Alternative agriculture research needs

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When Elmer Grey suggested a talk on alternative agriculture research needs I thought it was a great idea: That's the sort of talk I needed to hear. Then he asked if I would give it.

Damn.

You see, I attend enough alternative agriculture events to be aware of the long-standing gulf between the alternative and the mainstream agricultural science. It isn't new. Back in 1924 Rudolf Steiner, the founder of biodynamic agriculture, whose ideas influenced the development of organic agriculture, wrote:

> *I have always considered what the peasants and farmers thought about their things far wiser than what the scientists were thinking.... I have always been glad when I could listen to such things, for I have always found them extremely wise, while, as to science in its practical effects and conduct I have found it very stupid.*

Thirty years later, Dr. Throckmorton, the Dean of Agriculture at Kansas State University, minced no words in his essay "The Organic Farming Myth:"

> *In recent years there has grown up in this country a cult of misguided people who call themselves "organic farmers"* […] *These so-called organic farmers preach a strange, two-pronged doctrine compounded mainly of pure superstition and myth, with just enough half-truth, pseudo science and emotion thrown in to make their statements sound plausible to the uninformed.*
> […]
> *In other words, these men who have appropriated use of the word organic are saying that all soil scientists are wrong and that they are right. They are, in effect, saying that farmers are wrong in using almost 20 million tons of commercial fertilizers a year. They are asking that painstaking research results of many generations be cast aside. These cultists apparently believe that by a play on words such as "natural", "chemical" and "organic", they have the key to an immortal truth.*

This semester, Kansas State University's Organic Farming class meets Tuesdays and Thursdays in Throckmorton Hall. I am not aware of any serious discussion of harnessing the energy released by Dr. Throckmorton's spinning corpse to power the lightbulbs in the building that bears his name, but such an innovative use of a local renewable energy source would be most compatible with the National Organic Standards' emphasis on resource cycling.

The two sides haven't stopped calling each other names yet, but the gulf between them has narrowed, and there are more and more who hop back and forth. Part of the reason is the rapid growth in alternative agriculture.

You've heard the numbers. Twenty percent compounded annual growth in the value of the US organic sector for more than a decade. What twenty years ago was a fringe movement, on the hairy side of respectability, surpassed $15 billion in sales last year. More scientists are conducting studies relevant to organic agriculture, too. In the first five years of this decade there were 2168 organic agriculture publications in scientific journals, up from 558 in the first half of the 90s.

Last week more than 5,000 small farmers and 1,000 chefs, representing 130 countries, met in Turin, Italy for Terra Madre, an event focused on the de-industrialization of food production. Their goals? To put taste back at the heart of food, to save heirloom varieties, to keep small farmers in business and in local communities, and to shift agriculture onto firmer environmental ground. These are largely political and economic goals. What place, then for science?

Of course the organic sector is just one easily-identifiable segment of a much larger range of alternative agriculture systems that might be termed low-input, regenerative, or sustainable. A National Research Council Committee defined alternative agriculture as any system of food or fiber production that pursues the following goals:

- Greater incorporation of natural processes into agriculture (e.g. nutrient cycling, N-fixation, pest-predator relationships);
- Reduced use of off-farm inputs;
- Greater use of the genetic potential of plants and animals;
- Greater responsiveness of cropping patterns to the physical limitations of land;
- Greater emphasis on conservation of soil, water, energy, and biological resources.

The national organic standards attempt a synthesis of these concepts by defining organic agriculture as production that responds to site-specific conditions by integrating cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity. Such production can't use certain prohibited substances, either.

Unfortunately this second piece – the bit about allowed and prohibited substances – is in danger of becoming the be-all and end-all of organic agriculture according to some interpretations of the national standards. George Kuepper, a longtime contributor to the USDA-funded Appropriate Technology Transfer to Rural Areas (ATTRA) project, notes that "the organic community is obsessed with issues of what can and cannot be used in organic production. This creates particular challenges for new organic producers who assume that the key to organic production is product selection, much as it was when they farmed conventionally."

Kuepper continues:

> *The roots of input substitution and the general obsession with materials are varied and have a tortuous history. They are reinforced by the Standard itself, which requires three years of decertification wherever a prohibited substance is applied. At the same time a weak crop rotation, poor nutrient management, and lack of biodiversity would rate nothing more than a minor non-compliance, if the organic inspector notes it at all.*

If we, as researchers, wish to work on problems relevant to organic producers we must know something about allowed and prohibited substances. If the 'organic' systems we use in our research studies incorporate treated seeds, biosolids, or genetically-modified organisms, for example, we run the risk of having our work dismissed as useless by the community we intend to serve. Perhaps worse, our organically certified research land or grower cooperator sites could lose certification.

At the same time, we must move beyond the mindset in which organic agriculture is defined by allowed and prohibited substances alone. Far more interesting are the research questions posed by the goals defined by the USDA. What effects do different systems have on biodiversity? On ecological balance? On resource cycling? These are quantifiable terms that draw on ecological theory and can be used to generate testable hypotheses. These are also concepts relevant to alternative agriculture as a whole, not just organic systems. The national organic standards are a set of rules designed to accomplish certain ends. As scientists, we should pay more attention to testing the ability of systems to accomplish those ends, than their ability to satisfy a new set of rules. Human laws can be changed; natural ones can't.

An examination of alternative systems, some say, requires a systems-based approach to research as opposed to the factorial approach with which many of us are more familiar and comfortable. Factorial experiments are designed to deconstruct systems by isolating one or two factors for manipulation and analysis while all others are held constant. They do a good job of demonstrating cause and effect relationships.

According to Laurie Drinkwater, "The central underlying assumption of a systems approach is that agroecosystems are complex, and interrelationships among environmental conditions, management, and biological processes are important in determining outcomes…" In ecosystems, including agro-ecosystems, the whole may not equal the sum of its parts.

Drinkwater is not opposed to factorial studies, but suggests they be complimented by systems studies. She lists four characteristics of these:

1. They consider intact, realistic agro-ecosystems. For example they might compare working farms, or simulated farming systems. Many characteristics vary between treatments (e.g. tillage, rotation, fertility source).
2. They are interdisciplinary, with farmers and scientists from a range of disciplines working together. Interdisciplinary studies are different from multidisciplinary

studies, in which scientists from various disciplines each approach a different area of the project in isolation, with little interaction between them.

3. They are long term. Some differences between cropping systems can take decades to emerge.
4. They are multi-scale, looking at micro-scale processes, like N cycling in the rhizosphere, up to landscape-scale processes, like N flows through the watershed.

Engaging in agro-ecosystem studies requires a mindset more similar to that of the ecologist, paleontologist, epidemiologist, or anthropologist than the classic agronomist. Systems studies are expensive, time-consuming, labor intensive and more difficult to analyze than tightly controlled experiments. As a young scientist, I am aware that systems studies can take longer to lead to a publication, and that their conclusions may not be as clear-cut as factorial studies, even if they are more applicable to real-world scenarios. Systems studies are not good for career building.

The challenge, then, is to balance factorial and systems studies to collect enough short-term results to keep publishing while also exploring big-picture questions. This is exciting work. We have the potential to help build more sustainable agriculture systems while exploring scientific questions from a new perspective.