



## Ancient agriculture Practices for Management of Plant Diseases

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### Abstract

The traditional farming system is an ecologically based age-old farming system developed by ancient farmers through generations of their interaction with nature and natural resources for food, fodder, and fiber. Since in modern agriculture plant disease management is by molecular biology and the use of chemicals, it has led to several problems. There is a need to re-examine the potential of traditional agriculture. Traditional farming systems have generated control techniques that meet the essential criterion of environmental sustainability. To use the genetic germplasm, these techniques constitute a stock of highly diversified cultural practices that should be maintained for the viability of agriculture. Techniques such as biological control, cultural practices, and host plant resistance are alternative pest control methods practiced throughout the world of “Traditional agriculture”.

**Keywords:** Cultural practices, Plant disease management, subsistence agriculture, Traditional agriculture.

### Introduction

Diseased plants are the main biotic constraint, which causes significant losses to farmers across the world. It is estimated that 10-15% of yields in developing countries are lost due to diseases. Increased use of chemicals to control diseases has led to several problems such as environmental degradation, health hazards to humans, pest resistance. Modern agriculture is a highly energy-intensive and narrow genetic base because the attainment of higher yields and greater efficiency may lead to mono-cropping and overproduction. It is time to re-examine the potential of traditional agriculture to contribute to a sustainable system of production agriculture.

The majority of farmers in developing countries tend small plots. Half of the world’s population is engaged in agriculture and the vast majority live in rural areas and engage primarily in subsistence



agriculture. Poverty and socioeconomic insecurity characterize the lives of many rural people who often have few resources beyond the labor of their families. Traditional agriculture usually is associated with primitive agricultural systems.

Most thoughtful crop protectionists have been concerned about the future of crop protection technology based predominantly on pesticides despite the significant gains. This led to many studies on alternate approaches to crop protection. Most of the alternatives are not new such as host plant resistance and cultural and biological controls have all been in use since the beginning but not with the same degree of sophistication that exists today. If crop protectionists are to adapt old methods of crop protection studies should be made of their origin and development.

## **1. Ancient Agriculture**

Human beings commenced cultivating land by utilizing their then-existing implements to produce agricultural edibles for survival during the Stone Age and the Hunter-Gatherer Age. Ancient people developed sustainable agriculture practices that allowed them to produce food and fiber for thousands of years with few outside inputs. Traditional agriculture uses strategies of cultivation that were acquired through practices that began with the beginning of crop production 10,000 years ago. Most of the activities of the farmers in traditional agriculture are culture-based and are exhibited in tasks such as seed sowing, planting, transplanting, growth, and harvest. Although little information is available about traditional methods of cultivation, the available information is easy to understand and administer.

## **2. Plant Disease Management practices of ancient's farmers**

Most practices of traditional farmers for disease management in developing countries consist of cultural controls. It aims to improve plant growth by providing proper nutrition and moisture, and by creating conditions that are unfavourable to pathogens, thereby reducing disease development. Most of these practices are sustainable and although some are highly labour-intensive, this is not necessarily undesirable in settings where land, energy, capital are more limiting than labor. It is important to integrate traditional cultural practices into pest management systems for developing countries, especially those for the management of plant diseases. Despite the paucity of scientific information available on the crop protection components of ancient or modern traditional agricultural systems, we have enough knowledge of crop protection tactics today to make possible the identification of some of these components in several present-day traditional systems. The principal tactics for managing

diseases are host resistance, cultural controls, and biological controls. Cultural controls include operations such as ploughing, time of planting, irrigation, rotations, mixed cropping, etc.

### **2.1.1 Suppressive soils**

Suppressive soils have been referred to as soils in which there cannot be establishment or persistence of pathogen. It is associated with the level of fertility, types, and numbers of soil organisms, as well as the nature of the soil texture and drainage. Mechanisms through which soilborne pathogens are affected by rhizosphere microorganisms include consumption of pathogen stimulatory compounds, antibiotic compound production, direct parasitism, (micro)nutrients competition, production of lytic enzymes. Various pathogens for which suppressive soils have been demonstrated include fungi such as *Pythium splendens*, *Fusarium oxysporum*, *Gaeumannomyces graminis var. tritici*, *Aphanomyces euteiches*, *Phytophthora cinnamomi*.

### **2.1.2 Antagonistic plants and Trap crops**

Some plants release substances in the soil that are toxic to pathogens. When interplanted, these decrease the number of nematodes in the soil and the roots of the susceptible crops. The toxic chemical HCN secreted by Sorghum is antagonistic to *Fusarium*. Trap (or catch) crops are susceptible plants that are grown on land that contain pathogens. The pathogens infect the crop which must be destroyed before the life cycles of the pathogens are complete. If a few rows of rye are planted around a field of beans, peppers many of the incoming aphids carrying viruses that attack the beans, peppers will first stop and feed on the peripheral taller rows of rye as aphid-borne viruses are non-persistent they lose virus, thereby reduce inoculum.

## **2.2 Cultural practices**

### **2.2.1 Adjusting Plant density, Rate of Sowing**

In seed-beds, crowded stands of many vegetable and flower crops develop elongated stems that are prone to the attack of all damping-off organisms and soil-borne fungi that affect crops before stems lignify. A good example of the latter is *Sclerotium rolfsii* which, will attack irrigated cotton only when seedlings are unduly crowded. Leaves and petioles of crowded plants are also easy prey to downy mildews, e.g., *Peronospora tabacina* on tobacco and chili pepper, *P.parasitica* on Brassicae. This can be controlled by adjusting plant density and the rate of sowing.

### **2.2.2 Adjusting Depth and Time of Sowing**

Depth of sowing is usually determined by seed size and the moisture status of the soil. Deeper sowing may promote germination but it also lengthens the susceptible pre-emergence seedling phase. Smuts and seedling diseases caused by *Fusarium* spp. and *Rhizoctonia* spp. are more serious if seeds are planted deeply. Successes are achieved in reducing the incidence of virus diseases by sowing crops when vectors are least likely to harm them. In tomato, sowing should not be done in warm and humid seasons when vector (Thrips) populations are peak, to control Tomato Spotted Wilt disease.

### **2.2.3 Raised fields, Raised beds, Ridges and Mounds**

Drainage, fertilization, irrigation were important considerations, but planting in soil raised above surrounding area was also a significant disease management practice, especially for soil-borne pathogens. Flooding for Rice culture destroys soil-borne pathogens and vegetables and other crops can be grown subsequently on raised beds, with fewer disease problems.

### **2.2.4 Slash-and-Burn Agriculture**

It is also known as Shifting cultivation or swidden agriculture. Over centuries traditional agriculturalists evolved slash-and-burn agriculture as a solution to soil problems and a method for managing pests. The system consists of small plots which are partially cleared from thick jungle growth. The cut vegetation is burned and crops are planted in the ashes. The plots can be used for one to three years and then abandoned to native vegetation for a fallow period of up to 20 years. This not only conserves moisture, restores organic matter, prevents erosion but also reduces weeds, insects, and various pathogens.

### **2.2.5 Destruction of Crop residues**

Crop residues provide suitable substrates for many pathogens. Burying, burning, and removal of postharvest crop residues are important cultural control practices performed during intercrop periods. If crop residues are buried, some potential pathogens may be either killed or inhibited in their development. Deeply inverted surface trash assists in the control of groundnut (peanut) blight because the causal fungus (*Sclerotium rolfsii*) requires a food source near the surface of the soil. Plants with shallow root systems may also escape infection if debris from the previous crop is ploughed in deeply. This practice has been relatively successful in controlling the verticillium wilt of mint (*Mentha* spp.).



## **2.2.6 Flooding**

The paddy system of growing rice is perhaps the oldest example of using flooding for plant disease management. The primary purpose of flooding is to control weeds. However, it also reduces the number of fungal propagules, insects, and nematodes in the soil probably by subjecting them to attack by soil-borne bacteria. Rice blast (*Pyricularia oryzae*) is less severe on flooded paddy rice than on upland or non-irrigated rice like tillage practices, flooding may influence both the level of initial inoculum and the rate of spread of diseases. Flooding diseased cotton 'trash' for up to six weeks reduced the incidence of bacterial leaf blight (*Xanthomonas campestris* pv. *malvacearum*).

## **2.2.7 Mulching**

The infection of apple roots by *Sclerotium rolfsii* in Israel could be markedly reduced by the application of mulches, which reduced soil temperature enough to kill the pathogen on the root surfaces. Different types of mulches are used in traditional plant disease control. For example, cellulose-rich wood mulches are used for controlling *Phytophthora*, root rot caused by *P. cinnamomic* by reducing the sporangial production.

## **2.2.8 Organic amendments**

In preventing pathogens from establishing themselves in new or hitherto arid soil, organic amendments fulfil the primary function of raising the "biological buffering capacity" of these soils. Organic amendments act on both host and pathogen, often by their direct effect on the microbiota and their indirect effect on the availability of nutrients in the soil field tests in which barley straw was incorporated by rototilling in the top 15.2-17.8 cm of soil and reduced populations of *Verticillium albo-atrum* drastically. It acts either directly by the release of toxic matter or indirectly by effects on nitrification processes in the soil or by promoting germination of dormant propagules while no hosts are available to sustain their growth, or by the encouragement of competitive or antagonistic microbiota.

## **2.2.9 Crop rotation**

Crop rotation, the successive planting of different crops in the same area, is one of the oldest and most widespread cultural practices. It may also include a fallow period in which land is 'rested' from cultivation. Crop rotation improves soil fertility, moisture, and texture, and assists in weed and pathogen control. Rotations are most likely to be effective in controlling pathogens such as *Gaeumannomyces graminis*, *Pyrenophora tritici-repentis*, *Colletotrichum*, and *Phoma* spp., and some



pathogenic bacteria which only survive in the presence of a specific host (or its residues) or as resistant propagules.

### **2.2.10 Tillage practices**

Tillage incorporates various types of organic matter including crop residues, manure, green manure, volunteer crop plants, and weeds into the soil. Tillage reduces weeds and volunteer crop plants that harbour pathogens. It also buries plant pathogens from the topsoil into deeper layers of the soil where they cause less or no disease. Practices in the preparation of seedbeds can modify the physical properties of soils such as moisture characteristics, bulk density, aeration, and temperature profiles which in turn influence the incidence of disease. It reduces the inoculum levels of some pathogens through the exposure of the inoculum to desiccation by the sun. Tillage practices increase soil microflora which are competitors or antagonists of soil-borne pathogens.

### **Conclusion**

There are many potential crop protection problems that develop due to the transformation of traditional agriculture to be more productive. Recently attempts are made to reduce reliance on pesticides and to integrate tactics such as crop resistance, cultural control, and biological control with judicious use of chemicals. Cultural practices are often forgotten in modern literature of plant diseases even though traditional farmers have adequately managed plant diseases for many years, primarily with cultural practices. Traditional peasant systems of agriculture are not primitive leftovers from the past but are, the systems finely tuned and adapted both biologically and socially to counter the pressures and often represents thousands of years of adaptive evolution in which the vagaries of climate, the availability of land, and water, needs of people have been amalgamated in a system which allowed the society to exist and develop in the face of tremendous odds.

Traditional agricultural practices deserve more respect than they receive. The knowledge of traditional farmers is often broad, detailed, and comprehensive. Although traditional farmers may not know what fungi, bacteria, and viruses are in many cases they have effective, time-tested practices for managing pathogens. Traditional practices must be understood and conserved before they are lost with rapid advances in modern agriculture. Plant pathologists can learn much from traditional farmers to elucidate principles and practices useful in the future management of plant diseases.



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