



Organic Plant Disease Management in Hill Farming Systems

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Abstract

Hill farming system is defined as an agricultural system which is practised in hills or high altitude regions with steep slopes and unique environmental conditions. Farmers in these regions face many challenges such as soil erosion, runoff and nutrient loss. Because of the changing climate, temperature and humidity, many plant diseases develop easily. Plant diseases occur when three factors come together: a susceptible plant (host), a disease-causing organism (pathogen) and a favourable environment. To reduce plant diseases, organic management methods are better than chemical methods because they protect soil health and human health. Organic practices include crop rotation, intercropping, use of compost, botanicals and biological control agents. Combining traditional knowledge with modern organic practices can help make hill farming more sustainable, productive and resilient.

Keywords: Hill farming system, Organic management, Soil health, Sustainable.

Introduction

Hill farming can be defined as the subsistence or extensive agriculture practised in mountains,

steep terrains or upland regions in a way that it can provide sustainable cultivation, healthy food and fibres with less impact on the environment and also low losses of nutrients and energy. Hill farming is quite challenging in the Himalayan and north eastern regions due to obstacles like landslides, soil erosion, poor connectivity, runoff etc. Despite many limitations hill agriculture plays an important role in food production. Crops such as ginger, turmeric, potato, maize, vegetables and various fruit crops are commonly grown under hill farming systems. To manage these obstacles or challenges, sustainable and eco-friendly disease management approaches are becoming increasingly important in the hill farming systems.

Traditional farming systems in hilly regions were mainly based on shifting cultivation also known as jhum cultivation in the North-Eastern states. In NE regions estimated forest area is ~173219 km² out of which ~5876 km² under jhumming (Inter –Ministerial-Task-Force 2008). In this system farmers clear the forest land, cultivate crops for a few years and then leave the land fallow for natural regeneration. Earlier, the fallow period lasted for a span of 10-15 years, which helped restore soil fertility and microbial balance. However, in the recent years, with the

growing population pressure and shrinking land resources, the regeneration period has reduced drastically. As a result soil fertility has declined, disease incidence has increased and overall productivity has been affected. To overcome these problems, many farmers have gradually shifted towards settled farming systems such as terrace farming. Terrace farming reduces soil erosion, conserve moisture and improve nutrient retention by converting steep slopes into step like platforms.

Increasing Threat of Plant Diseases in Hill Regions

Plant diseases develop when three important factors interact together; a susceptible host plant, a disease causing pathogen and a favourable environment. This relationship has been commonly termed as disease triangle (Agrios, 2005). In hill farming systems, environmental conditions such as high humidity, continuous rainfall and moderate temperature often favour the growth and spread of the pathogens. Climate change has further intensified the disease problems in these regions.

Many fungal, viral and bacterial diseases are now emerging more frequently in the hill agriculture. Diseases such as late blight of potato caused by *Phytophthora infestans*, coffee leaf rust caused by *Hemileia vastatrix*, sheath blight, anthracnose, downy mildew, rusts and several leaf spot diseases are commonly observed in the hill crops. Viral diseases transmitted by insect vectors such as aphids, whiteflies and thrips have also become serious threats. Some important examples are tomato yellow leaf curl virus, potato leaf roll virus and cucumber mosaic virus.

The spread of these diseases not only affects crop but also increases the economic burden on hill farmers.

Why Organic Disease Management is Important

Organic disease management is gaining importance because it provides safer and more sustainable alternatives to chemical-based agriculture. In hill ecosystems, excessive use of chemicals can easily contaminate soil and water resources due to heavy rainfall and runoff. Moreover, continuous application of pesticides may destroy beneficial microorganisms and reduce soil fertility over time.

Organic management practices help maintain soil microbial diversity, improve soil structure and enhance natural resistance in plants (Gupta *et al.*, 2022). These methods are environmentally safe, cost effective and suitable for small and marginal farmers in the hill farming system. Another important advantage of organic farming is the growing demand for organic products in both domestic and international markets. Consumers are increasingly preferring food products which are free from chemical residues. Therefore, organic hill farming can also provide better economic opportunities for farmers.

Traditional Knowledge in Disease Management

Farmers in hill regions have been using indigenous methods for plant disease management for generations (Chhetry & Belbahri, 2009). These traditional knowledges are based on locally available resources and understanding developed through years of experience. Common traditional materials include wood ash, cow dung slurry, cow urine,

lime and neem extracts. These materials contain antimicrobial properties and help suppress several plant pathogens naturally. Cultural practices like mixed cropping, intercropping, and crop rotation have also been effective in reducing disease incidence. For example, intercropping maize with legumes helps improve soil fertility and reduce the spread of certain diseases. Likewise, crop rotation breaks the entire life cycle of soil-borne pathogens and minimises disease build-up in the field.

Integration of Traditional and Modern Organic Approaches

Modern organic disease management practices combine traditional farming knowledge with scientific approach to achieve better disease management. One of the most promising approaches is Bio-Intensive Integrated Disease Management (BIDM), which focuses on the combined use of biological agents, organic amendments and cultural practices (Mishra *et al.*, 2021). Beneficial microorganisms such as *Trichoderma harzianum* and *Pseudomonas fluorescens* are widely used as biological control agents. These microbes suppress soil-borne pathogens, improve plant growth and enhance the nutrient availability in soil.

Seed biopriming with cow urine or *Trichoderma* helps improve seed germination and protects seedlings from damping off diseases. Similarly, neem cake combined with *Trichoderma* improves soil health and reduces pathogen populations. Organic foliar sprays prepared from neem oil and plant extracts are also widely used. Preparations like Jeevamrut, Beejamrit, Agniastra are important elements of organic farming practices. Additionally, green manuring and biofumigation practices further help in

controlling nematodes and soil-borne pathogens naturally.

Conclusion

Hill farming systems are highly vulnerable to a wide range of plant diseases due to fragile ecosystems, changing climate and difficult environmental conditions. Conventional chemical based agriculture may provide short term solutions, but it often creates long term ecological and health problems. Organic plant disease management provides a sustainable alternative that protects crops while conserving soil health, biodiversity, and environmental quality. Traditional practices such as the use of neem, cow urine, crop rotation and intercropping, when integrated with modern biological control techniques, can effectively manage plant diseases in hill agriculture. As the demand for sustainable agriculture continues to grow, organic plant disease management will play a crucial role in building resilient and environmentally friendly disease control tactics in hill farming systems.

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