## UNIT IV

## ECOLOGICAL DIVERSITY AND AGRICULTURE

**Ecological diversity, wild life and agriculture – GM crops and their impacts on the environment – Insets and agriculture – Pollination crisis – Ecological farming principles – Forest fragmentation and agriculture – Agricultural biotechnology concerns.**

ECOLOGICAL FARMING PRINCIPLES

Ecological farming is recognised as the high-end objective among the proponents of sustainable agriculture. Ecological farming is not the same as organic farming, however there are many similarities and they are not necessarily incompatible. Ecological farming includes all methods, including organic, which regenerate ecosystem services like: prevention of soil erosion, water infiltration and retention, carbon sequestration in the form of humus, and increased biodiversity. Many techniques are used including no till, multispecies cover crops, strip cropping, terrace cultivation, shelter belts, pasture cropping etc.

Benefits

Ecological farming involves the introduction of symbiotic species, where possible, to support the ecological sustainability of the farm. Associated benefits include a reduction in ecological debt and elimination of dead zones.

Ecological farming is a pioneering, practical development which aims to create globally sustainable land management systems, and encourages review of the importance of maintaining biodiversity in food production and farming end products.

One foreseeable option is to develop specialized automata to scan and respond to soil and plant situations relative to intensive care for the soil and the plants. Accordingly, conversion to ecological farming may best utilize the information age, and become recognised as a primary user of robotics and expert systems.

Challenges

The challenge for ecological farming science is to be able to achieve a mainstream productive food system that is sustainable or even regenerative. To enter the field of ecological farming, location relative to the consumer, can reduce the food miles factor to help minimise damage to the biosphere by combustion engine emissions involved in current food transportation.

Design of the ecological farm is initially constrained by the same limitations as conventional farming: local climate, the soil's physical properties, budget for beneficial soil supplements, manpower and available automatons; however long-term water management by ecological farming methods is likely to conserve and increase water availability for the location, and require far fewer inputs to maintain fertility.

Principles

Certain principles unique to ecological farming need to be considered.

Food production should be ecological in both *origin* and *destiny*

Integration of species that maintain ecosystem services whilst providing a selection of alternative products

Minimise food miles, packaging, energy consumption and waste.

Define a new ecosystem to suit human needs using lessons from existing ecosystems from around the world

Apply the value of a knowledge-base (advanced data base) about soil microorganisms so that discoveries of the ecological benefits of having various kinds of microorganisms encouraged in productive systems such as Forest Gardens can be assessed and optimised; for example in the case of naturally occurring microorganisms called denitrifiers

MANAGING SOILS AND CROPS TO MINIMIZE PEST PROBLEMS

It is well established and known by most farmers that crop rotation can decrease many disease, insect, and weed pressures. A few other examples of management practices that reduce pest pressure follow:

Insect damage can be reduced by avoiding excess inorganic nitrogen levels in soils by using better nitrogen management.

Adequate nutrient levels reduce disease incidence. For example, calcium applications have reduced diseases in crops such as wheat, peanuts, soybeans, and peppers, while added potassium has reduced the incidence of fungal diseases in crops such as cotton, tomatoes, and corn.

Damage from insect and disease (such as fungal diseases of roots) can be decreased by lessening soil compaction.

Severity of root rots and leaf diseases can be reduced with composts that contain low levels of available nitrogen but still have some active organic matter.

Many pests are kept under control by having to compete for resources or by direct antagonism from other insects (including the beneficials feeding on them). Good quantities of a variety of organic materials help maintain a diverse group of soil organisms.

Root surfaces are protected from fungal and nematode attack by high rates of beneficial mycorrhizal fungi. Most cover crops help keep mycorrhizal fungi spore counts high and promote higher rates of infection by the beneficial fungi.

Parasitic nematodes can be suppressed by selected cover crops.

Weed seed numbers are reduced in soils that have a lot of biological activity, with both microorganisms and insects helping the process.

Weed seed predation by ground beetles is encouraged by reduced tillage and maintenance of surface residues. Reduced tillage also keeps the weed seeds at the surface, where they are accessible to predation by other organisms, such as rodents, ants, and crickets.

Residues of some cover crops, such as winter rye, produce chemicals that reduce weed seed germination.

Ecological crop and soil management practices can be grouped under one or more of three overall strategies:

Grow healthy plants with strong defense capabilities

Stress pests

Enhance beneficial organisms

These overall strategies are accomplished by practices that maintain and enhance the habitat both above ground and in the soil. Ecological approaches call for designing the field and farm to take advantage of the inherent strengths of natural systems. Most of this is done prior to, and during, planting a crop and has the goal of preventing problems from developing by contributing to one or more of the three overall strategies. However, there are also routine management practices that occur during the season even if you have done a lot of preventive management. For example, irrigation is frequently needed for high-value crops such as fresh market vegetables—even in humid regions. Also, scouting for pest problems and beneficials should be part of routine management during the season. If an unanticipated problem, such as an insect outbreak, arises, remedial action, such as applying the most ecologically sound pesticide or releasing purchased beneficials into the field, may be required to save the crop.

Ecological principles provide a good framework for sustainable management, but we must also recognize that crop production is inherently an “unnatural” process because we favor one organism (the crop plant) over the competing interests of others. With currently available pesticides, the temptation exists to simply wipe out competitors for example through soil fumigation but this creates dependency on purchased materials from off the farm and weakens the overall resiliency of the soil and cropping system. The goal of ecological crop and soil management is to minimize the extent of reactive management (which reacts to unanticipated occurrences) by creating conditions that help grow healthy plants, promote beneficials, and stress pests. The discussion below and in the rest of this book focuses on ways to maintain and enhance habitat in order to promote one or more of the three strategies listed above.


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