yield decreases due to resource competition may not overwhelm net economic returns. For example, our experience suggests that while some annual weeds like field pennycress may not represent major trouble, "wandering" perennial weeds such as field bindweed, quackgrass, and Canada thistle could jeopardize organic production. These species form extensive underground perennial structures such as rhizomes, tubers and roots from which they propagate and spread, presenting a special challenge to organic production.

Weed management in organic fields should be based on the development of an integrated program that takes advantage of many control practices to reduce the impact of weeds on crop yield and quality. A successful integrated weed management program in organic systems requires an understanding of the historical pest problems; the soil and crop management strategies; as well as machinery, markets and labor constraints.

What is Integrated Weed Management?

Integrated weed management (IWM) combines the use of biological, cultural, mechanical, and chemical practices to manage weeds, so that reliance on any one weed management technique is reduced. The main goals of an IWM program are to 1) use preventive tools to maintain weed density at a level that does not harm the crop, 2) prevent shifts towards more difficult to control weeds, and 3) develop agricultural systems that maintain or improve crop productivity, farm revenues, and environmental quality. Thus, designing a successful IWM program requires understanding the different biological and ecological factors that influence the short-, mid-, and long-term dynamics of weeds in agricultural settings.

More information on IWM can be found in Montguides *Integrated Strategies for Managing Agricultural Weeds: Making Cropping Systems Less Susceptible to Weed Colonization and Establishment* (MT200601AG) and *Weed Seedbank Dynamics & Integrated Management of Agricultural Weeds* (MT200808AG).

An organic farmer should integrate these practices to manage weeds:

- Crop rotation is at the core of organic weed management. Establishing crops with different phenologies and morphologies creates unstable environments that discourage weed establishment. It is critical to vary crop growth periods (i.e., winter vs. spring crops; early vs. late spring planting) to keep weed communities off balance.

- Growing a healthy and highly competitive crop is one of the best tools to manage weeds in organic farms. Because weeds grow best in areas of sparse competition such as between rows or in canopy gaps, increasing the density of the crop and reducing the space between rows improves crop competitiveness. Also, crops should be given a headstart by allowing them to emerge before weeds. When possible, organic growers should choose highly competitive crop varieties. For example, tall crop varieties with high tillering ability, early season growth and increased leaf area are more competitive against weeds.

- Cover crops and mulches prevent weed seed germination by blocking sunlight transmission. They can also reduce weed emergence and growth by releasing allelopathic chemicals.

- Cultivation is a widely used method to uproot or bury annual weeds in organic operations. In general, while burial works best on small weeds, larger weeds are better controlled by the destruction of the root-shoot connection or by eliminating the contact between the soil and the root systems. There are many cultivation implements that can reduce seed abundance by over 80 percent, however, caution should be used to avoid soil erosion.

- Thermal weed control through the use of flaming equipment can be used to manage broadleaf weeds prior to crop emergence. Although the initial equipment cost may be expensive, it may prove cheaper than hand weeding.

- Only a limited number of allowed non-synthetic herbicides such as acetic acid (vinegar) can be used in organic settings. In general, these products have no residual activity and no selectivity.

- Reduce weed seed inputs through the development of preventive tactics and the enhancement of seed mortality factors such as predation and decay. Use of composted manure and allelopathic crops, such as rye and oat that exude a chemical that inhibits small weed seed germination may prove beneficial.

In summary

Although no magical toolbox exists to guarantee a smooth and successful transition from conventional to organic practices, knowledge and access to appropriate technology are key factors in this process.

Economics

- Sound financial planning is critical for producers transitioning into organic production.

- Sufficient farm equity, a strong cooperative relationship with your lender, risk management, extensive farm plans, and in-depth recordkeeping are all important aspects that must be in place for a successful transition to organic production.

- Organic premiums are substantial, but require considerable effort and cultivation of buyers.

- Successful organic producers have very strong farm management, finance, and marketing skills.

Cropping systems

- Ask; there is little substitute for experience! An experienced neighbor may not be far away. The organic community tends to be inclusive and educationally inclined and most organic producers are more than willing to share their knowledge about what has been successful on their farms.

- Legume crops must become the foundation of organic cropping systems for providing biological N. Annual legumes most commonly include peas and lentils, while sweet clover is the gold standard for biennial legumes in dryland Montana.

- While cereal crop options will generally be familiar to conventional growers, limited oilseed options such as flax and safflower may not be as well known, increasing the learning curve.

- Competitive crop stands are critical, and complexity in crop growth timing (i.e., winter vs. spring crops, early vs. late planted spring crops) is key to managing weed populations and weather risk.

- Organic farming is management-intensive. Field conditions can change rapidly due to weather or unforeseen biological epidemics, requiring rapid flexible decisions on the part of the manager to minimize long-term problems.

Nutrient management

- Nutrient availability will generally be less of a problem during the transition years than long-term, especially when a farm was well fertilized prior to conversion.
- To supply nitrogen to your soil, legumes become the foundation of the rotation and must be present every 2nd or 3rd year at a minimum.
- Crops such as buckwheat, legumes and some mustards, are better able to take up phosphorus than cereals.
- Certified organic fertilizers may be necessary to maximize yields, but may be cost-prohibitive during transition.
- Soil testing is key for determining if nutrients are limiting growth and to better select the crop rotation for a specific field.

Weeds

- Develop an integrated weed management program that combines preventive cultural, mechanical, and biological practices to reduce weed pressure below threshold levels. Increasing seeding density, crop rotation, and use of cover crops are integral components of a successful weed management program in organic farms.
- Know your weeds. Get a correct identification of the weeds in your fields and understand their damaging potential. Be aware of difficult to manage weeds such as field bindweed and Canada thistle.
- Because chemical management options are very limited in organic farms, it is worth considering an intensive management program prior to converting to organic. To prevent the establishment of difficult to manage weeds, it may be necessary to isolate any infested land from organic production until these weeds are at manageable levels.
- Grow healthy and vigorous crops and maintain soil health. Weed management through cultivation should only be done with properly adjusted equipment under soil conditions that are not susceptible to erosion or compaction.
- Successful organic producers have learned that they may have to sacrifice a crop by destroying it through tillage in the event of a substantial weed, insect, or pest infestation in order to control these pests in future years.

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More print resources on organic agriculture can be found at:

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- Miller, P.R., D.E. Buschena, C.A. Jones, and J.A. Holmes. 2008. *Transition from intensive tillage to no-till and organic diversified annual grain cropping systems: Agronomic, economic, and soil nutrient analyses.* Agron J. 100: 591-599.

On-line resources (all websites verified on December 16, 2008) :

- Alternative Energy Resources Organization. http://www.aeromt.org
- Leopold Center for Sustainable Agriculture. http://www.leopold.iastate.edu
- Fertilizer Facts. http://landresources.montana.edu/fertilizerfacts
- Montana Department of Agriculture. How to Transition to Organic. http://agr.mt.gov/organic/awareness.asp
- Montana Organic Association. http://www.montanaorganicassociation.org
- National Sustainable Agriculture Information Service. http://www.attra.org
- Natural Resources Conservation Service. http://www.mt.nrcs.usda.gov
- Organic Farming Research Foundation. http://www.ofrf.org
- Organic Trade Association. http://www.ota.com
- Organic Trade Association, Pathway to Organic. http://www.howtogoorganic.com
- Organic Weed Management. http://www.wvu.edu/~agexten/farmman2/organic/weedmang.pdf
- Sustainable Agriculture Research and Education Program. http://www.sare.org
- University of Minnesota Organic Ecology. http://organicecology.umn.edu/
- Western Region Sustainable Agriculture Research and Education Program. http://wsare.usu.edu/

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