



Plant Disease Management under Natural Farming

*Vikram Singh¹, Promil Kapoor¹ and Neha Rohila²

¹Department of Plant Pathology, CCS Haryana Agricultural University,
Hisar-125004, Haryana, India

²Department of Genetics and Plant Breeding, CCS Haryana Agricultural University,
Hisar-125004, Haryana, India

*Corresponding Author's email: vikramrohilla56@gmail.com

Seasonal conditions, pathogen presence, crop type, environmental factors, and farmed varieties all influence the occurrence and prevalence of plant diseases, which are caused by pathogens that disrupt physiological activities and affect plant shape (Nazarov *et al.*, 2020). Major food crops like wheat, corn, soybean, potatoes, and rice suffer yearly losses of 13–22% due to plant diseases caused by pathogenic microbes, totaling over 220 billion USD worldwide (Savary *et al.*, 2019; Wang *et al.*, 2021). Pesticides do, however, have some disadvantages even though they greatly lower the frequency of disease. The chronic presence of pesticide-active substances in food restricts agricultural exports and lowers agricultural competitiveness worldwide, while the ongoing and inappropriate use of agrochemicals pollutes the environment (Wilson *et al.*, 2004; Dou *et al.*, 2015).

2.4 million tons of pesticide-active chemicals are released into the environment annually. The majority of research shows that using pesticides is bad for the environment and human health (Rezende *et al.*, 2016). In addition to short-term consequences including headaches, nausea, dizziness, and skin and eye irritation, the pesticides can have long-term impacts like cancer, asthma, infertility, and Parkinson's disease (Ahmad *et al.*, 2023). Due to insufficient training, careless handling, and a lack of personal protective equipment, agricultural workers are more susceptible to these risks and are more likely to be directly exposed through oral, respiratory, and cutaneous pathways (Muyesaier *et al.*, 2022).

Many still rely on expensive, off-farm inputs, despite the fact that tactics like organic farming and integrated pest management have provided some answers over time. This has led to a search for methods that are both accessible to farmers of all sizes and ecologically sound. As a result of this investigation, NF stands out as a system that coexists with nature and is founded on the idea that nature provides solutions for all of the problems that humans have created in the food industry and agriculture (Dorin *et al.*, 2022). Masanobu Fukuoka is credited with popularizing natural farming through his book "One Straw Revolution." The term "natural farming" was translated from the Japanese phrase "Shizen noho," which relates to his farming method (Neelam *et al.*, 2016). Because it incorporates crops, trees, and livestock while fostering functional biodiversity, this chemical-free farming method is recognized as an agro-ecology based diversified farming system (Kumar *et al.*, 2023). Subhash Palekar popularized the NF concept in India and received the Padma Shri (the country's fourth-highest civilian award) in 2016 for his efforts (Kumari *et al.*, 2024).

By boosting beneficial soil microbial diversity, triggering plant defense mechanisms, and inhibiting pathogens that cause disease, Natural Farming (NF) techniques provide an environmentally friendly substitute. The urgent need for alternative agricultural methods that can control illnesses and promote sustainable agro-ecosystems is highlighted by this situation. Working with nature instead of against it is the foundation of natural farming. It places a strong emphasis on using locally accessible natural inputs, boosting soil biological activity,

and strengthening the plant's innate immunity. In natural farming, disease control is preventive rather than therapeutic, with an emphasis on bolstering the entire agroecosystem. Different formulations and approaches for plant disease management under natural farming are described as follows:

Role of beejamrit

Beejamrit, an on-farm organic formulation generated from cow urine and dung, is another part of NF. It is enhanced with limestone or virgin forest soils for a full day (Sreenivasa *et al.*, 2010). It has free-living nitrogen bacteria and phosphate-solubilizing bacteria (PSBs) including *Azotobacter*, *Azospirillum*, *Pseudomonas*, and *Lactobacteria* that produce IAA and aid in plant growth (Mukherjee *et al.*, 2022). IAA promotes longer shoots, better root health, and higher seedling survival rates (Uggla *et al.*, 1996). To shield immature roots from soil and seed-borne pathogens in NF, beejamrit is frequently applied as a seed treatment in India (Naresh *et al.*, 2018).

Role of Jeevamruth

Because they participate in the cycle of nutrients like carbon and nitrogen, which are necessary for plant growth, soil microbes actively contribute to soil fertility. They are in charge of recycling nutrients in the soil by breaking down the organic materials that enters the soil. Soil microorganisms include mycorrhiza, cyanobacteria, and PGPR. When injected into the soil, beneficial microorganisms in Jeevamruth transform the nutrients in unavailable form into dissolved form. Until the soil is enriched, Jeevamruth is either sprayed or sprinkled on the agricultural field or fed to the irrigation tank at regular intervals of fifteen days.

Composition

Water 200 litre, cow dung 10 kg, cow urine 5-10 liter, Jaggary 1-2 kg, flour of the pulses 1 kg, a handful of soil. This mixture is well stirred for few days and sprayed on crop for every fortnightly. Application of Jeevamruth facilitated the growth of beneficial soil microorganisms and improved crop yield (Shaikh and Gachande, 2015; Nileema and Sreenivasa, 2011; Shubha, 2014).

Dashparni Ark

Cow urine, ten different leaves, and other natural ingredients are used to make the fermented dish known as dashparni ark. It works well against foliar fungal diseases and possesses antibacterial qualities.

Mulching

Mulching improves microbial activity, controls temperature, and preserves soil moisture. Beneficial fungus like *Trichoderma* and bacteria like *Pseudomonas*, which naturally oppose plant diseases, proliferate in organic mulches.

Practice no tillage

Earthworm populations are constantly impacted by annual tillage, chemical fertilization, and pesticide use. When tillage is avoided, soil moisture content rises, which promotes earthworm growth. It is known that earthworms increase the amount of pores or free space between soil particles. The movement of roots, worms, and insects, expanding gasses trapped in these spaces by ground water, and/or the disintegration of the soil's parent materials can all create pore spaces, which then enrich the soil with their castings. Before the previous crop is harvested, seeds are dispersed and covered with straw. When the following favorable season arrives, seeds begin to sprout (Palekar, 2016).

Botanicals

An essential part of natural farming methods are botanical extracts. Neem-based formulations with antifungal, antibacterial, and antiviral qualities include neem leaf extract, neem oil, and neem seed kernel extract. They aid in the management of bacterial blights, powdery mildew,

downy mildew, and leaf spot diseases. Azadirachtin is one of the neem chemicals that inhibits the growth of pathogens and decreases the number of vectors that cause viral infections.

Plant-Based Extract

Extracts of garlic, chilli, tulsi, and moringa show inhibitory effects against various fungal pathogens. These botanicals contain bioactive compounds that disrupt pathogen cell walls and metabolic processes.

Advantages of Natural Farming in Disease Management

1. Lessens reliance on chemical fungicides
2. Prevents resistance to pesticides
3. Promotes biodiversity in the soil
4. Makes food free of residue
5. Lowers input expenses
6. Encourages sustainability in the environment

The Sustainable Development Goals (SDGs), especially SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production), and SDG 15 (Life on Land), are supported by natural farming.

Challenges and Limitations

Despite its benefits, natural farming faces some challenges:

- The necessity of routine observation and preventative actions
- It acts more slowly than chemical insecticides.
- The need for farmer awareness and training
- Formulation standardization

However, these difficulties can be reduced with appropriate knowledge sharing and scientific validation.

Conclusion

By proactively promoting ecosystem resilience rather than eliminating diseases, natural farming (NF) offers a revolutionary and environmentally sound paradigm for global agriculture. This chemical-free method reduces the terrible biological and economic effects of plant diseases without the environmental and public health risks associated with synthetic pesticides by promoting native plant immunity, fostering functional microbial biodiversity, and restoring soil health. Additionally, the deliberate use of localized inputs, such as organic mulches, herbal extracts, Jeevamruth, and Beejamrit, directly ensures residue-free food production and reverses land degradation. Future initiatives must focus on connecting traditional agricultural knowledge with rigorous scientific validation in order to overcome present barriers to standardization and adoption. Ultimately, scaling natural farming practices offers a viable, low-input pathway toward establishing climate-resilient agroecosystems capable of sustaining healthy generations to come.

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