Organic Farming: The Search for Agricultural Sustainability in the northern Great Plains

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RESEARCH SUMMARY
North Dakota ranks second behind California in organic crop acreage. However, only limited research on organic farming methods has been conducted. The objective of this project is to establish a sustained research effort directed at solving the major obstacles faced by organic farmers and organic-in-transition farmers to financial and ecological sustainability in southwestern North Dakota and similar regions. Specifically, this project has four objectives: (1) devise strategies for transitioning from crop and crop/livestock enterprises using conventional practices to organic production methods that are profitable and maintain or enhance soil resources; (2) develop methods for providing adequate amounts of nitrogen (N), phosphorus (P), and potassium (K) Maintain economical yields of forage, grain, horticultural, and seed crops using organic production practices; (3) formulate weed control approaches in field and horticultural crops that do not rely on intensive tillage, are effective and economical, and are permitted under certified organic guidelines, and; (4) identify morphological and phenotypic growth traits along with genotypes of horticultural, oilseed, pulse, and small-grain crops that are adapted to organic production systems.

INTRODUCTION:

Organic farming is a production system for growing crops that excludes the use of most synthetic fertilizers and pesticides, applications of sewage sludge, genetic engineering, and ionizing radiation (USDA AMS, 2006). Organic farming has been one of the fastest growing sectors within production agriculture in the USA, doubling in area between 1990 and 2002, and again between 2002 and 2005 (USDA ERS, 2007). California led the nation with over 90 000 ha of certified organic cropland in 2005. North Dakota was second with 58 000 ha that year. North Dakota was the leading domestic producer of organic buckwheat, oat, and oilseeds, and was second or third for several others [dry beans, dry pea and lentil, pasture or hay crops (excluding alfalfa), and rye]. While the amount of arable land dedicated to organic farming is a small fraction of the total amount used in the state and nationally, the amount of organic cropland continues to expand while conventional cropland (i.e., land managed using synthetic chemicals) is shrinking in size.

Only limited research on organic farming has been conducted in North Dakota during the modern agricultural era (post 1960, when synthetic agrichemicals began widespread use). This research project proposes to initiate the first thorough, and sustained, modern investigation of organic farming in North Dakota. The project is designed to overcome barriers to organic farming by developing solutions to the primary problems faced by organic farmers in the state and region.

MATERIALS AND METHODS:

Several studies are included in this project. As a result, only a brief overview of most of the field experiments included in this project will be described.

Objective 1. Devise alternative strategies for transitioning successfully from crop and crop/livestock enterprises using conventional practices to organic production methods.

1. <u>Hay, Grain, and Seed Crop Transition Study</u>

Four, 3-yr crop sequences will be compared to identify which crop species and systems optimize economic returns and minimize weed infestations during the organic-in-transition period. The sequences will include: (i) continuous alfalfa (forage only); (ii) integrated crop/livestock; (iii) grain and seed crop rotation; and (iv) grain and seed intercrops rotation. Every crop phase in all sequences will be represented during each year of the study, as will every year into each phase and sequence, so that by the third year all phases and years into each sequence will be present. Replicating not only crop phases, but also year, into the various sequences over time will allow the fixed and random effects of years to be analyzed separately.

Objective 2. Develop methods for providing adequate amounts of N, P, and K to maintain economical yields of biofuel, forage, grain, horticultural, and seed crops grown using organic production practices.

2. <u>Green Manure Adaptation Study</u>

Alfalfa, yellow-flowered sweetclover, and other legume and non-legume species used as green manures by organic farmers (e.g., buckwheat) will be compared for their impact on weeds and soil N, P, and S. Crops will be established and maintained using appropriate agronomic methods for each species. Crop species will be terminated mechanically in mid-June to mid-July in the year that summer annual species are seeded. Above- and below-ground contribution of the green manures to the soil nutrient pool will be determined. Grain yield of wheat following the green manure crops and economic returns of the green manure/cereal crop combinations will be determined, as will whole plant N, P, and S content along with grain N concentration.

Objective 3. Formulate novel approaches for controlling weeds in field and horticultural crops that do not rely on intensive tillage, are effective and economic, and are permitted under certified organic guidelines.

3. Cover Crop Termination Method Study

Six cover crop treatments will be compared for their impact on weeds and subsequent crop performance. The cover crops will be established in 3 by 13 m (10 by 42 ft) plots the previous fall and terminated the following year in mid-June using a light tandem disk, a wide-sweep undercutter, and by crimping and rolling (http://www.newfarm.org/depts/notill/roller_gallery/index.shtml) to minimize soil disturbance. Seven field and horticultural crops species will be seeded into each cover crop by termination method combination using a low-disturbance, no-till research planter

Above- and below-ground biomass of crop and weed species will be determined just prior to killing cover crops. Similarly, weed density in a 0.25-m^2 area will be determined 45 days after those crops are seeded and again just prior to harvest.

4. Vegetable Sequencing Study

Horticultural crops will be grown over a 3-yr period to determine the impact of crops and crop sequences on yield and quality, and on weeds. Weed-free and weedy (i.e., no weed control) treatments will be included as controls. The crop and control treatments will be allocated in a matrix design (Tanaka et al., 2002) that will allow 64 treatment sequence combinations to occur in the third year. Field experiments will be conducted under rainfed (dryland) and irrigated conditions in fields that were fallowed the previous year. Weed density crop yields will be determined by harvesting grain, fruit, or seed from each strip or subplot when appropriate. Economic returns will be computed for each vegetable sequence combination included in the study.

5. Impact of Tillage Elimination on Weeds Study

A 6-yr forage-grain and seed crop rotation will be established under both clean- and reduced-till and compared for yield, economic returns, and weeds. Tillage (pre- and post-plant, pre-emergence, in-crop, and/or post-harvest) along with cultural practices (e.g., delayed planting) will be used to control weeds in the clean-tillage system, where <5% residue will remain on the soil surface after seeding any crop. A wide sweep followed by a light tandem disk will be used to kill and incorporate the perennial forage crop and annual cover crops as green manures. Tillage in the reduced-till system will be limited to the use of a wide sweep to kill third-year forage stands, and to in-crop weed control using implements that minimize soil disturbance (e.g., high-residue rotary hoe) as needed. The judicious use of products as herbicides on the approved list of substances by the OMRI that meet federal and state regulations, if in existence, will occur as needed to supplement the cultural and limited tillage practices to control weeds in the reduced-till system, so that at least 30% of the soil surface is covered by growing crop plants or their residue continually. Weed density and crop yield will be determined, as will dockage for grain and seed samples.

6. Herbicide Efficacy Study

Approved and restricted products listed by the OMRI as herbicides along with experimental compounds will be evaluated for efficacy in controlling weeds. Field pea will be sown in plots and herbicides will be applied as recommended by manufacturers. In many instances, treatments will be applied prior to sowing pea since most herbicides approved for use in systems managed organically are nonselective. Control by each herbicide of weed species will be evaluated visually and recorded on a percentage basis. Efficacy will be determined at 15, 30, and 60 days after seeding pea. Carryover and contact injury of herbicides to pea plants will be evaluated visually by comparing vegetative growth in plots where treatments were applied to weed free plots at the same time an efficacy rating is determined.

Objective 4. Identify morphologic and phenotypic growth traits of horticultural, pulse, oilseed, and small-grain crops and genotypes that are suited for sustainable production in organic production systems.

7. Cultivar Adaptation Studies.

The P.I. along with Co-PIs, crop breeders, organic farmers, and organic seed suppliers will identify fruit (e.g., grape), oilseed (e.g., flax), pulse (e.g., pea), small-grain (e.g., spring wheat), and vegetable (e.g., tomato) genotypes that may be suited for production in systems managed organically. Seed of selected cultivars along with experimental germplasm will be acquired, seeded, and compared for agronomic performance under certified organic and organic-in-transition conditions, with particular emphasis placed on interaction with weeds (both an ability to suppress as well as compete with weeds).

RESULTS AND DISCUSSION

Results of this project will not be generated until the 2008 growing season has ended

LITERTURE CITED

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