Management of Pest in Organic Agriculture

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The interaction between living organisms and their environment is crucial for a plant's health. Plant's health is more at risk in monocultures and on-farm diversification provide a balanced tri-tropic interaction between plants, pests and predators. This is may be treated as well-managed ecosystem and the way for successful reducing the level of pest or disease population. Plant health condition depends to a large extent on the fertility of the soil. When nutrition and pH is well balanced, the plant becomes stronger and is therefore less vulnerable to infection. Climatic conditions, such as suitable temperatures and sufficient water supply, are further factors which are crucial for a healthy plant. If one of these conditions is not suitable, the plant can become stressed. Stress weakens the defense mechanisms of plants and makes them easy targets for pests and diseases. One of the most important points for an organic farmer is therefore to grow diverse and healthy plants.

Prevention practice and monitoring

Knowledge about plant health and pest and disease ecology helps the farmer to choose effective preventive crop protection measures. Some important preventive crop protection measures are the following ones:

Use of well adapted and resistant varieties

- select varieties which are well adapted to the local environmental conditions as it allows them to grow healthy and makes them stronger against infections of pests and diseases.

Use of dirt-free healthy seed and planting material

- Use disease free seeds from reliable sources prior to inspected for pathogens and weeds at all stages of production.

Use of suitable cropping systems

- Mixed cropping systems: can limit pest and disease pressure as the pest has less host plants to feed on and more beneficial insect life in a diverse system
- Crop rotation: reduces the chances of soil borne diseases and increases soil fertility.
- Green manuring and cover crops: increases the biological activity in the soil and can enhance the presence of beneficial organisms

Use of balanced nutrient management

- Moderate fertilization: steady growth makes a plant less vulnerable to infection. Too much fertilization may result in salt damage to roots, opening the way for secondary infections.
- Balanced potassium supply contributes to the prevention of fungi and bacterial infections

Input of organic matter

- Increases micro-organism density and activity in the soil, thus decreasing population densities of pathogenic and soil borne fungi.
- Stabilizes soil structure and thus improves aeration and infiltration of water.
- Supplies substances which strengthen the plant's own protection mechanisms.

Adopt suitable cultivation methods

- Facilitates the decomposition of infected plant parts.
- Regulates weeds which serve as hosts for pests and diseases.
- Protects the micro-organisms which regulate soil borne diseases.

Maintain proper water management

- No water logging: causes stress to the plant, which encourages pathogens infections.
- Avoid water on the foliage, as water borne disease spread with droplets and fungal disease germinate in water.

Conservation and promotion of natural enemies

- Provide an ideal habitat for natural enemies to grow and reproduce.
- Avoid using products which harm natural enemies.

Selection of optimum planting time and spacing

- Optimal planting time is chosen.
- Sufficient distance between the plants reduces the spread of a disease.
- Good aeration of the plants allows leaves to dry off faster, which hinders pathogen development and infection.

Adopt clean cultivation

- Remove infected plant parts (leaves, fruits) from the ground to prevent the disease from spreading.
- Eliminate residues of infected plants after harvesting.

Monitoring

Regular monitoring of pests, diseases and weeds is the basis for effective management. Information regarding specific pests, diseases and weeds helps in monitoring process.

Typical signs and of pest attacks on crop plants

Most crop pests belong to the insects, mites and nematodes. However, mammals (like elephants, monkeys or voles), and birds (like sparrows, starlings and crows) can also damage crops. Insect damage can be categorized as biting and chewing (e.g. caterpillars, weevils), piercing and sucking (e.g. aphids, psyllids) and boring (e.g. borer, leaf miner) species. Some are slow moving (e.g. caterpillars), fast moving (e.g. fruit flies), hidden (e.g. stem borer), or easy to observe (e.g. caterpillars, weevils).

- **Pest damage is often species-specific**: leaves with holes or missing parts is an indication of caterpillar or weevil damage; curled leaves is an indication of aphids; damaged or rotten fruits are often caused by larvae of fruit flies; withering plants can also be caused by larvae of noctuids or the stem borer; and branches or trunks with holes may be an attack by lignivorous insects.
- Mites are very small and cannot be seen with the naked eye. However, some mite species (spider mites) weave a typical tissue on attacked plant parts and can, therefore, easily be detected. If mites are present on plants, leaves and fruits become yellowish.
- Nematodes are also very small and therefore, they are not easy to observe with the naked eye. They mostly attack plant roots; plants become yellow, wither and die.

Typical signs of disease attacks on crop plants

Most crop diseases are caused by fungi, bacteria or viruses.

Fungi cause estimated at two-thirds, of infectious plant diseases. They include all white and true rusts, smuts, needle casts, leaf curls, mildew, sooty moulds and anthracnose. In addition, they are responsible for most leaf, fruit, and flower spots, cankers, blights, wilts, scabs, and root, stem, fruit, wood rots among many others. Parts of plants or the total crop plant can wither and die.

Bacteria cause any of the four following main problems.

- Some bacteria produce enzymes that breakdown the cell walls of plants anywhere in the plant. This causes parts of the plant to start rotting (known as 'rot').
- Some bacteria produce toxins that are generally damaging to plant tissues, usually causing early death of the plant. Others produce large amounts of very sticky sugars; as they travel through the plant, they block the narrow channels preventing water getting from the plant roots up to the shoots and leaves, again causing rapid death of the plant.
- Finally, other bacteria produce proteins that mimic plant hormones. These lead to overgrowth of plant tissue and form tumors.
- Viruses mostly cause systemic diseases. Generally, leaves show chlorosis or change in colour of leaves and other green parts. Light green or yellow patches of various shades, shapes and sizes appear in affected leaves. These patches may form characteristic mosaic patterns, resulting in general reduction in growth and vigour of the plant.

Curative method

The natural enemies of pests are other organisms (fungi, bacteria, viruses, insect predators, and insect parasitoids) which kill pest. Therefore, the organic farmer should try to conserve natural enemies already present in the crop environment and enhance their impact. This can be achieved with the following methods:

- ✓ Minimize the application of natural pesticides (chemical pesticides anyway are not per-mitted in organic farming).
- ✓ Allow some pests to live in the field which will serve as food or host for natural enemies.
- ✓ Establish a diverse cropping system (e.g. mixed cropping).
- ✓ Include host plants providing food or shelter for natural enemies (e.g. flowers which adult beneficial insects feed on).

Mechanical control

Light traps can be used to catch moths such as armyworms, cutworms, stem borers and other night flying insects. Light traps are more efficient when placed soon after the adult moths start to emerge but before they start laying eggs.

Colour and water traps can be used to monitor adult thrips. In some cases, thrips can even be reduced by mass trapping with colored (blue, yellow or white) sticky traps or water traps in the nursery or field. Yellow sticky traps can be used to control whiteflies, aphids and leaf mining flies.

Fruit bagging prevents fruit flies from laying eggs on the fruits. In addition, the bag provides physical protection from mechanical injuries (scars and scratches). Bagging works well with melon, bitter gourd, mango, guava, star fruit, avocadoes and banana (plastic bags used).

Biological control

Biological control is the use of natural enemies to manage populations of pests (such as ladybird beetles, predatory gall midges, hoverfly larvae against aphids and psyllids) and diseases. This implies that we are dealing with living systems, which are complex and vary from place to place and from time to time. If populations of natural enemies present in the field are too small to sufficiently control pests reared natural enemies are released in the crop to boost field populations and keep pest populations down. There are two approaches to biological control through the release of natural enemies: Preventive release of the natural enemies at the beginning of each season and curative release when pest populations start to cause damage to crops. Bacteria such as Bacillus thuringiensis (Bt). Bt has been available as a commercial microbial insecticide since the 1960s. Viruses such as NPV (nuclear polyhedrosis virus), effective for control of several cater-pillar pest species. Every insect species, however, requires a specific NPV-species. Fungi that kill insects, such as Beauveria bassiana. Different strains of this fungus are commercially available. Fungi that work against plant-pathogens. Some examples include: Trichoderma sp., widely used in Asia for prevention of soil-borne diseases such as damping-off and root rots in vegetables.

Natural pesticides

Some plants contain components that are toxic to insects. When extracted from the plants and applied on infested crops, these components are called botanical pesticides or botanicals.

- ➢ Most botanical pesticides are contact, respiratory, or stomach poisons. Therefore, they are not very selective, but target a broad range of insects. This means that even beneficial organisms can be affected. Yet the toxicity of botanical pesticides is usually not very high and their negative effects on beneficial organisms can be significantly reduced by selective application.
- ➢ Botanical pesticides are generally highly bio-degradable, so that they become inactive within hours or a few days.
- ➢ Some commonly used botanicals are: NEEM: It contains several insecticidal compounds. The main active ingredient is azadiractin, which both deters and kills many species of caterpillars, thrips and whitefly. Both seeds and leaves can be used to prepare the neem solution.

- Pyrethrum: Pyrethrum is a daisy-like Chrysanthemum. Pyrethrins are insecticidal chemicals extracted from the dried pyrethrum flower. The flower heads are processed into a powder to make a dust. This dust can be used directly or infused into water to make a spray. Pyrethrins cause immediate paralysis to most insects,
- Chilli pepper: Chillies and capsicum pepper have both repellent and insecticidal effects. To make the chilli extract grind 200 g of chillies into a fine dust, boil it in 4 L water, add another 4 L of water and a few drops of liquid soap. This mixture can be sprayed against aphids, ants, small caterpillars and snails.
- Garlic: Garlic has antifeedant (insect stop feeding), insecticidal, nematocidal and repellent properties. To make the garlic extract, grind or chop 100 g garlic into 0,5 L of water. Allow mixture to stand for 24 hours, add 0,5 L of water and stir in liquid soap.

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