Organic and Conventional Agriculture Reconsidered

In a recent paper by Pimentel and colleagues, "Environmental, Energetic, and Economic Comparisons of Organic and Conventional Farming Systems" (*BioScience* 55: 573–582), two claims made by the authors warrant closer examination.

The authors cite data from the Rodale Institute's 22-year Farming Systems Trial (FST) showing individual crop yields were "similar to those of conventional systems." However, they presented no data on total system yields.

I was able to glean wheat yield data from another paper on Rodale's FST for the years 1986–1995, during which they averaged just less than 49 bushels per acre (Hanson et al. 1997). At these yields and assuming a weight of 60 lbs per bushel, the organic wheat would yield an average of 3,302 kg/ha of grain per crop. Combined with the corn and soy yields, this gives an average of 11,906 kg/ha of total grain produced per 3-year rotation. After 15 years, the organic legume rotation would provide 59,530 kg of grain, whereas the conventional rotation would yield 74,253 kg over the same period. Thus, the conventional system yields 25% more grain than the organic system over time. Even with organic wheat yields of 65 bushels per acre, the organic system would produce 20% less grain than the conventional system.

Most disturbing, however, were statements that the "environmental benefits of...less soil erosion...were consistently greater in the organic systems than in the conventional systems" and "crop rotations and cover cropping typical of organic agriculture reduce soil erosion." Nowhere in the paper were any data provided from the FST or any other source to substantiate these claims. In fact, ongoing work by USDA-ARS researchers has demonstrated the opposite: soil erosion potential (as measured by soil properties) is essentially equal between organic and traditional nonorganic farming systems, but both are significantly more susceptible to erosion than a nonorganic, no-till farming system (Green et al. 2005).

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Hanson JC, Lichtenberg E, Peters SE. 1997. Organic versus conventional grain production in the mid-Atlantic: An economic and farming system overview. American Journal of Alternative Agriculture 12: 2–9.

Response from Pimentel and colleagues

Conventional and organic corn, soybean, and wheat showed no significant differences in yield. Average yields in all crops were at or above the county levels for conventional farmers in both the conventional and organic systems. Initially, conventional-farming corn yields were higher under the conventional production system, but after a 4-year transition period to organic production, there was no difference in overall corn or other crop yields. In drought years, conventional corn yields were significantly lower than in the organic systems.

Soil carbon affects erosion. Increasing soil carbon and enhancing soil aggregation improve soil resistance to wind and water erosion (Troeh et al. 1999). Our study demonstrated that increased mycorrhizal activity under organic cropping systems was a key aggregating agent. Since water either infiltrates or runs off soil, the water percolating through all test crop systems was measured. Data showed that in the organic systems, percolation was enhanced and water runoff decreased. In addition, organic matter increased in the organic systems, whereas no increase occurred in the conventional systems, further confirming reduced erosion in the former.

Avery cites a study by Green and colleagues (2005) to confirm there is no difference between organic farming and conventional farming in terms of soil erosion. There are serious problems in drawing this conclusion from the abstract of the article: There is no information on what type of organic farming system the measurements were made on, and there is no description of how the organic system was farmed.

Although no-till corn has soil conservation merits, it has several costs, including increased pesticide and nitrogen fertilizer use; more weeds, insects, slugs, and voles; and corn seed needs (Troeh et al. 1999). No-till corn requires more fossil energy than conventional culture. In our experiments, the organic corn systems required 30% less energy. Finally, results showed that tillage in organic systems built organic matter at a rate comparable to that of no-till agriculture (Troeh et al. 1999).

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Tamarisk Tensions

In the August 2005 feature article, "Tiff over Tamarisk: Can a Nuisance Be Nice, Too?" the author raises several issues about which there is currently scientific debate, and presents some of the differing perspectives. A phenomenon surrounding discussions of tamarisk in the West is revealed and reinforced in the article—the polarized nature of the debate. Over the years, this polarization has fueled acrimonious exchanges between scientists and led to confusion regarding the effects of tamarisk, thus hindering the ability of resource managers to formulate clear policies for managing this species. Unfortunately, the author has perpetuated the polarized nature of the tamarisk debate by labeling two camps—"revisionists" and "traditionalists."

I suggest that instead of continuing to view those engaged in research on, or management of, tamarisk as falling into one camp or another, all participants recognize and seek to better understand the ecological complexity behind the issues. It is this complexity that enables those with different perspectives to find examples that support their "side." Tamarisk grows across a huge geographic area, encompassing several ecoregions, along dynamic riparian lands managed by entities with different priorities. There are many instances where tamarisk invasion has been facilitated by streamflow regulation, but there are others where tamarisk has invaded relatively pristine sites. Tamarisk's abundance and its associated effects on ecosystems vary greatly. Different wildlife taxa respond differently to tamarisk—some are unaffected or benefit, others do not thrive in tamarisk habitat. Tamarisk may use more or less water than other vegetation that might replace it. Scientists and resource managers should stay focused on seeking to better understand this complexity, so that they can best support the development of appropriate management strategies.

One key issue that I think was underreported in the article is that of restoration or revegetation associated with tamarisk control. The extent to which wildlife use or water use changes following tamarisk control depends largely on what vegetation replaces tamarisk. Thus, the feasibility and cost of producing and maintaining desired replacement vegetation deserve careful consideration *before* embarking on control efforts, not after, as is often the case.

Finally, I had asked that the word "mesic" be added to a comment attributed to me in the article so that it read, "Recent studies do not show that tamarisk consumes more water than mesic native species." The scientific evidence does not clearly show that tamarisk uses more water than mesic (moist site) native riparian species such as cottonwood and willow. There is, however, evidence that tamarisk uses more water than many xeric (dry site) native species (e.g., some grasses and shrubs).

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Note: BioScience *regrets the missing "mesic."*

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Editor's note: The photograph of the turtle in figure 1 of "A Biosocial Approach for Analyzing Environmental Conflicts: A Case Study of Horseshoe Crab Allocation" (*BioScience* 55: 735–748) was taken by Massimo Demma.