MARUMEGH

Kisaan E- Patrika

Available online at www.marumegh.com
 ISSN: 2456-2904

NON-CHEMICAL BASED PLANT DISEASE MANAGEMENT PRACTICES FOR FARMERS

Bhargavi G, Anita P* and Sunaina B

Affiliation: Department of Plant Pathology, Rani Lakshmi Bai Central Agricultural University, Jhansi, Uttar Pradesh, 284003

***Corresponding author email:** anitapau6243@gmail.com

Introduction

Plant diseases are important biotic constraint, which cause significant losses to farmers across the world. It is estimated that 10-15% of yields in developing countries is 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 highly energy intensive and narrow genetic base and because of attainment of higher yields and greater efficiency may lead to mono-cropping and over production. It is time to re-examine the potential of traditional agriculture to contribute to sustainable system of production agriculture.

The majority of farmers in the developing countries own small plots. Half of the world's population is engaged in agriculture and vast majority live in rural areas and engage primarily in subsistenceagriculture. 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 in spite of 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 beginning but not with same degree of sophistication that exists today. If crop protectionists are to adapt old methods of crop protection it is desirable that studies be made of their origin and development.

1.Traditional 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.Traditional Farmers Practices for Plant Disease Management

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 unfavorable to pathogens, thereby reducing disease development. Most of these practices are sustainable and although some are highly labor 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 management of plant diseases. In spite of 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 presentday 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 Biological control

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 nature of the soil texture and drainage. Mechanisms through which soilborne pathogens are affected by rhizosphere microorganismsinclude 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*, *Gaeumannomycesgraminis var. tritici* ,*Aphanomyceseuteiches*, *Phytophthora cinnamomi*.

2.1.2 Antagonistic plants and Trap crops

Some plants release substances in soil that are toxic to pathogens.When interplanted, these decrease the number of nematodes in the soil and in 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 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, peppersmany 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 attack of all damping-off organisms and soil-borne fungi that affect crop before stems lignify. A good example of the latter is *Sclerotiumrolfsii*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., *Peronosporatabacina*on tobacco and chilli pepper, *P.parasitica*on Brassicae. This can be controlled by adjusting plant density and 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 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 achieved in reducing 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 diseaseproblems.

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 problem 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 upto 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 (*Sclerotiumrolfsii*) 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 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 (*Pyriculariaoryzae)* 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 (*Xanthomonascampestris*pv.*malvacearum*).

2.2.7 Mulching

The infection of apple roots by *Sclerotiumrolfsii*in Israel could be markedly reduced by 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 preventingpathogens from establishing themselves in new or hitherto arid soil, organic amendments fulfill 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 micro biota and their indirect effect on the availability of nutrients in the soilfield tests in which barley straw was incorporated by rototilling in the top 15.2-17.8 cm of soil and reduced populations of *Verticilliumalbo-atrum*drastically. It acts either directly by release of toxic matter or indirectlyby 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 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 *Gaeumannomycesgraminis, Pyrenophoratritici-repentis, Colletotrichum andPhoma* 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 harbor pathogens. It also buries plant pathogens from the top soil into deeper layers of the soil where they cause less or no disease. Practices in the preparation of seed beds can modify physical properties of soils such as moisture characteristics, bulk density, aeration and temperature profiles which in turn influence the incidence of disease. It reduce inoculum levels of some pathogens through exposure of the inoculum to desiccation by the sun. Tillage practices increase soil micro flora which are competitors or antagonists of soil-borne pathogens.

2.2.11 Intercropping

Intercropping, the growing of a crop or crops between the rows of another crop, is more common on smaller farms. Labour requirements increase as the number of crops increases, but total production is generally higher where intercropping is practiced. In Nigeria, where cassava is grown with maize, melons or other crops which increase the ground cover, water splash of soil is reduced and the incidence of soil-borne bacterial blight (*Xanthomonascampestris*pv. *manihotis*) is decreased. The incidence of disease is often less in mixed plantings than in monocultures because the distance between similar plants is greater than in more intensive growing systems so it is less likely that propagules or vectors of pathogens will successfully move from one host to another. The intervening plants pose physical barriers to the dissemination of aerial pathogens or their vectors.

2.2.12 Fertilizer applications and Crop Nutrition

Soil nutrient status may influence the susceptibility of plants to attack by pathogens. Heavy applications of **nitrogenous**fertilizers are commonly thought to predispose plants to disease, it increase infection by obligate parasites such as the powdery and downy mildews. Rice blast (*Pyriculariaoryzae*) and scald (*Rhyncosporiumoryzae*) increase in high nitrogen soils whilst maize head smut (*Sphacelotheca reiliana*) tends to decrease in severity.Fertilizing with **phosphates** can delay the onset and lessen the severity of take-all in barley (*Gaeumannomycesgraminis*). Adequate **potassium** levels inhibit the development of a wide range of parasites including fungi (*Fusarium oxysporumf.sp. vasinfectum*), bacteria (*Corynebacterium insidiosum*and *Xanthomonas* spp.), various viruses and nematodes. **Calcium** is another nutrient which can influence disease incidence. Adequate supplies of calcium make cell walls more resistant to penetration by facultative pathogens such as Rhizoctonia, Sclerotium, Botrytis and Fusarium. Applications of some of the minor nutrientscan also decrease host susceptibility to disease. Applications of zinc reduce the incidence of maize downy mildew, while

Sulphurfertilization inhibits the occurrence of cercospora leaf spot in groundnuts and copper applications reduce take-all in wheat.

2.3 Host Plant Resistance

Host plant resistance is an important tool to control diseases. The use of resistant varieties is very much welcomed by resource poor farmers because it does not require additional cost and it is environment-friendly. Traditional land races and centers of genetic diversity are excellent source of resistance to biotic and abiotic stress. Resistant cultivars are developed through identification and selection. The fungus *Mycosphaerellagraminicola,* SeptoriaTritici Blotch (STB) is a major disease of wheat. Most currently grown wheat cultivars are more or less susceptible to *M. graminicola*.

Conclusion

There are many potential crop protection problems that develop due to 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 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.

References

Glass, E. H. and Thurston, H. D. 1978. Traditional and Modern Crop Protection in Perspective. *BioScience*, **28**(2):109–115. https://doi.org/10.2307/1307424

Kannan, V. R. and Bastas, K. K. 2015. Sustainable Approaches to Controlling Plant Pathogenic Bacteria, CRC Press.

Meghvansi, M. K. and Varma, A. (Eds.). 2015. Organic Amendments and Soil Suppressiveness in Plant Disease Management. Springer Nature. https://doi.org/10.1007/978-3-319-23075-7

Ogle, H. and Dale, M. L. 1997. Disease management: Cultural practices. https://www.semanticscholar.org/paper/Disease-management%3A-cultural-practices-Ogle-Dale/2f2dd7518f134d7365e7faff5f6b6788ddd6373e

Palti, J. 1981. Cultural Practices and Infectious Crop Diseases. Springer-Verlag. https://doi.org/10.1007/978-3-642-68266-7

Thurston, H. D. 1990. Plant disease management practices of traditional farmers. Plant Disease, **74**(2): 96–102.

Thurston, H. D. 1992. Sustainable Practices for Plant Disease Management in Traditional Farming Systems. Westview Press.