The LTRAS Century

Long Term Research on Agricultural Systems

Issue 4 **University of California, Davis** **March, 1996**

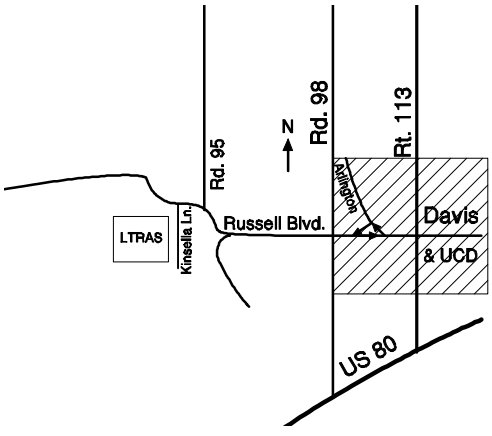
Second LTRAS Field Day Scheduled for April 4, 1996

Please join us from 1-3 PM on April 4, 1996, for a field day at the LTRAS site (see map below). University of California Vice President **W.R. "Reg" Gomes** (Division of Agriculture and Natural Resources) and Dean **Barbara Schneeman** (College of Agriculture and Environmental Sciences) will open the program with brief discussions of the role of the university in applied field research on production agriculture and related environmental issues.

A field tour will feature experiments with winter wheat and winter legume cover crops. We will be presenting data on N production by these cover crops and their effects on subsequent crop yields.

Some of the researchers working at the site will present posters giving preliminary results on a variety of topics. Visitors are welcome to walk the fields after the formal presentations. LTRAS staff will be available to answer questions.

We hope to see you there!



LTRAS is located on Kinsella Lane, off Russell Blvd., about 6 miles west of Rt. 113.

Organic Matters

The most striking result from our second cropping year is the outstanding early season performance of our organic corn and especially tomatoes, relative to their conventional counterparts (Figure 1).

For tomatoes, this strong early growth also resulted in a higher final yield for the organic system -- the opposite of our results for last year (Figure 2).

Annecdotal evidence and some experimental data suggest that the performance of organic systems may improve over years, although this could mainly reflect increasing grower experience with organic methods. This year's results may show whether this sort of "transition" effect is actually occurring at LTRAS.

Alternatively, our results for 1995 could indicate a greater susceptibility of the conventional system to adverse effects of the unusually wet winter and spring of 1994-1995. For example, soil compaction (often a problem with wet soils) could have been less severe in the organic system, due to water consumption by the cover crop (normally considered a *negative* effect of cover crops!) and additional organic matter.

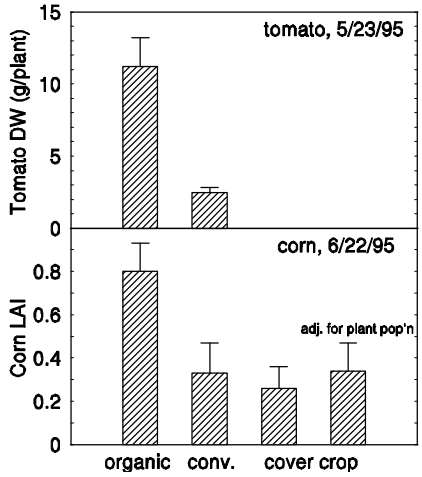


Figure 1. Early-season growth of organic and conventional crops in 1995. The organic and cover-crop systems both followed a winter legume cover crop; the organic system also received manure.

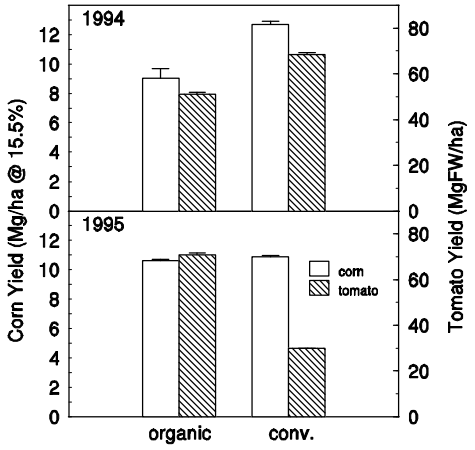


Figure 2. Final yields of organic and conventional corn and tomatoes in 1994 and 1995.

Consistent with this hypothesis, soil bulk density later in the season was slightly higher in the conventional system. However, the difference was statistically significant only at depths of 10-22 cm (Fig. 3).

Soil fertility differences could also be important. Soil nitrate levels in the organic system were roughly double those in the conventional system early in the season (Fig. 3). Plant tissue N concentrations were also higher in the organic (4.46%) than in the conventional (3.12%) tomatoes in May.

Continuous mineralization of organic N in the cover crop residues and composted manure could have maintained higher nitrate levels in the organic system, despite possible leaching losses in both systems. We do not yet have lysimeters installed to monitor nitrate leaching below the root zone in either system. Other soil and tissue analyses (P, K, Ca, etc.) are in progress.

Although the superior performance of our organic system in 1995 should encourage skeptics to reconsider the merits of organic amendments, our results should be interpreted cautiously. This was an unusually wet year and we did not have access to the equipment needed for optimal bed preparation under these conditions. (We are planning to purchase lightweight vegetable cultivation equipment that should help solve this problem.)

We also need to remember that our rates of manure application to the organic system (up to 10 tons/acre in 1995) greatly exceeded the statewide supply (about 1 ton/acre). Distribution is also a problem; transportation of manure consumes large quantities of fossil fuels. Concerns about the future availability of inputs ("What happens when the oil runs out?") therefore apply to organic as well as conventional systems.

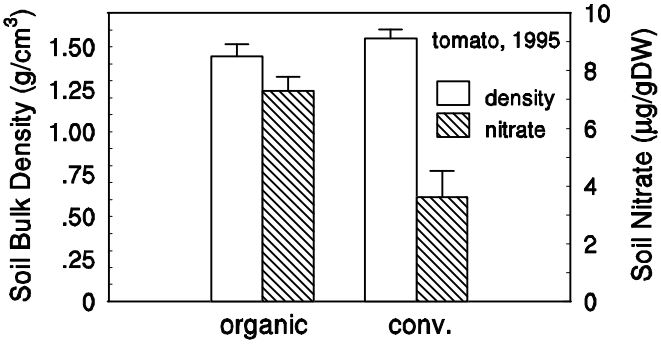


Figure 3. Soil data for tomatoes, 1995. Bulk density measured 8/22/95 at 10-22 cm depth. Nitrate measured 5/26/95 at 0-30 cm depth.

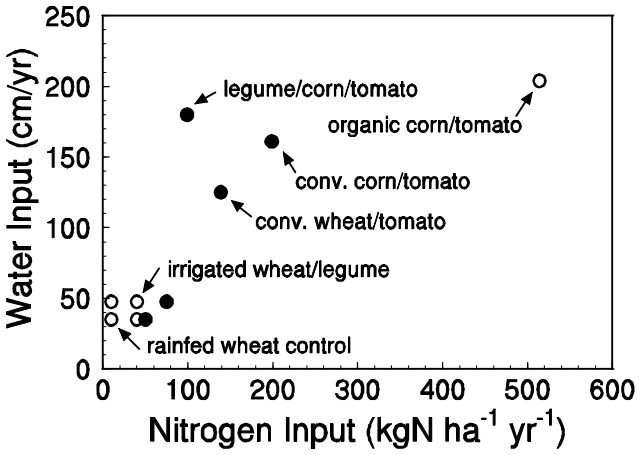


Figure 4. Approxinate inputs of water and nitrogen (per year) to the ten cropping systems at LTRAS. Solid circles indicate application of synthetic N fertilizer to one or both years of a given two-year rotation.

Our organic system shouldn't necessarily be considered "low input." This system currently has the highest *total* N inputs of any of our cropping systems (Fig. 4). Because only a fraction of the total N in organic materials is available over the short-term (typically 25-40% during the first year), these higher rates have been needed to match the *available* N in the conventional corn/tomato system. We plan to reduce manure application rates as organic N accumulates in the soil.

The organic system also used more water than its conventional counterpart (Fig. 4). Higher observed water infiltration rates in the organic system required more irrigation for water to reach the end of the furrows. But high infiltration rates would also improve the soil's ability to absorb rainfall, thereby decreasing runoff.

LTRAS Seed Grants Awarded

The LTRAS Seed Grants Program, described in the last issue of the *LTRAS Century*, has made the following awards:

- Louise Jackson (Vegetable Crops), Dennis Rolston & Kate Scow (Land, Air & Water Resources), "Nitrogen cycling, gaseous emissions, and microbial dynamics during cropping system transitions," $36,941.
- Robert Norris (Vegetable Crops), "Weed seedbank determination and weed community dynamics in relation to long-term cropping systems," $20,390.
- Don Phillips (Agronomy & Range Science), "Identifying plant signals to enhance growth of desirable microbes," $20,000.
- Ted Hsiao (Land, Air, & Water Resources), "Rooting depth and soil physical characteristics: effects of the LTRAS cropping rotation and organic systems," $20,000.
- Daralyn Pearson, Lori Timm, and Bruce Jaffee (Nematology), "A comparison of nematode-trapping fungi in conventional vs. organic agricultural systems," ($1,760). (This low-budget proposal was submitted by two undergraduates with their faculty sponsor.)

The Technical Committee was pleased with the quality and diversity of projects submitted and we look forward to seeing the results of these research projects. Thanks again to the **Department of Agronomy & Range Science** for supporting this program through a one-time allocation from the **Mary J.L. McDonald** endowment.

New Grants Received

Research at LTRAS is starting to attract a significant amount of funding from a variety of sources. In addition to the grants reported in the last issue, the following grants are currently supporting research at LTRAS. In several cases, part of the work is being done at other locations.

Long-Term Sustainability of Irrigated Agriculture -- RF Denison, JW Hopmans, LE Jackson, RO Miller, RF Norris, DA Phillips, DW Rains, DE Rolston, KM Scow. $275,000 over three years from USDA/NRI.

Rotation Length and Organic Transitions -- RF Denison. $7000 seed money this year from UC Sustainable Agriculture Research and Education Program. External funding will also be sought.

Sources and Sinks of PM-10 in California's San Joaquin Valley -- Robert Flocchini. $449,061 over four years from USDA.

Developing Site-Specific Farming Information for Cropping Systems in California -- RO Miller, R Plant, S Pettygrove, RF Denison, S Upadhyaya, T Kearney, G Miyao, L Jackson. $64,300 over two years from CDFA Fertilizer Research and Education Program.

Composition and Distribution of Fugitive Dust from Central Valley Crop Management Systems -- MJ Singer and RJ Southard. $60,000 over two years from Kearney Foundation.

More Help from Our Friends

Baseline funding for LTRAS is provided by the **College of Agriculture and Environmental Sciences** (UC Davis) and by the University of California **Division of Agriculture and Natural Resources.** Without this support for our core operations, we would be unable to compete for research grants such as those listed above.

We would also like to thank our supporters for generous contributions of goods or services and the organizations that have worked with us over the past year.

- **Adams Grain Co.**
- **Arrow Earth, Inc.**
- **Button & Turkovich, Inc.**
- **Calif. Crop Improvement Assn./ Foundation Seed Certification Service,**
- **Campbells Soup Company**
- **Davey Farms, Inc.**
- **Foster Farms, Fertilizer Division**
- **Greenheart Farms, Inc.**
- **Growers Ag Service, Inc.**
- **Hennigan Land Leveling, Inc.,**
- **Lockwood Seeds**
- **J.H. Meek & Sons, Inc.**
- **Orsetti Seed Company, Inc.**
- **Pioneer Hi-Bred International**
- **Solex Corporation**
- **Speedling, Inc.**

Thanks!

Cropping System	First Year	Alternate Year
rainfed wheat control	unfertilized rainfed wheat	fallow
rainfed wheat/legume	unfertilized rainfed wheat	rainfed legume cover crop
rainfed wheat/fallow	fertilized rainfed wheat	fallow
irrigated wheat control	unfertilized irrigated wheat	fallow
irrigated wheat/legume	unfertilized irrigated wheat	rainfed legume cover crop
irrigated wheat/fallow	fertilized irrigated wheat	fallow
conventional wheat/tomato	fertilized irrigated wheat	fertilized irrigated tomato
conventional corn/tomato	fertilized irrigated corn	fertilized irrigated tomato
legume/corn/tomato	legume cover crop followed by irrigated corn	fertilized irrigated tomato
organic corn/tomato	legume cover crop followed by corn w/ irrigation and compost	legume cover crop followed by tomato w/ irrigation and compost

Summary of the ten LTRAS cropping systems, including crops, nitrogen sources, and irrigation status. Both starting points of each two-year rotation are represented by three one-acre replicate plots, for a total of six plots per cropping system.

LTRAS in a Nutshell

The UC Davis Long Term Research on Agricultural Systems program (LTRAS) conducts field research on the sustainability and environmental impact of agriculture. We are now in the third cropping year of a 100-year experiment investigating the relationship between sustainability and external inputs, with emphasis on irrigation water and nitrogen fertilizer. Long-term trends in key soil properties (including organic matter, weed seeds, pH, and salinity) will be monitored. Resulting differences in yield, resource use efficiency, profitability, and environmental impact (such as leaching of nitrate or pesticides) will be used to evaluate the sustainability of ten cropping systems differing in external inputs of water and nitrogen (see table above).

Previous long term experiments at other locations found that some important soil parameters change over periods of decades rather than years. Up to 100 years may therefore be needed for a direct and unambiguous assessment of sustainability. LTRAS is also expected to make important contributions to agricultural science over a much shorter time period.

Information from LTRAS, together with other research at UC Davis and elsewhere, will be used to develop "leading indicators" for sustainability, such as computer models and new methods for soil and plant analysis. These improved research tools will facilitate designing new cropping systems with better performance. LTRAS is primarily a research facility, but it also serves as a resource for extension outreach and for graduate and undergraduate teaching.

LTRAS Staff Directory

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- **LTRAS facility phone number: 757-3162.**

Executive Committee

- Graham Fogg; Land, Air & Water Resources, UCD.
- Louise Jackson; Vegetable Crops, UCD.
- Robert Miller; LAWR, UCD.
- Robert Norris; Weed Science, UCD.
- Richard Plant; Agronomy & Range Science, UCD.
- plus permanent staff.

The LTRAS Century is an occasional publication of the Long Term Research on Agricultural Systems project at UC Davis. For a free subscription, send your name and address to:
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