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Meghalaya Livelihood Improvement through Forest Enhancement

Meghalaya Basin Development Authority

Japan International Cooperation Agency

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From:

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To:

The Block Project Manager
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Sub: Guideline for Disease & Pest Management in Community Nurseries

With reference to the subject cited above please find attached herewith guidelines for disease & pest management in community nurseries at Annexure-1. You are directed to take immediate action to control the diseases in the nurseries.

Enclo: As stated

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Annexure-1

Guidelines for Disease & Pest Management in Community Nurseries

Plant Nutrition and Management of Seedlings in Nursery

Introduction

Plants, like animals and human being, require food for their liveliness, growth and development. This food is composed of certain elements and compounds often referred toas plant nutrients. The essential nutrients are the key components of the soil fertility. The chemical compounds required by the organism are termed as nutrients and their supply and absorption for growth is defined as nutrition. Plant nutrients are available in the form of organic and inorganic substances. Plants require 16 essential elements for their normal growth and completion of life cycle. On the basis of their relative concentration in plant tissues these are divided in to macro-nutrients and micro-nutrients. There are different types of manures and fertilizers available in the market for the supply of these nutrients. These fertilizers are provided to the plants by different fertilizer application techniques. Complete nutrition at nursery growth stage is very essential to avoid unhealthiness and deficiency. Proper nutrition gives healthy growth and resistance against pests, diseases and abiotic stresses in the environment. In the nursery, nutrient requirement is very low but it should be provided at the correct time. Advance fertilizer application technique enhances the nutrient absorption efficiency.

Integrated Nutrient Management (INM) is new attitude to supply nutrient to crop. Integrated Plant Nutrient System (IPNS) is the maintenance of soil fertility at an optimum level for sustainable productivity through optimization of benefits from all possible sources in an integrated manner. **Integration of organic and inorganic fertilizers and manures give better results than the use of only organic or only inorganic fertilizers and manures.** INM gives healthy and well developed plants in nursery. It also reduces the costof production of nursery plants.

There are several media and media mixtures available for use in nursery. Media for plant growth and seed germination has great significance in nursery business. The material for media can be used alone or as a combination of one or more products.

Water management in the nursery is also an important component. Quality of irrigation water plays an important role in production of healthy plants. Suitability of irrigation water depends upon water quality, soil, media, plant type, irrigation method, drainage and climate. We can achieve maximum water use efficiency by adopting advance irrigation technologies.

Plant Nutrients and their Requirement

Plant Nutrition:

Plants require food for their growth and development. The plant food is composed of certain elements which are often referred to as plant nutrients or plant food elements. Plants absorb a large number of elements from soil, air and water during growth and development. **But only sixteen elements are found to be essential in plant nutrition.** The criteria to judge essentiality of an element to plants have been worked out. They are as under:

1. Deficiency of the nutrient makes it difficult for the plant to complete the vegetative or reproductive stage of its growth.
2. The deficiency is specific to the nutrient in question and as such can be prevented or corrected only by supplying that particular element to the plant.
3. The nutrient must have direct influence on the plant. It must be directly involved inthe metabolism of the plant.

Essential plant Nutrients and their Sources:

Source	***Plant Nutrients***	***Class of Nutrient***
Air	Carbon (C)	Macronutrients
Water	Oxygen (O_2)	Macronutrients
	Hydrogen (H_2)	Macronutrients
Soil	Nitrogen (N)	Macronutrients
	Phosphorous (P)	Macronutrients
	Potassium (K)	Macronutrients
	Plant Nutrients	***Class of Nutrient***
	Magnesium (Mg)	Macronutrients
	Calcium (Ca)	Macronutrients
	Sulphur (S)	Macronutrients
	Iron (Fe)	Micronutrients
	Manganese (Mn)	Micronutrients
	Boron (B)	Micronutrients
	Zinc (Zn)	Micronutrients
	Copper (Cu)	Micronutrients
	Molybdenum (Mo)	Micronutrients
	Chlorine (Cl)	Micronutrients
	Nickel (Ni)	Beneficial elements
	Cobalt (Co)	Beneficial elements
	Sodium (Na)	Beneficial elements
	Vanadium (V)	Beneficial elements

Nitrogen, Phosphorous and Potassium are called as Primary nutrients, while Calcium, Magnesium and Sulphur are called secondary Nutrients.

<u>Macronutrients:</u>

Out of the 16 essential plant nutrients six elements are used by plants in large quantities. These are N, P, K, Ca, Mg and S. Since these elements are used in relatively large amount they are designated as "Macronutrients". The first three nutrients namely NPK are utilized by plants in considerable quantities. Majority of soils of the world are consequently found deficient in these nutrients, hence N, P, and K are often called as Primary Nutrients. Ca, Mg and S are called secondary nutrients due to their secondary importance to the manufacturers of NPK fertilizers.

Micronutrients:

The other seven nutrients namely Fe, Mn, B, Zn, Ca, Mo, Cl and Ni are used by field crops in very small quantity hence these are called Micronutrients. These nutrients are also called Trace, Minor or Rare elements. They are however essential to plant growth.

The nutrients should fulfill the conditions for proper growth and development of plants.

They must be present in the soil in available form. The nutrient must be present in optimum concentration for plant growth. Deficiency or excess of any nutrient limits plant growth. There must be a proper balance among the concentrations of the various soluble nutrients in the soil solution.

Nutrient Deficiency Symptoms in Plants:

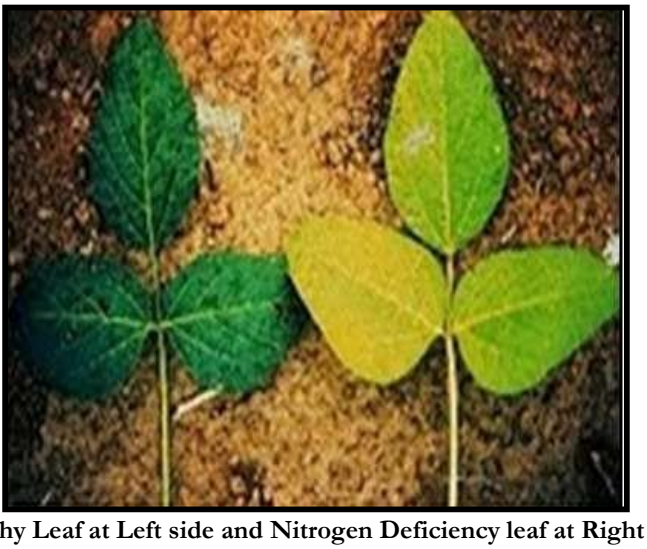
The plants suffering from severe deficiencies or toxicities of mineral nutrients usually develop well defined and typical signs of disorders in various organs particularly in leaves and which can be easily detected by the eyes. Usually specific abnormal colors are developed in the leaves due to deficiency of plant nutrients. So this requiresexperience and practice in the field to recognize particular nutrient deficiency.

Plant Nutrient showing deficiency on older or lower leaves:Nitrogen,
Phosphorous, Magnesium, Potassium and Zinc

Plant Nutrient showing deficiencies on younger leaves or bud leaves are:Calcium,
Boron, Copper, Manganese, Sulphur and Iron

Typical Deficiency Symptoms

1. **Nitrogen (N):** Yellow or pale green color of leaves. Drying of bottom leaves and short plant height.



Healthy Leaf at Left side and Nitrogen Deficiency leaf at Right side

2. **Phosphorous (P):** Leaves developing red and purple color. Slow growth and late maturity is observed. Lower leaves dry and develop purple colours between veins. Leaf petioles also develop purple color.

Phosphorous Deficiency in Plant

3. **Potassium (K):** Bottom leaves are scorched or burned on margins and tips. Leaves thicken and curl. Deficiency first develops in the wet portion of field.

Potassium Deficiency in Plants

4. **Calcium (Ca):** Yong leaves of the terminal buds develop wrinkled appearance and dieback at the tips and margins. Stalk finally dies at the terminal bud.

Calcium Deficiency in plant

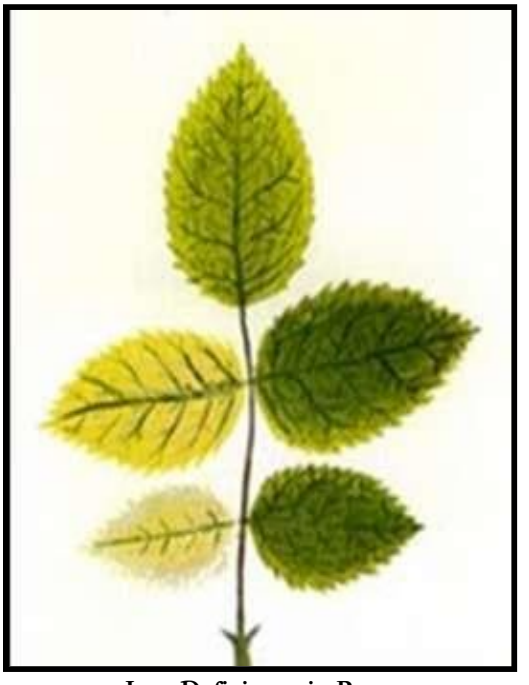
5. **Magnesium (Mg):** There is general loss of green color starting with the bottom leaves and moving upward. Veins of the leaves remain green. In cotton the lower leaves turn purplish red with green veins.

Magnesium Deficiency in plant

6. **Sulphur (S)**: The veins and the tissue between them become light green in colour in young leaves. The growth of the plant is slow.

Sulphur Deficiency in Gerbera

7. **Iron (Fe):** Young leaves turn chlorotic. The main veins remain green. The stalk is short and slender. There is dieback of young growing tissues.



Iron Deficiency in Rose

Iron Deficiency in Gerbera

8. **Manganese (Mn):** Spots of dead tissue scattered over young leaves. The smallest veins tend to remain green.

Manganese Deficiency in plant

9. **Zinc (Zn**): There is yellow stripping of the leaves between the veins. Older leavesdie, and plant is severally dwarfed.

Zinc Deficiency

10. **Boron (B):** Yong leaves of the terminal bud becoming light green at the base, with final breakdown. In later growth, leaves become twisted; stalk finally dies at terminal bud. Browning of curd and lesions in pith in cauliflower.

Boron Deficiency in Gerbera

11. **Copper (Cu):** Yong leaves permanently wilted without spotting or marked chlorosis. Yellowing and chlorosis of normally green leaves. White tip or yellow tip diseases is observed in grains with dwarfed or distorted heads.
12. **Molybdenum (Mb):** Lower leaves of tomato showing mottling, necrosis and curling of leaf edges. In oats, leaves bend backward, later break at affected areas with necrosis.
13. **Chlorine (Cl):** Leaves display the symptom of wilting of leaf blade tips. Chlorosis, bronzing and necrosis are also observed in areas proximal to wilting.
14. **Nickel (Ni):** Visual deficiency symptoms of nickel have not yet been found adequately. Its deficiency causes accumulation of nitrates and decrease in amino acid content in barley containing less than 0.1mg Ni/Kg.

Fertilizers Supplying Various Plant Nutrients

1. Nitrogenous Fertilizers:

Sr. No.	***Name of fertilizer***	***N %***
1.	Ammonium sulphate	20.6
2.	Urea	46
3.	Urea coated	45
4.	Calcium ammonium nitrate	25
5.	Urea ammonium nitrate	32

2. Phosphatic Fertilizers:

Sr. No.	***Name of fertilizer***	***P_2O_5 %***
1	Single Super Phosphate	16 (P_2O_5 powdered)
2	Triple Super Phosphate	48
3	Bone Meal Raw	20
4	Bone Meal Steamed	16
5	Single Super Phosphate	16 (P_2O_5 granulated)

3. Potassic Fertilizers

Sr. No.	***Name of fertilizer***	***K_2O %***
1	Potassium chloride (MOP)	60 (Powder)
2	Potassium sulphate	50
3	Potassium chloride (MOP)	60 (Granular)

Nitrogen and Phosphorous Complex Fertilizers

1. Diammonium phosphate: 18 % N: 46 % P_2O_5
2. Ammonium Phosphate Sulphate: 20 % N: 20 % P_2O_5
3. Ammonium Phosphate Sulphate Nitrate: 20 % N: 20 % P_2O_5 : 13 % S
4. Ammonium Phosphate Sulphate: 18 % N: 9 % P_2O_5
5. Nitro Phosphate: 20 % N: 20 % P_2O_5
6. Urea Ammonium Phosphate: 28 % N: 28 % P_2O_5
7. Urea Ammonium Phosphate: 24 % N: 24 % P_2O_5
8. Urea Ammonium Phosphate: 20 % N: 20 % P_2O_5

Nitrogen, Phosphorous and Potassium Complex Fertilizers

1. N:P:K (15:15:15)
2. N:P:K (10:26:26)
3. N:P:K (12:32:16)
4. N:P:K (22:22:11)
5. N:P:K (14:35:14)
6. N:P:K (17:17:17)
7. N:P:K (14:28:14)
8. N:P:K (19:19:19)
9. N:P:K (20:10:10)

Micro Nutrients

1. Zinc sulphate Heptahydrates ($ZnSO_4$, $7H_2O$): Zn - 21%
2. Manganese sulphate (MnSO4): Mn- 30.5%
3. Borax (Sodium tetra borate) ($Na_2B_4O_7$, 10 H_2O) – for soil: B- 10.5 %
4. Copper sulphate ($CuSO_4$, $5H_2O$): Cu- 24 %
5. Ferrous sulphate ($FeSO_4$, $7H_2O$): Fe- 19 %
6. Ammonium molybdate (NH_4): Mo- 52 %
7. Chelated zinc Zn- EDTA: Zn- 12 %

8. Chelated Fe- EDTA:	Fe- 12 %
9. Zinc sulphate monohydrate ($ZnSO_4.H_2O$):	Zn – 33 %
10. Manganese Sulphate:	Mn 9.6 %
11. Boric acid (H_3BO_3):	B – 17 %

Fortified Fertilizers

1. Boronated Single Super Phosphate:	16% P_2O_5, 0.18% B
2. Zinc Coated Urea:	N - 43%, Zn - 2%

Plant Protections in Nursery

4.2.1 Pest Management in Nursery

If you ever visit a garden or crop field you will come across cuttings on leaf margins, holes in leaves, chewed and damaged parts of plants, spots on leaves etc. They are due to the attack of various organisms which are known as pests. A pest is any organism, animal, plant or microorganism that causes damage to the plants, animals or human beings. The word pest is derived from the Greek word 'pestis' which means to annoy, to disturb or to destroy.
The Organisms designated as 'pests' compete with humans for food, fiber and shelter; transmit pathogens; feed on human food and threaten human health, comfort or welfare.

Major Pest Groups:

The major pests of agricultural importance can be broadly divided into the following groups:

Insect Pests: Insect pest and mites cause heavy damage to crops. Amongst the one million species of insects about 200 species can be termed as serious pests in agriculture.

Plant Diseases: Fungi, bacteria and viruses cause diseases in plants and insects. Nematodes are also sometimes classified as pathogens.

Garden Snails: They are called molluscs and become pests around home gardens,in lawns, greenhouses and ornamental plantings.

Weeds: These are the plants that either compete with crop plants thus affecting yieldand quality, or may interfere with the use of land and water resources.

Vertebrate pests: These are mainly rodents, birds and some other mammals likebats rabbits etc. that cause damage to crops and stored products.

Pest Control:

A nursery man adopts various methods to protect seedling from the pests. This activity is called as is the applied control or pest control. Traditionally pest control meansthe use of chemical pesticides. In the present day context, pest control includes the use of all those methods which are employed for preventing pests and diseases without disturbing environment.

Methods of Pest Control:

Important methods of pest control are briefly described below:

1. **Cultural Method:** It refers to manipulation of farm practices to check the pests. Some of the important cultural methods are: Crop rotations, Tillage methods (deep summer ploughing), High seed rate, Water management, Manipulation of date of sowing, and Trap cropping.
2. **Physical Method:** These methods involve modification of physical factors in the environment to minimize or prevent pest problem. Various physical methods are: Temperature manipulation, Moisture manipulation, Light manipulation, and Use of sound.

3. **Mechanical Method:** This refers to the use of mechanical implements and devices for removal and destruction of pests. Some of them are, Screens, traps, nets and suction devices, Hooking devices with iron rod in the hole bore by the insect, Banding with grease or polythene sheets on stem, Covering of seedling with net; andtrenching and water barrier-ant pans.
4. **Legal or Regulatory Method:** This refers, to the legal restrictions proposed by the Central and State Governments to check the spread of pests. The regulations such as Inspection and quarantine and Destructive Insect Pests Act can be enlisted under this heading.
5. **Resistant Varieties:** Use of resistant varieties help in avoiding or tolerating or recovering from pest attack. Resistant varieties have been identified against various pests in a number of crops.
6. **Biological Method:** This method refers to the use of natural enemies of pests viz. parasites, predators and microbes or pathogens (bacteria, virus, nematodes, fungi, protozoa etc.) so as to suppress the pest species. Biological control program can be carried out in the following ways: conservation and encouragement of indigenous natural enemies, importation of exotic natural enemies and mass rearing and releases of parasites/predators and microbes.
7. **Chemical Control:** The use of chemicals for the control of pests is known as chemical control. Pesticides are the chemicals used to kill or repel or attract or sterilize pests.
   Pesticides are without any doubt an effective means of killing pests quickly and on demand. No other control method provides users with an immediate and visibly effective means of pest control. Over the years, the indiscriminate use of pesticides bas resulted in a number of serious detrimental effects on the environment.
8. **Use of Botanical Pesticides:** These include the use plant products with a potential to control pests. Many plant products (leaf extracts, oils and cakes) have the property of inhibiting the development of pests and diseases. The plant extracts and oils are sprayed on the crops. Neem oil, neem cake and other neem based formulations have been found effective against pests.

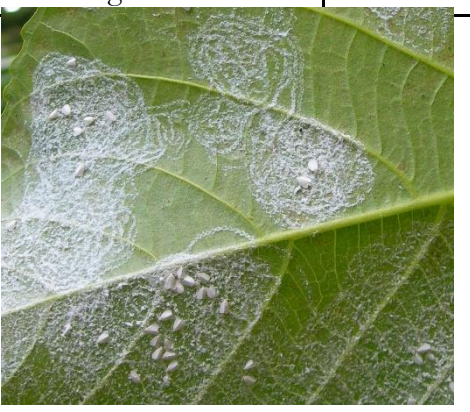
Use of Pesticides in Pest Control

The development of effective, economical pesticides has had a profound effect on man's continual battle with pests. In many cases pesticides have been incorporated as tools in well planned pest control programmer without serious hazards to humans or to the environment. Application of pesticides must be done at proper time, at right rate by using suitable equipment. The pesticides are applied on seeds, foliage and other parts or in soil against different pests and diseases. The various methods of pesticides application are Seed treatment, foliar application, Soil application, Granular application, Seedling root dip, Fumigation, Baiting etc.

Pest	***Damage***	***Management***
Aphids	Aphids damage the plants by sucking the leaf sap in young stage, cotyledonary leaves crinkle and in severe cases the plants withers off.	Spraying Malathion (0.1 %) or Metasystox (0.1-0.2%)
		
Jassids	Both nymphs and adults suck the sap from the lower surface of the leaves. The infested leaf curl upward along the margins, which may turn yellowish and show, burnt up patches.	Spraying Malathion (0.1%) or Dichlorvos (0.05%)
 		
Leaf Roller	Caterpillars roll leaves and feed on chlorophyll while remaining inside the folds. The folded leaves wither and dry up.	Spraying of Carbaryl (0.1%) or Malathion (0.05%)
 		

Pest	***Damage***	***Management***
Red Spider mite	Different stages of mites arefound in colonies covered by white-silky webs on lower surface of leaves. Nymphs and adults suck cell sap and white patches appear on leaves. Affected leaves become mottled, turn brown and fall.	Acaricides like Omite (0.05%) and Wettable Sulphur (0.3%) gives effective control of mites.
		
Mealy Bug	Nymphs and adults of mealy bugs suck sap from the leaves, tender shoots and the fruits. Aheavy black sooty mould may develop on the honeydew like droplets secreted by mealy bugs.	Spraying of insecticides likeDichlorvos (0.02%) or Chlorpyriphos (0.05%) with fish oil rosin soap was found to control the insect population.
		
Root-Knot Nematodes	The affected plants show the development of galls on the roots. The plants become stuntedand the leaves show chlorotic symptoms.	Treating the nursery beds with Phoret @ 5 g a.i./m^2 or Neem Cake 1 kg/m^2 Select resistant varieties.
		

Pest	***Damage***	***Management***
Thrips	Nymphs and black adults feed on tender leaves causing silvering, mottling and distortion of leaves.	Soil application of thimate twice at 15 days interval at 5 gm/bed and alsotake spray.
		
Leaf Miner	Larvae attack tender leaves and feed in the epidermal layers of the leaf by making serpentine mines in which air gets trapped and gives them silvery appearance.	Spraying the plants with Quinalphos @0.05%
		
Leaf Eating Caterpillar	Larvae feed on lower surface of leaves by scraping while greenish-brown mature larvae feed voraciously during nights on these leaves.	Spraying of Quinalphos @0.05% or Carbaryl @ 0.1% or Chlorpyriphos @0.05%
		
Cutworms	The tender plants are found damped at ground level duringthe night Young larvae feed gregariously on foliage but later segregate and enter into soil.	Soil application of Phorate (1kg a.i./ha)

Pest	*Damage*	*Management*
		
Whitefly	The damage by whitefly also leads to yellowing of leaves and stunted growth, in severe cases leading to shedding of leaves	Spraying Triazophos 40 EC (1.5 ml/ L of water) + 1.0 ml of Dichlorvos 76EC per litre of water.
		

Diseases Management in Nursery

Plant diseases is one of the major bottlenecks in seedling Production in plant nurseries.

Favorable Conditions for Diseases Infestation

Plant diseases are caused by various sources like micro-organisms, including fungi, bacteria, viruses, mycoplasmas, etc. or may be incited by physiological causes including high or low temperatures, lack or excess of soil moisture and aeration, deficiency or excess of plant nutrients, soil acidity or alkalinity, etc.

The causative agents of disease in green plants are in thousands and include almost every form of life. But primary agents of disease may also be inanimate. Thus nonliving (abiotic) agents of disease include mineral deficiencies and toxicities, air pollutants, biologically produced toxicants, improperly used pesticide chemicals, and other environmental factors as wind, water, temperature and sunlight.

Abiotic factors: Nonliving agents certainly qualify as primary agents of disease; they continuously irritate plant cells and tissues; they hamper the physiological processes of the plant; they evoke pathological responses that later show up as symptoms and characteristic of the different diseases. The abiotic agents of plant disease are termed noninfectious and the diseases they cause are termed noninfectious diseases.

Micro-organisms: The micro-organisms obtain their food either by breaking down the dead plant and animal remains (saprophytes) or by attacking living plants and animals (parasites). In order to obtain nutrients, the parasitic organisms excrete enzymes or toxins and kill the cells of the tissues of the host plant. These toxins kill or damage whole plant or a part of it, and cause considerable disturbance in its normal metabolic processes.

Parasites: The parasites are one of the major factors causing plant diseases. Parasites are those living organisms which colonize the living tissues of the host-plant. These diseases can be transmitted from plant to plant. These biotic agents are, therefore, infectious, and the diseases they cause are termed infectious diseases.

Media for Transportation

Wounds and Natural Openings

The parasite must enter the host plant to cause an infection. A parasite can enter the host through the following means, through wounds, through natural openings, or by growing directly through the unbroken protecting surface of the host. Viruses are injectedinto the plant through the proboscis of insects feeding on the juice of the host plant. Bacteria enter through wounds or natural openings like, stomates, hydathodes, and lenticels. But many fungi can penetrate plant parts by growing directly through plant surfaces, exerting enormous mechanical pressure and possibly softening host surfaces by enzymatic action.

Availability of Food

Availability of food or nutrition within the body is essential for the parasite to grow within the host. This act of colonization is termed infection.

Temperature Effects

The growing season of the parasite is affected by the temperatures of the surrounding. Many pathogen systems of cereal rusts in particular are affected by temperature.

Method of Disease Control in Nursery

(A) Preventive Measures

Cultural Practices: Cultural practices usually influence the development of disease in plants by affecting the environment. Such practices are intended to make the atmospheric, edaphic, or biological surroundings favorable to the crop plant, unfavorable to its parasites. Inoculation can be controlled by following preventive measures.

1. **Survival between Crops**: Organisms that survive in the soil can often be controlled by crop rotations with unsusceptible species. Catch crop has been used to control certain nematodes and other soil-borne pathogens. Soil-borne plant pathogens can be controlled by biological methods. Plant parasites may be controlled by encouraging the growth of antagonistic organisms. This can be achieved by adoption of cultural practices such as green manuring and the use of appropriate soil additives. Soil-borne plant parasites may also be killed during their over-seasoning stages by such cultural practices as deep ploughing, flooding, and frequent cultivation and fallow. Plant diseases caused by organisms that survive as parasites within perennial hosts or within the seed of annual plants may be controlled therapeutically.
2. **Production of Inoculum for the Primary Cycle**: Environmental factors (particularly temperature, water, and organic and inorganic nutrients) significantly affect Inoculum production. Warm temperature usually breaks dormancy of over seasoning structures;rain

may leach growth inhibitors from the soil and permit germination of resting spores and special nutrients may stimulate the growth of seasoning structures that produce inoculum.

3. **Dispersal of Inoculum and Inoculation**: Cultural practices that exemplify avoidanceare also effective in avoiding dissemination. Dispersal can also be avoided over a larger span with the help of plant quarantine.
4. **Sample Inspection**: One of the preventive measures to control the diseases is the use of sample inspection method. Laboratory evaluation of the representative sample drawn by the certification agency for the determination of germination, moisture content, weed seed content, admixture, purity, seed-borne pathogens.

(B) Control Measures

Chemical Control: The pesticide chemicals that control plant diseases may be used in different ways, depending on the parasite to be controlled and the circumstances required for parasitic activities. Relatively insoluble protective fungicides are applied repeatedly to the green leaves of potato plants to safeguard them from penetration by the fungus of late blight. Also, systemic fungicidal chemicals may be used therapeutically. The oxathiin derivatives that kill the smut fungi that infect embryos is therapeutic. The Benomyl which has systemic action against powdery mildews and other leaf infecting fungi is also therapeutic in its action. Volatile fungicides are often useful as soil- fumigating chemicals that have eradicative action.

The chemical control of plant diseases is classified in three categories: seed treatments, soil treatments and protective sprays or dusts.

1. **Seed Treatments**: Chemical treatments of seed may be effective in controlling plant pathogens in, on, and around planted seed. Seed treatment is therapeutic when it kills bacteria or fungi that infect embryos, cotyledons, or endosperms under the seed coat. Seed treatment is called eradicative when it kills spores of fungi that contaminate seed surfaces. Seed treatment is protective when it prevents penetration of soil-borne fungi into seedling stems.

   Seed treatment is of two types; viz., physical and chemical. Physical treatments include

   hot-water treatment, solar-heat treatment, etc. Chemical treatments include the use of fungicides and bactericides.

   These fungicides are applied to seed by different methods. In one method, the seed in small lots is treated in simple seed-treaters. The seed-dip method involves preparing fungicide suspension in water and then dipping the seed in it for a specified time.

2. **Soil Treatments**: Soil-borne plant pathogens greatly increase their populations as soils are cropped continuously, and finally reach such levels that contaminated soils are unfit for crop production.

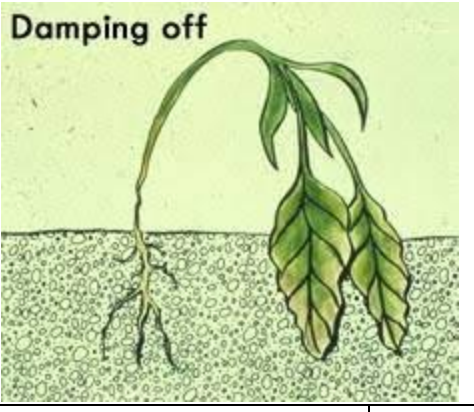
   Chemical treatments of soil eradicate the plant pathogens and offer the opportunity for uninterrupted agricultural uses by rapid reclamation of infested soils. Preplanting chemical treatment of field soils for the control of nematode-induced diseases, fumigation of seedbed and greenhouse soils with methyl bromide, etc is commonly practiced to eradicate weeds, insects, and plant pathogens.

   Field applications of soil-treatment chemicals for fungus control are usually restrictedto treatments of furrows. Formaldehyde or captan applied against sclerotia-producing fungi that cause seedling blights, stem rots, and root rots of many nursery seedlings. Other soil-treatment fungicides are vapam and "Vorlex". Soil treatments are made at the time of planting are most effective against parasitic attacks that come early in the growing season.

1. **Protective Sprays and Dust**: Protective fungicides prevent germination, growth and penetration. In order to use protective fungicides effectively, the farmer must not only select the right fungicide for the job but also apply it in the right amount, at the right times and in the right way. Too little fungicide fails to control disease; too much can prove toxic to the plants to be protected. The nurseryman and applicator, therefore, must always follow use instructions to the latter. Timing of applications is also critical.

Disease	**Symptoms and Damage**	**Management**
Anthracnose	Regular to irregular spots on leaves with dark margins and grayish centre.	Spray Carbendazim/Bitertanol/ Thiophavate methyl, Calixin, Kavach/ Rovral (2 g/*l*.) in humid weather
		
Bacterial canker	Cankerous spots on leaves	Apply Copper oxycholride during rainy season
		

Powdery mildew	White mealy growth on leaves	Wettable sulphur Carbendazim /Bitertanol / Thiophavate methyl, Calixin, Kavach/Rovral (2 g/*l*.) in September-March
		
Downy mildew	Pale-olive spots with milkywhite mycelium on the under surface of leaves	Apply Copper oxychoride, contact fungicide should be apply at 3-7 days interval and systemic fungicide at 10-15 days intervals.
		
Rust	Pale yellow pustules of uredospore are prominent on under surface showed necrotic pin head lesions.	Spraying Chlerothalonil (2 g/l) or Biteranol (1 g/l) are recommended
		

Damping off	The infections take place at the base of the young stems or at the soil level. Tissue becomes water soaked and rapidly collapse thus topping the seedlings. These pathogens cause pre- and post emergence damping off and wire stem of seedlings. It causes mortality of seedlings.	Treat seed/soil/media with Captaf/thirum/ Tricoderma etc.
		
Stem rot/ foot rot/ collar rot	Rooting of seedling stem near collar region	Spray Kavach/Rovral/Metalaxy/Mancozeb/ Aliette (2 g/l)
		
Leaf spot	Dark brown to light brown, tiny pustules on leaf surface, the pustules soon enlarge and turn blakish in the centre	Spray Carbendazim/Bitertanol/ Thiophavate methyl, Calixin, Kavach/ Rovraal (2 g/l.) in rainy season/ November Regined

Wilt	The foliar are yellowing and production of crookneck shoots. The leaves and shoots wither and become brownish. Stems whencut open show brown discoloration at the vascular region.	Soil fumigation and treating the nursery beds with benlate or with Thiophanate methyl and using *Tricoderma* etc.