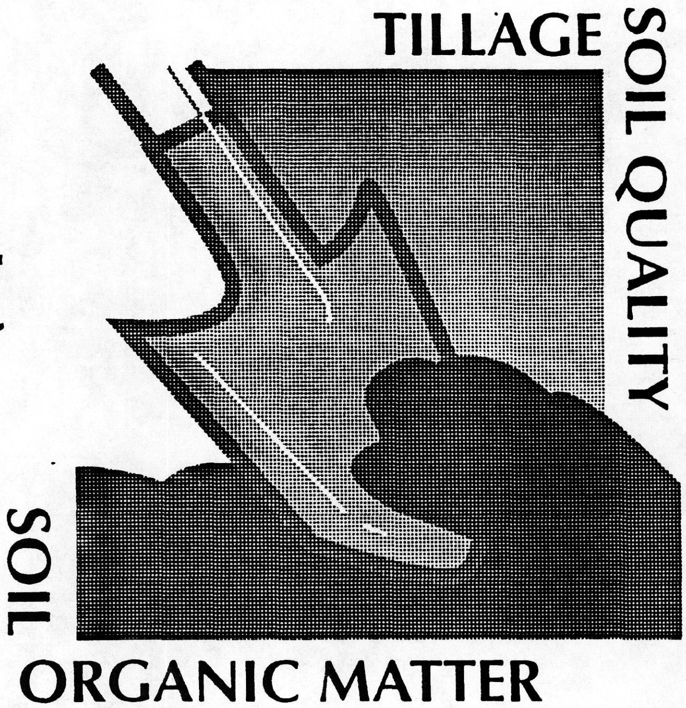
SW96-016

PROCEEDINGS

Emerging Soil Management Options *for* CALIFORNIA



Wed • Apr. 22, 1998
Five Points , CA

Thu • Apr 23, 1998
Davis , CA

Program

Wednesday, April 22, 1998
Five Points, CA

7:30 am	**Registration and Refreshments**
8:00 am	**Welcome and Introduction to Goals of Conference** *Jeff Mitchell, UC Davis / Kearney Agricultural Center*
8:05 am	**Overview of San Joaquin Valley Crop Rotations and Tillage in San Joaquin Valley Production Systems** *Jeff Mitchell and Dan Munk, UC Davis / Kearney Agricultural Center*
8:20 am	**Conservation Tillage and Carbon Cycling: Soil as a Source or Sink for Carbon** *Don Reicosky, USDA ARS Morris, MN*
8:50 am	**Carbon and Nitrogen Dynamics After Tillage in California Soils** *Louise Jackson, UC Davis*
9:20 am	**Discussion / Break**
9:30 am	**Soil Management: The Key to Sustainability** *Aref Abdul-Baki, USDA ARS Beltsville, MD*
10:00 am	**Affordable Small Farm Equipment for High Residue Production of Vegetables** *Ron Morse, Virginia Polytechnic Institute and State University*
10:30 am	**Integrating Cover Crops and Strip-Tillage for Vegetable Production** *John Luna, Oregon State University*
11:00 am	**Conservation Tillage Cotton Systems** *Dion McBay, Monsanto Corporation*
11:30 am	**San Joaquin Valley Grower Panel Discussion** *Kurt Quade, Jim Ashford, Tim O'Neill, John Diener and John Diener*
12:15	**General Discussion: Options for Reduced Tillage in California's San Joaquin Valley**
12:30	**Lunch outside in park**
1:15 pm	**Pegasus Tillage in Cotton** *Lyle Carter, USDA ARS Shafter Cotton Research Station*
1:35 pm	**Ridge Till: A Conservation Tillage System for California Furrow Irrigated Farm Land** *Ralph Cesena, Sr., Cesena Distributing Company*
2:00 pm	**Strip Tillage** *Jeff Mitchell, UC Davis / Kearney Agricultural Center*
2:20 pm	**No-till tomatoes** *Jeff Mitchell, Aref Abdul-Baki and Ron Morse*
2:40 pm	**Wrap-up Discussion**

CARBON AND NITROGEN DYNAMICS AFTER TILLAGE IN CALIFORNIA SOILS

Louise Jackson, Associate Professor/CE Specialist
Department of Vegetable Crops, University of California - Davis

Intensive Management and Frequent Tillage in Vegetable Production Systems

In the past 100 years, California agriculture has changed dramatically due to the development of large, statewide water transport systems, which fostered the development of intensively-farmed, high-input production systems. Until the 1920's, cattle production on annual grassland and dry-farmed grains were the predominant agricultural commodities. Associated with intensively-tilled, irrigated agriculture for vegetables has been the degradation of soil and water quality, and the contamination of watersheds with nitrate (NO_3-N).

The Salinas Valley is the leading producer of cool-season vegetables (*e.g.*, lettuce, broccoli) in the nation. Large amounts of fertilizer are applied. Two to three crops are produced per year. Tillage is frequent year-round, and little organic matter is returned to the soil. Tillage ranges from single passes for weed control to ripping, disking and leveling a field between crops. There are serious problems with water and soil quality in this area. Nearly half the wells in the upper aquifer exceed the public health drinking water standard for NO_3-N. Several soilborne diseases, *e.g.*, corky root of lettuce and fusarium wilt of celery, are widespread. Levels of soil organic matter (SOM) have decreased by half since the area was dry-farmed at the turn of the century. Intensive management undoubtedly contributes to these problems.

Effects of Tillage on Soil Organic Matter

In other areas of the USA, research has shown that tillage causes net mineralization of SOM and thereby decreases soil N retention and N cycling capacity. Grassland soils, which maintain low inorganic N pools when undisturbed, show enormous increases in NO_3-N leaching following tillage. Plowed soils have higher inorganic N pools compared to no-till and native sod treatments (Follett & Schimel, 1989). No-till soils, however, do have greater denitrification rates (Linn & Doran, 1984).

Tillage may be important in stimulating the rapid decline in SOM and active fraction SOM, and may contribute to the net NO_3-N loss in these cropping systems. Soil organic matter comprises several fractions which decompose at different rates, including a small labile fraction, largely composed of decaying plant material and microbial cells, that is quickly utilized by microorganisms. Most of the SOM in agricultural soils is degradation-resistant, and turns over much more slowly (Jenkinson, 1990). The labile fraction, which plays a prominent role in soil nutrient dynamics (Parton *et al.*, 1987), and which may function as a temporary nutrient reservoir (Paul, 1984), declines with cultivation (Cambardella & Elliott, 1994), and when a fallow period is included in the crop rotation (Biederbeck *et al.*, 1994). The labile fraction of SOM is protected within soil macroaggregates, and is thought to be the primary SOM pool that is depleted as a result of tillage (Elliott, 1986). Rapid CO_2 loss is another consequence of tillage; peak flux can occur within a few hours of soil disturbance (Roberts & Chan, 1990; Reicosky & Lindstrom, 1993).

Research Program in the Salinas Valley

In our research, we are studying the pulses of microbial activity that occur after tillage. We are examining how soil microbial nitrogen transformations are altered by tillage, and consequently affect the production and loss of NO_3-N from the rooting zone. Our focus is on the short-term processes that occur immediately after tillage events in the intensively managed soils for vegetable production in the Salinas Valley. A peak and then a decline in microbial activity and respiration has been shown to occur soon after tillage. Nitrate production increases gradually during the post-tillage period.

We are testing the hypothesis that in these highly tilled, degraded soils, short pulses of available carbon may be rapidly and opportunistically used by microorganisms, with only limited retention of available carbon in microbial biomass. Tillage appears to be a disruptive process that may have important implications for explaining the loss of soil organic carbon and nitrogen in tilled systems. It may reduce the potential for retention of total and active carbon and nitrogen as SOM, and increase NO_3-N accumulation, and consequently increase losses by leaching and denitrification when subsequent rainfall or irrigation occurs.

Comparison of soils from different management histories (*e.g.* vegetable and grassland soils on the same soil type) provide a means to better understand the relationships between carbon and nitrogen dynamics, tillage, and moisture, as well as to assess the effects of tillage on various land use practices. Differences in the structure of soil microbial communities are expected to occur with management history, and thus will show different changes in response to disturbance. For example, when vegetable and grassland soils were sieved, both soils showed marked increases in soil NO_3-N, and rapid fluctuation of microbial biomass and dissolved organic carbon occurred in the first few days after disturbance, but responses were greater in the grassland soil (Calderon *et al.*, 1998). Microbial community structure in the grassland soil, as measured by phospholipid fatty acid analysis, also indicated greater fluctuation in the grassland soil, suggesting lower recovery in response to disturbance. Two weeks after sieving, microbial biomass was either lower (grassland soil) or similar (vegetable soil) indicating that the temporary release of carbon from tillage was not retained in the microbes in the soil.

Our preliminary work indicates that while tillage can provide short pulses of available carbon to microbes in soil, microbial biomass rapidly fluctuates, microbial processes are disrupted, microbial community structure is altered, and soil NO_3-N accumulates. Repeated tillage may select for opportunistic, rapid utilization of available carbon by microorganisms, but not necessarily for efficient use and retention of carbon in the microbial biomass and in the labile fraction of the SOM.

References

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