SUSTAINABLE
AGRICULTURE FARMING
SYSTEMS PROJECT
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Looking ahead

Welcome to the *Sustainable Agriculture Farming Systems (SAFS) Project, Fall 2006, Vol.7/No.1* newsletter, which presents research results from the UC Davis Center for Integrated Farming Systems' (CIFS) sustainable agriculture project. It is produced in cooperation with the statewide UC Sustainable Agriculture Research and Education Program. These articles continue our efforts to provide information on economically and ecologically sustainable research and management practices for California growers. To increase our contact with growers, we are considering a fall or winter research update meeting.

We are also very pleased to announce that the SAFS/CIFS research team has received an additional $188,000 to continue water quality research and economic/ecological assessments of winter cover crop and conservation tillage practices from the CalFed program.

—Will Horwath, project leader

Weed control in conservation tillage systems

by Tom Lanini, Gene Miyao, Kent Brittan, and Zahangir Kabir

photo by Gene Miyao

No-till cover crop planting into corn residue at SAFS site.

A reduction in tillage operations saves fuel, time and reduces dust, but also makes weed control more challenging. Tillage for weed control uproots weeds or cuts the the "roots-to-shoots" connection of weeds, and thus prevents them from competing with the crop. Tillage is also used to incorporate certain herbicides, moving them into the soil where they are active. In contemplating the shift to conservation tillage, how will weeds be managed? A few options include subsurface drip irrigation, mulches, a propane flamer, and certain herbicides.

Subsurface drip irrigation can help to prevent weed emergence. Weed seeds typically germinate near the soil surface when environmental conditions are favorable. In a dry climate, lack of moisture can prevent seeds from germinating. Rainfall generally does not occur in sufficient quantities to allow weed seeds to germinate during the typical summer growing season in California. Therefore, burying a drip tape and restricting moisture to the crop root zone can prevent weed seed germination. We examined the use of subsurface drip irrigation in a reduced tillage processing tomato system and were able to maintain or improve tomato yields in both years of the study, reduce water use and reduce weed densities by 98 percent. This system works for annual weeds emerging from seed, but is ineffective against established perennials.

Mulches or cover crops that are left on the surface can help shade the ground and also reduce weed emergence. The thicker the mulch layer, the more effective is the weed control. However, mulches also create problems. Planting into thick mulch requires special attachments to cut and move the thatch from the seed line to improve planting conditions. In

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the process, the removal of the mulch may allow weeds to germinate in the crop row. Cover crop mulches may also reduce soil moisture. In addition, soil temperatures under the mulch are lower than bare soil, which reduces heat units needed for seedling growth. Later in the season, cultivation is often required for weed control where trash from the mulch is often an operational problem for conventional cultivation equipment. Rodents such as gophers may be an increased problem with cover crop vegetation. During furrow irrigation, mulches can partially block water movement, often a problem for efficient water management. At harvest, mulches may create more dust as equipment picks up debris.

Flaming can control small emerged weeds, but is not effective against grasses or larger weeds. Flaming does not require igniting the weed; it is simply necessary to heat the leaves to approximately 130 degrees Fahrenheit, until the membranes burst. If a plant has been sufficiently flamed, it should be possible to press the leaf between thumb and fingers and leave a finger impression. Broadleaf weed seedlings are easily controlled. In our study, we used sprinkler irrigation to stimulate weed germination. We flamed this area 14 days later and were able to control emerged weeds with the flamer. Pre-irrigation followed by flaming reduced in-season weed density in fields with high weed densities, but did not improve weed control in a field with low weed densities. We unsuccessfully used a liquid propane flamer to control large winter weeds in a reduced tillage system. The rising cost of liquid propane makes this option less economical. The risk of fire should be considered in areas where dry vegetation is near.

Herbicides have allowed Midwest corn and soybean farmers to shift to no-till crop production. In California, fewer herbicide options are available. In corn, herbicides that require incorporation may not be effective in no-tillage systems unless they can be moved into the soil by furrow irrigation. Sprinkler irrigation can move many of these herbicides into the soil but are not economical for corn production. Postemergence herbicides are key to no-tillage systems. Statewide, the trend is toward postemergence in all corn production. Growers throughout California use Roundup Ready® (RR) corn technologies in both no-till and standard-till production. Most growers rotate portions of their corn acreages with RR and conventional corn varieties depending on weed pressures, to reduce seed cost and avoidance of weed resistance. We have examined RR corn in a no-till system, with good results for weed control and yields. In tomato, fall bed herbicides are generally moved into the soil by rainfall, so tillage may not be important if timely rainfall occurs. Trifluralin (Treflan®), which requires mechanical incorporation, would not be used in a no-till system. In our system, which lacked sprinkler irrigation, rimsulfuron (Matrix®) provided initial control of emerged weeds, but residual activity was very limited compared to other locations where sprinkler irrigation and cultivation were both used.

There is growing interest in conservation tillage practices in California that reduce environmental degradation and cut crop production inputs. In contrast, weed control remains a great challenge. Development of effective weed control strategies and new management systems in conservation tillage is necessary. Our continuous research emphasis will be to find potential mechanisms to suppress weeds in conservation tillage and increase knowledge of sustainable agricultural practices for crop production.

Part II: Growers review winter cover crops, conservation tillage

by Lyra Halprin, Gene Miyao and Aaron Ristow

[Editor's Note: Part I appeared in Vol. 6, No. 3 of the SAFS newsletter. The complete story is available online at http://www.safs.ucdavis.edu/newsletter/]

Frank Muller. Yolo county farmer Frank Muller uses winter cover crops and conservation tillage to various degrees on different crops he farms both organically and conventionally with his large family operation, Joe Muller and Sons.

"We do include winter cover crops on some target crops," he said. "We use them ahead of our later-planted tomatoes so we can follow best management practices and not fight putting them in when the ground is too wet. But we avoid practices that compromise our yield goal."

Muller said he is interested in learning about practices that help him save money while producing the same or increased yields.

"You want your expectations to always be high—we want to incorporate these more sustainable practices and hopefully increase yields," he said. "Once our yield bar has been set, we will not lower our expectations."

He noted that his operation's use of conservation tillage has been very successful in some crops.

"We raise a lot of sunflower seeds," he said. "We have our tillage program down to one pass with a stalk chopper after the sunflower harvest before we plant wheat. Without a doubt, we are successful using conservation tillage there."

Muller noted at the other end of the spectrum, he uses more conventional tillage in high-value crops like tomatoes or peppers.

"With tomatoes we can't have a lot of residue on top of the bed because trashy conditions make harvest difficult," he said. "We're numbers people here. If it's less cost effective in the big picture, it doesn't make sense."

Muller said his operation's tillage has changed quite a lot in the last few years; the number of field passes has been reduced 60 percent, but many standard implements are still used.

He said if farmers can see that alternative farming practices

consistently provide greater returns, they would readily adopt them.

"People can see that some farmers are having success using cover crops and reduced tillage, and they see diesel prices rising so they want to adopt these practices," he said. "But we also have to see that they provide short-term profitability."

The problem for him, Muller said, is that what works on one farm in one microclimate, may not work for his operation.

"I'd like to see a project that focuses on maximizing return. Researchers should identify the model of best management practices, including conservation tillage and winter cover crops," he said. "The goal of this project would be to create an economic model that is superior to conventional models. Lower costs, higher yields, and greater environmental benefits will draw a crowd."

photo by Z. Kabir

Several growers and UC Cooperative Extension personnel who cooperate on the SAFS project discussed farming practices at Sano Farms in Firebaugh. L-R: Yolo County farm advisor Gene Miyao, Sano Farms farm manager Jesse Sanchez, Yolo County farmers Bruce Rominger and Tony Turkovich, and UCCE vegetable crops specialist Jeff Mitchell.

Paul Underhill. Yolo County organic farm partner Paul Underhill said he has increased the planting of fall cover crops (grasses) on 220-acre Terra Firma Farm. The cover crops are irrigated in October and mowed after they have "frosted down," which has worked well as preparation for summer cash crops. Unfortunately, during 2006's very wet spring, winter cover crops like vetch were still green and weren't turned under in time.

"Our vetch cover crops will work better this year if we wait to plant the cash crops until fall and winter," he said. "That takes some of the stress out of using winter cover crops."

He said the extended rain, which made it impossible to incorporate or mow winter cover crops on time, is what big growers fear—they can't get into fields and plant 500 acres of a cash crop quickly on saturated fields.

"We like to plant cover crops before our biggest cash crops," he said. "Our organic plants produce way bigger yields after winter cover crops."

Although Underhill said it would be useful for smaller farmers to share the use of expensive planting and mowing equipment for cover crops, he noted that wet years underscore why it is hard to share equipment: "during the few dry windows for mowing or planting, everyone wants to use the equipment."

He said he appreciates reading the SAFS/CIFS project research results and was especially interested to see that researchers had documented a phenomenon he and other organic growers have seen on their land—the use of cover crops has helped build up soil nitrogen, but plants don't seem to be able to access it.

"We know we're building up nitrogen in our soils, but we still have to apply expensive organic nitrate fertilizer," he said. He said he has been watching commercial microbial products such as "EM" and "Microlizer" that purport to increase the availability of existing nitrogen in the soil, but he would like university researchers to conduct "an objective test on all those products."

"We know the nitrogen is in the 'nitrogen bank' in the soil, and we're trying to do 'withdrawals,'" he said. "We'd like to know if these microbial products would help."

Tony Turkovich. Grower Tony Turkovich farms several thousand acres in Yolo and Solano counties as a partner in Button & Turkovich Ranches. He said his operation has used cover crops and conservation tillage for many years in varying degrees.

"We grow a lot of alfalfa using conventional tillage to get it established, but use minimum tillage on most of the other ground," he said. "We have used no-till in corn and wheat, but we're trying not to grow those crops, which tend to be unprofitable."

Turkovich said that they do not generally plant cover crops before high-value crops like tomatoes and peppers, which must be planted early, although the later-planted tomatoes are sometimes preceded by cover crops.

"The majority of our fields have cover crops, including the orchards," he said. "This year we planted garbanzo beans on some fields, which although they are harvested as a cash crop, also function as a winter cover crop."

"All told, around three-quarters of our fields have some kind of winter cover crop," he said. "Cash crops that provide some of the benefits of a winter cover are certainly a consideration in our crop selection."

Turkovich noted that in the north part of the state, farmers

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have traditionally thought of winter cover crops as "big, lush, leguminous plants."

"But with diesel reaching $3 a gallon, and many costs associated with working the cover crops in, we're rethinking the legumes and looking at the cereal cover crops reported to be used more in the southern San Joaquin Valley," he said.

He said he is interested in finding out more about plants that can be used as cover crops "whose roots improve soil structure, but don't have as much above-ground biomass and therefore wouldn't require significant spring tillage."

Turkovich said he'd like to see more research investigating new cover crops that enrich the soil and improve water quality, as well as equipment and techniques that growers can use to plant directly into residue, which would reduce the need to spend time and money working plant trash into the soil.

"With fuel and fertilizer costs going up, conservation tillage is definitely more attractive as a way to save field costs," he said. "Cover crops need to be reevaluated in relation to the rising costs of fuel and fertilizer and whether we can manage them in a cost-effective way."

More information on UC Davis sustainable agriculture farming systems projects is available online at **safs.ucdavis.edu**, including expanded newsletter articles, SAFS/LTRAS updates, and other resources.

SAFS Principal Investigators

Crop Ecology	Louise Jackson, lejackson@ucdavis.edu
Crop Production	Steve Temple, srtemple@ucdavis.edu
Economics	Karen Klonsky, klonsky@primal.ucdavis.edu
Entomology	Frank Zalom, fgzalom@ucdavis.edu
Hydrology	Wes Wallender, wwwallender@ucdavis.edu
Nematology	Howard Ferris, hferris@ucdavis.edu
Plant Pathology	Lynn Epstein, lepstein@ucdavis.edu
Soil Microbiology	Kate Scow, kmscow@ucdavis.edu
Soil Fertility	Will Horwath, wrhorwath@ucdavis.edu
Soil & Water Relations	Jeff Mitchell, mitchell@uckac.edu
Weed Ecology	Tom Lanini, wtlanini@ucdavis.edu

SAFS Technical Staff

Research Manager	Z. Kabir, kabir@ucdavis.edu
Crop Production Manager	Dennis Bryant, LTRAS associate director dcbryant@ucdavis.edu
Project Technician	Stephanie Ma sama@ucdavis.edu

SAFS Technical Advisors

UC Cooperative Extension Farm Advisors, Yolo & Solano Counties	Gene Miyao, emmiyao@ucdavis.edu Kent Brittan, klbrittan@ucdavis.edu

Growers

Jim Durst, jdurst@onemain.com; Scott Park, parkfarm@syix.com; Frank Muller, jmsyvsm@aol.com; Bruce Rominger, brrominger@ucdavis.edu; Ed Sills, esills@earthlink.com; Tony Turkovich, tturk@bigvalley.net

UC Sustainable Agriculture Research & Education Program (SAREP) Cooperating Outreach Staff

Publications Editor	Lyra Halprin, lhalprin@ucdavis.edu
Web Development	James Cannon, safsweb@ucdavis.edu

SUSTAINABLE AGRICULTURE FARMING SYSTEMS PROJECT

Department of Land Air & Water Resources
University of California, Davis
One Shields Avenue
Davis, CA 95616