Sustainable Agriculture for California: A Guide to Information

The system of agriculture... if the epithet can be applied to it, which is in use in this part of the United States is as unproductive to the practicioners as it is ruinous to the landholders. Yet it is pertinaciously adhered to. To forsake it; to pursue a course of husbandry which is altogether different and new ... requires resolution, and without a good practical guide may be dangerous.

George Washington, 1783

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4.0. SOIL MANAGEMENT, ECOLOGY AND FERTILITY

Our most serious problem, perhaps, is that we have become a nation of fantasists. We believe, apparently, in the infinite availability of finite resources. We persist in land-use methods that reduce the potentially infinite power of soil fertility to a finite quantity, which we then proceed to waste as if it were an infinite quantity. Wendell Berry

When people inquire about sustainable agriculture and ask what really distinguishes it from conventional agriculture, farmers doing it, though they might disagree on other things, would probably say that along with making a profit the most important thing is that their soil remain as productive and fertile in coming decades as it is today. This attitude is woven into their approach to agriculture and, in turn, is why proper soil quality management information, based on agroecological and soil conservation principles, is so important in this guide.

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4.1. BIOFERTILIZERS--GENERAL

The 1973 and 1979 oil crises reminded California's farmers that fossil fuels are nonrenewable, limited resources. The farm sector was affected by shortages of fossil fuels and rapid price increases in nitrogen fertilizers made from fossil fuels. If not as dramatically evident as in 1973 and 1979, the costs of nitrogen from fossil fuels has continued to rise unabated over recent years.

In sustainable agriculture, fossil fuel based fertilizers are seen as one of the major, expensive external inputs that can be reduced or eliminated by skillful management of biological resources. Sustainable practices, while emphasizing the need for increased efficiency and conservation in petro-chemical fertilizer application, often go the next step futher by emphasizing on-farm produced, relatively inexpensive nutrient sources produced on the farm. Together these are coming to be known as biofertilizers because they directly or indirectly provide fertile soil conditions through on-farm biological processes. Green manures are perhaps the best known of these. This section covers general treatments of the subject while the next several sections cover specific aspects.

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4.1.1. BIOFERTILIZERS—MYCORRHIZAL FUNGI

Mycorrhizal fungi can improve crop phosphorus uptake, drought tolerance, and enhance plant growth. Mycorrhizal fungi also provide protection against some types of plant pathogens. Commercial inoculum is now available for many crops and climate zones and shows considerable promise for improving plant growth. Mycorrhizal fungi can be killed or harmed by chemical pest treatment and plants may develop phosphorus deficiency symptoms if the symbiotic mycorrhizal association is affected.

Mycorrhizal fungi are particularly beneficial for perennial plants that will be grown in environments where phosphorus is limited or not readily available to plants. Mycorrhizal fungi can serve as bridges between plants of different species and have been shown to transfer nutrients and carbon. This behavior can be exploited in some intercrops.

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4.1.2. BIOFERTILIZERS--EARTHWORMS AND OTHERS

Earthworms, though not providing direct symbiotic benefits for crops, enhance soil fertility and structure in so many ways that they belong in this section with the many other organisms which enhance soil fertility.

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Natural biological nitrogen fixation with the legume-Rhizobium symbiosis has been shown to be highly effective and offers considerable potential for energy conservation. Yet only a few legume species have been evaluated in California and legume based cropping systems have been little studied since the early part of this century. Intercropping nitrogen fixing trees with fruit trees appears to offer many advantages, and an acacia/citrus intercrop has done very well in Australia.

Selecting the appropriate strain or strains of rhizobia can be important. Salt tolerant and salt loving species have been found recently. Nitrogen fixation may take place at considerable depths in some ecosystems. Active nodules have been found at 5-6 m depth.

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4.3. GREEN MANURES and COVER CROPS

Green manure and cover crops are grown and plowed under to improve soil fertility and structure. They may also be used for grazing and reducing soil erosion. Green manures and cover crops can increase the general level of fertility by fixing nitrogen, mobilizing minerals, and by building up soil organic matter. One of the common benefits of green manures and cover crops is increased infiltration of water.

However there are also some potential disadvantages. Green manure crops may exhaust reduce the supply of soil moisture for the following crop, adversely affect growth through allelopathy or, in some cases, lead to an increase of certain diseases, insects, and nematodes. Attention to choice and timing of green manure and cover crops is important.

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The key features of this farming system, also common in Europe, are the use of self-regenerating annual legumes and integration of grazing animals in the rotation. The legume eliminates the need for nitrogen fertilizer by biologically fixing nitrogen from the atmosphere. The grazing animals recycle nitrogen, help manage the legume component, and suppress weeds.

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4.7.1. NEW TILLAGE METHODS (non-conservation tillage)

Soil compaction, damaged soil structure and soil erosion are all problems that lend themselves to sustainable solutions. These include permanent bed systems, track systems, emphasis on reduced field traffic and multiple operations per pass as well as conservation tillage. Spaders rather than rototillers reduce soil disruption.

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4.7.2. CONSERVATION TILLAGE

Conservation tillage has some big pluses in regard to can provide many soil conservation benefits. Conservation tillage emphasizes leaving crop residues on the surface to reduce erosion and reducing tillage. Prevalent in the Midwest, it is being adapted to California conditions. It has a potential big minus, however, in regard to maintaining soil and water quality: These benefits can be offset by the adverse impacts of conventional conservation tillage typically substitutes large amounts of herbicides used to replace tillage for weed control.

Sustainable conservation tillage systems are being developed, however. Flame weeding, mowing, efficient herbicide conserving equipment (e.g., wick applicators), the use of living mulches or weed suppressing crops and even the use of weeder geese and grazing by animals and other biological means of control may all start to play bigger roles here.

Although not yet fully modified for California's climate and crops, conservation tillage and its many variants are being more widely used. Over 256,000 acres were in reduced tillage (60%), mulch tillage (24%), no-tillage (16%), ridge tillage (<1%), or strip tillage (<1%) in California in the mid-80's according to the Conservation Tillage Information Center (Study of Tillage Practices, 1985).

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4.9. Restoration of degraded farm land

The long-term harvest from unsustainable production includes a bill that all of us will have to pay for a long time to come: degraded or wasted farm land. Depending on the type of degradation, though, there can be ways to bring back soil fertility, soil organic matter, tilth and to counter problems such as soil salinity.

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5.0. WATER MANAGEMENT

This state is running out of water. And the water that it has is, in more and more places, becoming of doubtful drinking and agricultural quality. At the same time, both the state and federal government have, in many districts, heavily subsidized irrigation water. This, too, may change. Concern about agricultural water management and conservation is one sustainable agriculture issue that is embraced by all California farmers. More work needs to be done in this area, but the following works are very helpful.

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Irricab: current annotated bibliography of irrigation. 1976-86 (temp. ceased). International Irrigation Information Center. P.O.B. 49, 50250 Bet Dagan Israel. [Ref S613 I7 R/D/B]. Like Irrigation and Drainage Abstracts, this is a superior abstract journal covering all subjects related to water management and irrigation.

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5.1. IMPROVING IRRIGATION

The efficiency of conventional irrigation systems can be improved with minor revisions and more careful management. Recent material of interest includes:

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Issues in Sustainable Agriculture Measurement of Sustainability Land Use Degradation of Prairie Soil Resources Soil Erosion Decline in Organic Matter Soil Salinity Soil Acidification Assessment Preservation of Biodiversity Water Use and Quality on the Prairies Use of Common Property Economic Situation Social Problems on the Plains Impacts of Trade on Sustainability Trade and the Environment Federal and Provincial Policies Global Change. Analytical Methodology Contributions to Measurement of Sustainability Measurement of Sustainability Issues Principles for Sustainable Agriculture on the Prairi ATTRA, also known as the National Sustainable Agriculture Information Service, is managed by the National Center for Appropriate Technology. ATTRA provides information and technical assistance to those engaged in or serving commercial agriculture, such as farmers, ranchers, extension agents, farm organizations and farm-based businesses and others involved in sustainable agriculture in the U.S. ATTRA is a valuable complement to the SARE program and other USDA research programs through its provision of readily accessible sustainable and organic farming information to farmers. and ranchers across Agriculture must change to meet the rising demand, to contribute more effectively to the reduction of poverty and malnutrition, and to become ecologically more sustainable. This transformation will be crucial for achieving many of the post-Ââ€2015 Sustainable Development Goals (SDGs). Poverty and hunger must be eradicated in our generation and should therefore be a prominent stand-Ââ€alone goal.Â Major elements of a sustainable development path for agriculture and food systems are: â€¢ Shifting towards healthier diets; â€¢ Ensuring the supply of safe, nutritious food to all through increasing agricultural productivity on.