Lesson 6

The role of vermicompost in pest and disease

Learning outcomes

- The trainee knows which plant diseases vermicompost are useful for.
- The trainee knows that vermicompost suppresses parasitic organisms in the soil that cause disease in plants.
- The trainee knows that the use of vermicompost suppresses fungal activity.
- The trainee explains that the use of vermicompost reduces the use of chemicals in the fight against plant pests.

Instructions for the trainer

- The trainer shares theoretical knowledge through presentation.
- The trainer hands the SM-5 (table: relation between disease/pest and crop) to the trainee. Asks them to fill in the blank sections in the table. During this study, trainees should be encouraged to interact with each other.

Basic requirements: Projector, computer.

6. The role of vermicompost in pest and disease

Vermicompost is known to be useful in the treatment of different plant diseases (Table 4). Many plant diseases caused by soil-borne, foliar plant pathogens and pests have been suppressed by vermicompost products, which have proven effective as organic fertiliser and biological control agents. The excessive and repeated use of chemical pesticides in conventional agriculture has resulted in "biological resistance" to crop diseases and pests. As a result, significantly higher doses are now needed to inhibit the growth of high-yielding crops that are more susceptible to pests and diseases [44]. The use of vermicompost has been shown to suppress disease-causing factors in many crops, such as chickpeas and tomatoes. It has been proven by numerous studies that the use of vermicompost as a substitute for chemicals yields successful results in the fight against plant diseases.

Earthworm has a stimulatory effect on soil microbial activities, thus it suppressed the plant diseases more potentially than aerobic compost. There is a lot of research on the suppression effect of organic matter amendments in soils, with gratifying levels of reduction in plant parasitic nematode infestations. There are few publications on the suppressing effect of solid vermicomposts on numbers and outbreaks of plant parasitic nematodes relative to OM and thermophilic compost additives. Solid vermicompost applications for control of plant parasitic nematode populations have been studied. Solid vermicomposts ranging from 2 to 8 $kg.ha^{-1}$ were applied to tomatoes, peppers, strawberries, and grapes in field treatments. They were able to suppress plant parasitic nematodes with great success. These researchers investigated the suppression capacity of plant parasitic nematodes in vermicomposts made from paper waste, food waste, and cattle manure under field circumstances and found considerable suppression [45].

Apart from using compost or biocontrol agents individually, the fortification of compost with bio-control agents has been suggested to increase the colonization process of biological agents in composts.

Numerous composts and biofortified composts have been reported to decrease the number of pathogens and defend crops against soil borne pathogenic agents when applied as soil amendments [46, 47]. Antagonistic effect of vermicompost and vermicompost fortified with Trichoderma harzianum, Bacillus subtilis and Pseudomonas fluorescens was investigated against Fusarium oxysporum and it was shown that biofortification not only facilitated plant growth but also significantly reduced wilt disease. As these microbial strains have the potential to secrete antifungal metabolites, hydrolytic enzymes, and antibodies. A scientific study on the management of tomato Fusarium wilt with biofortified vermicompost revealed that vermicompost application alone or after fortification with microbes such as Trichoderma harzianum, Pseudomonas fluorescens and Bacillus subtilis significantly improved the growth and nutritional status of tomato plants. Furthermore, disease incidence was found to be lower in plants treated with vermicompost biofortified with biocontrol agents, especially Trichoderma herzianum, compared to control plants [48].

Table 4. **Plant diseases and pests suppressed by the use of vermicompost [49]**

No	Disease/pest	Crop
1	Jassid (Empoasca verri), aphid (Aphis craccivora)	Groundnut
2	Damping off and root rot	Cucumbers and Radishes
3	Damping-off	Tomatoes
4	Damping-off	Impatiens walleriana
5	Tetranychus urticae, Pseudococcus sp. Myzus persicae	Bush beans, Eggplant, tomato, Cucumber, and Cabbage
6	Collar rot	Chickpea
7	Fusarium wilt	Chick pea
8	Helicoverpa zea and Pieris rapae	Cabbage
9	Meloidogyne incognita	Brinjal
10	Earworm (Helicoverpa zea)	Corn plant
11	Aphid (Lipaphis erysimi)	Mustard
12	Fusarium wilt	Tomato
13	Damping- off	Cucumber
14	Polyphagotarsonemus latus	Chili
15	Late blight disease	Potato
16	Fusarium wilt	Cucumber

Vermicasts can also manage arthropod pests such as caterpillars: like tomato hornworms, cabbage white caterpillars and cucumber beetles including sucking arthropods such as aphids, spider mites and mealy bugs. Vermicomposts derived from food waste are known to significantly control mealybug attacks on cucumber and tomato, two-spotted spider mite (Tetranychus urticae) attacks on bush bean and egg crops, and aphid (Myzus persicae) attacks on cabbage, even at low amounts [50]. Vermicompost also has a positive effect on the occurrence and number of plant nematodes. It was reported that vermicast application at the rate of one kg per square metre significantly reduced the occurrence of Meloidogyne incognita in tobacco plants [51].

6.1. Vermicompost tea in pest and disease management

In agriculture, the use of vermicompost tea is increasing due to its potential to manage the diversity of air and soil-borne diseases (Table 5). With this in mind, liquid extracts of composts are seen as alternative options to the use of conventional chemical fungicides and pesticides in response to the growing need for agriculture and food protection for environmental sustainability. The efficacy of compost tea may be different depending on differences in the types of composts used, sources and preparation methods. However, it has been documented that the most excellent results are obtained by applying aerated tea instead of still tea. This is probably because dissolved oxygen favours microbial diversity and activity. In the last 10 years, the application of vermicompost tea as a biocontrol agent has increased significantly. Mycelial growth of Botrytis cinerea, Sclerotinia sclerotiorum, Rhizoctonia solani, Corticium rolfsii, and Fusarium oxysporum was significantly inhibited by liquid extracts from vermicomposts. The high potential of using vermicompost as a suitable substitution technique to control plant diseases is pointed out. It is recommended that farmers apply these liquid solutions directly to the leaves as a simple, cheap, and environmentally friendly plant protection method with high yield potential. In a study investigating disease prevention potential of vermicast tea against Phytophthora infestans on three varieties of tomato; it was revealed that vermicast tea reduced the

susceptibility of leaves, stems and fruits of tomato plants to diseases caused by Phytophthora infestans [49].

Vermicompost teas have significant potential to kill or suppress pests. It is reported that drenching of vermicast tea suppresses spider mite damage. By applying vermicompost tea, the soluble phenolic compounds reach the plant and make the plant tissues unpalatable, thereby disturbing survival and reproduction rate of pests [50]. It is reported that earthworms take-up soil substances, swallow humic acids through their guts and finally excrete polychlorinated and monomeric phenols into the final vermicast. Vast microbial communities and their activities in vermicompost tea led to the release of nutrients in slow but balanced manner that reduces nitrogen inputs, improves phenol content of plants, thus resulting in plant tolerance against pests [52].

Table 5. **Plant diseases and pests suppressed by the use of vermicompost tea [49]**

No	Disease/pest	Crop
1	Powdery mildew	Pea and Balsam
2	Late blight	Tomatoes
3	Foot rot	Rice
4	Acalymma vittatum, Manduca sexta	Cucumber and Tomato
5	Fusarium wilt	Brinjal
6	Reniform nematode	Zucchini
7	Sclerotium cepivorum	Onion
8	Meloidogyne incognita	Zucchini and Cucumber
9	Meloidogyne incognita and Rotylenchulus reniformis	Cucumber
9	Meloidogyne incognita	Banana plant
10	Meloidogyne incognita	Tomato