

Major Diseases of Horticultural Crops and this Management

Dr.G. Thiribhuvanamala, Dr.S.Nakkeeran and

Dr. K.Eraivan Arutkani Aiyanathan

Department of Plant Pathology

Centre for Plant Protection Studies

Tamil Nadu Agricultural University

Coimbatore – 641 003

Introduction:

The Horticulture (fruits including nuts, vegetables including potato, tuber crops, mushroom, ornamental plants including cut flowers, spices, plantation crops and medicinal and aromatic plants) has become a key drivers for economic development in many of the states in the country and it contributes 30.4 per cent to GDP of agriculture, which calls for knowledge and technical backstopping. Intensive cultivation of the high valued horticultural crops, resulted in the outbreak of several diseases of National importance. In recent days, stakeholders import planting materials from North American Countries. Introduction of planting materials also impose threat in the introduction of new diseases not known to be present earlier. However, the diseases, if not managed on a war foot, it will result in drrastic yield reduction and quality of the produces. Hence adoption of suitable management measures with low residue levels in the final produces becomes as a need of the hour. In this regard, this paper gives emphasis on the diagnosis of plant diseases and their management.

Diseases of Mango and their management

1. Anthracnose :*Colletotrichum gloeosporioides*

Anthracnose symptoms occur on leaves, twigs, petioles, flower clusters (panicles), and fruits. The incidence of this disease can reach almost 100% in fruit produced under wet or very humid conditions. On leaves, lesions start as small, angular, brown to black spots and later enlarge to form extensive dead areas. Panicles develop small black or dark-brown spots, which can enlarge, coalesce, and kill the flowers. Petioles, twigs, and stems are also susceptible and develop the typical black, expanding lesions. On the lesions and dead portions, minute pink cushion shaped fructifications called acervuli are seen under moist conditions. Fruits may also drop from trees prematurely due to rotting. On immature fruits infections penetrate the cuticle, but remain quiescent until ripening of the fruits begins. Green fruit infections that take place at mature stage remain latent and invisible until ripening and carry the fungus into storage.

Favorable conditions : Under favourable climatic conditions of high humidity, frequent rains and a temperature of 24 - 32° C coinciding with flowering favours anthracnose infections in the field. The pathogen survives between seasons on infected and defoliated branch terminals and mature leaves. Field infection in developing fruit leads to Quiescent infection/Latent infection. Later once the ripening starts, lesions begin to develop under post harvest conditions which affects fruit quality and leads to enormous loss.

Management

- Proper sanitation of orchard by periodical removal of fallen plant debris and pruning of trees eradicates the fungus and checks further spread of the disease.

- Maintaining tree vigour with proper irrigation and fertilization.
- Fungicide sprays should begin when panicles first appear and continue at the recommended intervals until fruits are picked.
- Spraying the trees twice with Carbendazim (0.1%) or Mancozeb (0.2 %) or combination of Carbendazim 12 % + Mancozeb 63 % @ 0.1 % at 15 days interval during flowering to control blossom infection and twice during pea nut stage to prevent fruit infection.
- Alternate sprayings of Carbendazim and Mancozeb to avoid development of resistance in pathogen to fungicides .
- Spraying five times with *Pseudomonas fluorescens* FP 7
- (0.5%) from flowering until harvest at 3 weeks interval reduces anthracnose incidence and improves fruit quality.
- For post harvest anthracnose, fruits are dipped in hot water at 50 C for 30 min. in combination with 0.05 % carbendazim.

2. Die back / Fruit Stem end rot : *Lasiodiplodia theobromae*

The disease is characterized by drying of twigs and branches followed by complete defoliation, which gives the tree an appearance of scorching by fire. Tip die back disease occurs on the branches, trunk of infested trees that start drying slowly at first and suddenly branches become completely dried /killed resulting gummy substance oozes out or remains hanging on the tree .The dark area advances and young green twigs start withering first at the base and then the twig or branch dies, shrivels and falls called **die back**. This may be accompanied by exudation of gum. In old branches, brown streaking of vascular tissue is seen on splitting it longitudinally.

Stem end rot appears as rotting from pedicel end of fruit during ripening until pathogen remains latent forming appressoria that remains quiescent in the subcuticular layer in green fruits(**Quiescent infection/Latent infection.**).

Favorable conditions : High summer temperatures predispose the plant to attack by the pathogen. Relative humidity of 80% with temperature of 25.9 to 31.5 °C favor disease development. Survives in dead/ diseased twigs, bark of the trees and fallen fruits.

Management

- Pruning of infected plant parts from 7- 10 cm below the infection site and pasting the cut ends with Bordeaux paste .
- Spraying the trees twice at 15 days interval with Carbendazim (0.1%) or combination of Carbendazim 12 % + Mancozeb 63 % @ 0.1 % during pea nut stage to prevent fruit infection.
- Fruits should be harvested with stalk (5 cm), otherwise, the opening must be sealed with wax.

3. Powdery mildew : *Oidium mangiferae*

The disease affects inflorescence, leaves and young fruits

Symptoms : Appearance of a whitish, powdery growth of the fungus on leaves, panicles and young fruit which later turns brown and fall. The white growth can also be seen on the undersurface of young infected leaves which becomes distorted. Severe infection of young leaves results in premature leaf drop. On mature leaves, the spots turn purplish brown, as the white fungal mass eventually disappears. On developing inflorescence powdery growth leads to drying of flowers . Young fruits at

peanut stage are covered with mildew that leads to corky tissue and drops.

Favorable conditions : Spread of the disease occurs when rains or mists accompanied by cooler nights during flowering especially when the weather is cool and dry .Minimum temperature of 13- 15 °C , .maximum temperature of 23-25°C with moderate relative humidity (64-72%) favours disease development.Pathogen survives in affected plant debris and under favourable conditions ,air borne conidia is disseminated by wind and attacks new flushes.

Management

- Pruning of diseased leaves and panicles.
- Three sprays of fungicides at different stages starting with Wettable Sulphur (0.2%) at the time of panicle initiation followed by Dinocap (0.1%) subsequently followed by Tridemorph (0.1%) at 15-20 days interval.
- Sparying with mycobutanil @0.1% or Triademefon @0.1% or carbendazim @0.1% or Thiopahante methyl 0.1% found effective against disease

4. Grey leaf Blight : *Pestalotia mangiferae*

Symptoms

Brown spots develop on the margin and at the tip of the leaf lamina which coalesce covering the leaf margin and becomes dark brown. Black dots appear on the spots which are acervuli of the fungus. If infection starts from tip, it advances on either side of mid rib and within 3-4 months severe defoliation results.

Favorable conditions : Heavy infection is noticed during the monsoon when the temperature is 20-25° C and high humidity. Conidia survive on mango leaves for over a year. Spreads through wind borne conidia and rain splashes. Wound leads to more disease.;

Management

- Removal of infected plant parts. Spraying one time with Copper oxychloride @ 0.25 % or Mancozeb @ 0.25% or Bordeaux mixture @ 1.0% at the visual appearance of disease.

5 . Sooty Mould (*Capnodium mangiferae* *C.ramosum*)

The disease is common in the orchards where mealy bug, scale insects and hoppers are not controlled efficiently. Honey dew secretion by insects make the fungi produce mycelium which is superficial and dark and forms black encrustation on leaves. In severe cases, the trees turn completely black due to the presence of mould over the entire surface of twigs and leaves. The severity of infection depends on the honey dew secretion of the above insects. Presence of a black sooty mould on the leaf surface adversely affects the photosynthetic activity of the leaf and thereby fruit set is reduced.

Favorable conditions : Reduced ventilation favors sooty growth on leaves . High humidity spreads the disease within orchard. Honey dew secretions from insects stick to the leaf surface and provide necessary medium for fungal growth. Conidia spread by rain splashes. During rain sooty growth is washed away.

Management

Pruning of affected branches and their prompt destruction .Spraying systemic insecticides like to control insects.Spraying of 5 per cent starch

(1kg Starch/Maida in 5 litres of water. Boiled and dilute to 20 liters) helps to control the disease as dried starch flakes removes the fungus.

6.Mango malformation: *Fusarium moniliforme var. subglutinans*

Symptoms

Three types of symptoms: bunchy top phase, floral malformation and vegetative malformation. **In bunchy top phase** in nursery at 40-5 months old. bunching of thickened small shoots, bearing small rudimentally leaves. Shoots remain short and stunted giving a bunchy top appearance. **In vegetative malformation** induces excessive vegetative branches of limited growth in seedlings. They are swollen with short internodes forming bunches of various size and the top of the seedlings shows bunchy top appearance. **In malformation of inflorescens**, shows variation in the panicle. Reduction in length of primary axis and secondary branches of panicle makes the flowers to appear in clusters..Secondary branches are transformed into number of small leaves giving a witches broome appearance. Malformed head dries up in black mass and persist for long time. Such panicles dot not bear..The infection is localized.

Favorable conditions :Diseased propagated material spreads disease. The fungus does not sporulate insitu but sporulates on dried malformed panicles. The disease is severe in north west region at temperatures between 10-15 °C during December to January before flowering. Disease is mild in areas with 15-20 °C , sporadic bwteen 20-25 °C . Occurrence of malformation differs based on age of planrts. Plants at 4-8 years are susceptible. In some cases mites have been reported to be carrying the fungus and cause spread.

Management.

- Diseased plants should be destroyed
- Use of disease free planting material
- Incidence reduced by spraying 100-200ppm NAA during October.
- Pruning of diseased parts along the basal 15-20 cm apparently healthy portions followed by the spraying of Carbendazim (0.1%) or Captafol (0.2%).

8. Bacterial leaf black spot / canker (*Xanthomonas campestris* pv. *mangiferae-indicae*)

Symptoms

This disease that affects all the above ground parts of plant, i. e., leaves, petioles, twigs, branches and fruits . The disease causes fruit drop (10-70%), yield loss (10-85%) and storage rot (5-100%). Many commercial cultivars of mango are susceptible to this disease. Bacterial leaf spot is noticed on the leaves as angular water soaked spots that become necrotic and dark brown and viscous bacterial exudates deposit on these necrotic portions that become corky and hard after drying. Sometimes, longitudinal cracks also develop on the petioles. Cankerous lesions appear on petioles, twigs and young fruits. The water soaked lesions also develop on fruits which later turn dark brown to black. They often burst open, releasing a highly contagious gummy ooze containing bacterial cells. The fresh lesions on branches and twigs are water soaked which later become raised and dark brown in colour with longitudinal cracks but without any ooze

Favorable conditions :The bacteria enters through natural openings such as stomata, wax and oil glands, leaf and fruit abrasions, leaf scars, and at the apex of branches in the panicle. Periods of high humidity, surface wetness and wind accompanied with rain cause most rapid and maximum

dissemination of bacteria. Survives in infected plant parts and spread through rain splashes and wind. Disease is rapid during rainy days.

Management :Field sanitation and removal of affected plant parts. Three sprays of Streptocycline (200ppm) or Agrimycin-100 (100 ppm) after first visual symptom at 10 days intervals. Monthly sprayings of Copper oxychloride (0.3%) checks the further spread. Removal of diseased fruits under storage. Dipping fruits in 200 ppm Agrimycin is effective.

9. Red Rust (*Cepbaleuros virescens*)

The disease is caused by an algae that causes reduction in photosynthetic activity. Initially the spots are greenish grey and velvety in texture which

finally turn to rusty spots on leaves and twigs. Post sare initially circular, elevated and later coalesce. Numerous filaments which may be sterile or fertile project outwards through cuticle. In severe cases, defoliation of leaves there by lowering vitality of the host plant. reddish brown. After shedding the spore the algal matrix remains attached to leaf surface, leaving a creamy white mark at the original rust spot.

Favorable conditions :Disease is common in closed plantations. High humidity favours development of fruiting bodies.

Management :Supply of balanced nutrients to the plants and two sprays of Bordeaux mixture (1%) or Copper oxychloride (0.3%) in the month of July at 15 days interval. Algal growth on leaves

Integrated Disease Management Strategies

- Proper sanitation of orchards by removal of fallen plant debris and pruning of trees during the months of July –August eradicates the

fungus and checks the spread of diseases.

- Application of Bordeaux paste on the cut ends of branches prevents entry of pathogens.
- During flowering, spray the trees twice with Carbendazim (0.1%) at 15 days interval to control blossom infection and twice during pea nut stage to prevent fruit infection by anthracnose and stem end rot.

Alternate sprayings of Carbendazim and Mancozeb to avoid development of resistance in pathogen to fungicides. SAAF (Carbendazim 12 % + Mancozeb 63 %) @ 0.1 % can be recommended as an alternate for better control . Three sprays with Wettable sulphur (0.2 %) at 15 days interval starting from panicle initiation to prevent powdery mildew (sprays can be

- reduced depending on disease incidence)
- From fruit set until 15 days before harvest, alternate Carbendazim (0.1%) with a copper oxy chloride (0.3 %) every 14–28 days which takes care of fruit infections by anthracnose, stem end rot and bacteria.
- Spraying five times with *Pseudomonas fluorescens* FP 7 (0.5%) from flowering until harvest at 3 weeks interval reduces anthracnose incidence and improves fruit quality.
- Spraying of 5 per cent starch solution to remove sooty mould growth.
- Avoid injuries /damage on the fruits during picking and transit.
- Post harvest infection due to fungal pathogens are controlled by dipping the fruit in hot water ($52 \pm 10^{\circ}\text{C}$) or hot water in combination with Carbendazim (0.05%) for 5 minutes

Diseases of Banana and their Management

1. *Fusarium wilt:* *Fusarium oxysporum* Fsp. *cubense*

Symptoms: Symptoms are characterized by yellowing of leaves from margins inwards towards mid rib. Petiole buckling takes place; as a result leaves hang around the pseudostem forming yellow skirt like pattern. The emerging heart leaf dies and only few erect leaves are seen on diseased plant. As the disease progresses, the younger leaves collapse until the entire canopy consists of dead or dying leaves. Longitudinal splitting of pseudostem is seen in advanced stages. The infected rhizomes when cut shows pinkish discoloration of vascular strands in pseudostem and brown discoloration of corm. The cut end of corm smells like rotten fish.

Susceptible varieties are Rasthali, Karpooravalli, Neypoovan , Monthan

Favorable conditions Primary inoculum is from infected suckers and pathogens in soil in the form of chlamydospores. Movement of infected planting material, contaminated trash helps in long distance dispersal. Within field, irrigation water and farm implements are the major cause for spread of disease. Fungus gains entry through roots. Nematodes predispose the disease.

Management

- Considering the long-term survival of *F. oxysporum* f. sp. *cubense* in soil, proper field sanitation, use of disease free planting material/ tissue culture plants can reduce disease incidence
- Severely affected plants should be uprooted and burnt. Highly infected soil should not be replanted with banana at least for 3-4 years
- An integrated approach for management of *Fusarium* wilt has to be followed by use of pathogen free suckers, pairing of suckers

(Sucker treatment with Carbofuran granules @ 40 g / sucker before planting), Sucker dipping with 0.2 % carbendazim for 45 minutes at the time of planting , corm injection with 2% Carbendazim (3ml/plant) or capsule application with Carbendazim (50mg /capsule)/ at 3rd, 5th and 7th month after planting will offer protection to the wilt susceptible cultivars .

- Application of *Trichoderma viride* or *Pseudomonas fluorescens* @ 50g/ plant at the time of planting and at 4th , 6th and 8th month reduces the disease incidence

2. Sigatoka leaf spot: *Mycosphaerella musicola*

Symptoms: Symptoms are characterized by oval to round necrotic lesions which first appear as pale yellow on lower surface of leaf. Correspondingly on the upper leaf surface, pale yellow specks appear which later on extends to form yellow oblong spots with or without yellow halo. When the disease progresses these spots further increase in size, join with each other forming large dead necrotic

areas on the leaf preventing photosynthetic functioning of the leaf. Destruction of mature and functional leaves in large number at the time of shooting leads to failure of bunches to fill out and ripen. Fruit set will be poor with reduced size, uneven ripening and angular shape having discoloured flesh. Sometimes premature ripening of banana bunches takes place in field itself.

Favorable conditions : The disease is influenced by in intermittent rainfall, high relative humidity and low temperature (23- 25 °C). Closer spacing, weeds, shade, frequent irrigation increase

Management

- Proper, wider spacing must be practised.
- Severely infected plants and leaf blades should be removed and destroyed periodically.
- The orchard must be clean and free from weeds and grasses to avoid humidity build up.
- In the wet season, application of a protectant fungicide like Mancozeb @0.2% or chlorothalonil @0.1% every three to four weeks is recommended. During periods of high disease threat or extended wet weather, propiconazole, a systemic fungicide, can be substituted for Mancozeb.

Foliar spray any one of the following fungicides commencing from October-November or mat months coinciding with rainfall at monthly interval. Carbendazim 1 g / lit., Benomyl 1 g / lit., Mancozeb 2 g / lit., Copper oxychloride 2.5 g / lit., Ziram 2 ml / lit, Chlorothalonil 2 g / lit. Alternation of fungicides prevents fungicidal resistance. spray Propiconazole 1 ml/lit or 0.5 ml/lit along with petroleum based mineral

- oil 10ml / lit or *Pseudomonas flourescens* (0.5%),

3. Rhizome rot or soft rot or Tip over disease: *Erwinia caratovora* sub *sp. caratovora*

Symptoms:

Rhizome Rot, also known as Soft Rot or Tip Over Disease is commonly observed during the first 3–4 months after planting under high temperature conditions, especially during late summer and rainy season. The heart leaves become shrivelled, brown and dried and the adjacent leaves are reduced in size. Rotting of pseudostem base and

upper portion of corm accompanied with foul smell. Severely affected plants show breaking of pseudostem at base leaving infected and rotted corm in soil. Slimy fluid of bacteria oozes out from the cut portions of corm and pseudostem. Young plants of 1-3 months are more susceptible during summer months.

Favorable conditions : The bacteria survives in soil and infected plant residues and they enter the plant through wounds and spread across fields through water and infected planting material.

Management

- Management of *Erwinia* rot begins with the selection of suckers from diseases free field.
- Sucker dip in Copper oxy chloride (Blitox @ 5.0 g/l) + 300ppm streptomycin sulphate for 30 min or carbofuran @ 40 g/plant + Copper oxy chloride drenching.or dipping of suckers in 5000 ppm of Copper oxy chloride for 30 min., reduced rhizome rot in banana
- Intercropping with sunhemp in the interspaces till 4 MAP can further reduce disease by lowering the soil temperature and can add nitrogen source to soil.
- Under field conditions, soil drenching streptomycin sulphate (500 ppm) ,Streptocycline 500 ppm and Copper oxy chloride 2000 ppm reduce the rhizome rot disease incidence.
- Also dipping the suckers in Copper oxy chloride (40 g/10lit) Streptocycline (3g/ 10 lit.) for 30 min. before planting
- Application of bleaching powder @6 g /plant followed by immediate irrigation at the onset of disease.

4. Moko wilt: *Ralstonia solanacearum*

Symptoms: Initial symptoms are characterized by yellowing of the inner lamina close to the petiole which is followed by wilting of inner leaves. The lower leaves become yellow which progresses upwards. Petiole break at this junction and droop around the pseudostem. If diseased suckers are planted, the terminal leaves become necrotic and plant dies. Young sword sucker from diseased plant show wilting and blackening. When pseudostem is cut pale yellow to dark brown vascular discoloration of strands are seen along with yellowish brown oozing of bacteria from cut ends. . In some cases no external symptoms are produced until bunch development. The presence of yellow fingers in green bunches and inner pulp exhibits dark brown discoloration. Fruit rot and fruit stalk discoloration , wilted or blackened regrowth of suckers, dead male flower buds and peduncles with vascular discoloration are other symptoms of Moko disease.

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Favorable conditions : Pathogen is soil borne and survives in infected debris . Spread is by irrigation water, farm implements and infested soil and insects.

Management: Early detection and destruction of the suspected plants may help in preventing the spread of the disease. All the tools used for pruning and cutting should be disinfected with formaldehyde. As the insects can carry the disease causing bacterium on the male flowers, removal of the male flowers as soon as the last female hand emerge help in minimising the spread of the disease.

5. Viral diseases of Banana

Banana Bunchy Top Disease: Primary transmission is by infected suckers and secondary transmission by the aphid vector *Pentalonia nigronervosa*.

Infected suckers put forth narrow leaves, which are chlorotic and exhibit mosaic symptoms. The affected leaves are brittle with their margins rolled upwards. Characteristic symptom of bunchy top virus is the presence of interrupted dark green streaks along the secondary veins of the lamina or the midrib of the petiole. The dark green, hook like extensions of the leaf lamina veins can also be seen between the midrib and the lamina. The diseased plants remain stunted and do not produce bunch of any commercial value. The suckers that develop after a 'mother' plant has been infected with BBTV are usually severely stunted, with leaves that do not expand normally and remain bunched at the top of the pseudostem. Therefore the disease can result in a 100% yield loss. When very late infection occurs in the season, the plant would show dark green streak on the tip of the bracts of male flower bud. The aphids are found clustered around the unfurled heart leaf and leaf sheaths. The aphids produce honeydew which attracts ants around the plant. The BBTV symptoms are visible only 22- 23 days after infected by the virus.

Infectious chlorosis/ Cucumber Mosaic Virus :

Primary transmission is by infected suckers and secondary transmission by the aphids *Aphis gossypii* and *Aphids maidis*. The disease is characterized by typical mosaic symptoms on the leaves. Mosaic plants are easily recognised by their dwarf growth and mottled,

distorted leaves. The earliest symptoms appear on young leaves as light green or yellowish streaks and bands giving a mottled appearance. Necrosis of emerging cigar leaves leading to varying degree of necrosis in the unfurled leaf lamina. Internal tissues also show necrosis. Plants do not produce bunches but act as a virus reservoir. Affected plants throw small bunches with malformed fingers. Uneven ripening has been associated with this virus.

Banana Bract Mosaic Virus (BBrMV) :

Primary transmission is by infected suckers and secondary transmission by aphid vectors *Aphis gossypii*, and *Rhopalosiphum maidis*. Purple coloured spindle shaped streaks on pseudostem. Clustering of leaves at crown with a travelers palm appearance, elongated peduncle and half filled hands. Bunches have unusually long peduncle, chocking of bunches, raised corky growth on peduncle is also observed. Bracts show thick purple longitudinal streaks. Dark reddish spindle shaped streaks are seen on pseudostem

Banana Streak Virus (BSV) : Primary transmission is by infected suckers and secondary transmission by the mealy bugs *Planococcus citri* and *Saccharicoccus sacchari*. A prominent symptom exhibited by BSV is yellow streaking of the leaves, which becomes progressively necrotic producing a black streaked appearance in older leaves. Necrotic streaks are observed on midrib, petiole and pseudostem. Bunch choking, abortion of bunch and seediness in fingers are observed. Delayed fruit bunch emergence, reduction in fruit size, malformation of fingers when floral initiation and early bunch development coincide with a period of

increased virus synthesis. Sometimes necrosis of emerging leaves internal necrosis of the pseudostem and plant death.

Integrated management for virus diseases

- Eradication of infected plants and sword suckers.
- Strict quarantine measures to be followed
- Ensure virus free planting materials.
- Avoid cucurbitaceous crops around banana field
- Spraying dimethoate or methyl demeton 0.1 % for vector control
- Destroy bunchy top virus affected plants by capsule application of 200 mg of 2,4 -D / capsule in to corm (7 cm deep) using capsule applicator or inject 5 ml of 2,4-D solution (125 g / lit.) in pseudostem using injector.
- Control vector by spraying 1ml Methyl demeton (or) 2 ml (or) 1 ml Phosphomidon in 1 litre of water (or) injection of 1 ml /per plant (1 ml diluted in 4 ml water)at 45 days interval from 3rd month till flowering.
- Removal of weeds

Major Diseases of Chillies, Tomato Brinjal, Onion, Bhendi Gourds and water melon and their management

In vegetable crops, Damping off, root rot, leaf spots, powdery mildew and downy mildew and virus diseases (Mosaic and leaf curl) cause severe yield loss.

Damping off : *Pythium aphanidermatum* is observed in most of the vegetables (Chillies, Tomato , Brinjal, Cabbage, Onion)

Symptoms: Occurs as pre emergence and post emergence damping off. In the pre-emergence the phase the seedlings are killed before emergence where

young radical and the plumule are killed leads to rotting of the seedlings. The post-emergence phase is characterized by the infection of the young seedlings which become soft and water soaked at the collar region at the ground level and leads to toppling or collapse of the seedlings.

Favourable conditions: pathogen Survives in soil and excess soil moisture favours disease.

Management

- Provide raised seed bed in nursery and fumigate with formaldehyde
- Treat the seeds with Thiram @ 3 g/kg seed or *Trichoderma viride* @ 4 g kg seed or *Pseudomonas fluorescens* @ 10 g /kg of seed 24 hours before sowing.
- Soil application of *Pseudomonas fluorescens* @ 2.5 kg/ha mixed with 50 kg of FYM.
- Avoid stagnation of water.
- Drench with Copper oxychloride @ 2.5 g/l or Bordeaux mixture 1%.

Wilt: Wilt caused by *Fusarium* sp affects most of the vegetable crops

(i) Tomato -*Fusarium oxysporum* f. sp. *lycopersici*

(ii) Chillies-*Fusarium oxysporum* f. sp. *vesicatoria*

(iii) Bhendi- *Fusarium oxysporum* f. sp. *vasinfectum*

(iv) Water melon- *Fusarium oxysporum* f. sp. *Niveum*

(iv) Water melon- *Fusarium oxysporum* f. sp. *Niveum*

Symptoms : Wilting of the plant is characterised by an initial of yellowing of the upper leaves that turn yellow and droop. Finally the vascular system of the plant is discoloured, particularly in the lower stem and roots and plants ecome wilted.

Favourable conditions: Soil and seed borne. Survives in soil for more than 10 years. Spreads through irrigation, farm implements.

Management

- Drenching with 1% Bordeaux mixture or Copper oxy chloride @ 2.5 g/lit.
- Seed treatment with *Pseudomonas fluorescens* Pf1 @ 10 g /kg of seed, followed by nursery application of Pf1 @ 20 g/m² and seedling dip with Pf1 @ 5g/l along with soil application of Pf1 @ 2.5 kg mixed with 50 kg FYM /ha at 30 days after transplanting.
- Spot drench with Carbendazim @ 1g/lit for wilt affected plants

Leaf spots: Leaf spots caused by *Cercospora* sp., *Septoria* sp., *Alternaria* sp. and *Botrytis* sp occurs at all stages of the crop and leads to yield loss .

(i) Chillies: *Cercospora capsisci*

(ii) Tomato : *Septoria lycopersici*

(iii) Bhenidi: *Cercospora malayensis*, *C. abelmoschi*

(iv) Brinjal: *Cercospora solani* –*melongenae*, *C. solani*, *Alternaria melongenae*, *A. Solani*

(vi.) Onion leaf blight and Purple blotch : *Botrytis* sp., *Alternaria porri*

(viii) Water melon: *Alternaria cucumerina*, *Colletotrichum orbiculare*

Symptoms

Leaf spots are brown and circular with small to large light grey centres and dark brown margins or dark black irregular spots with concentric rings or specks which coalesce and cause drying and defoliation. Stem, petiole and pod lesions also have light grey centres with dark borders. Severely infected leaves drop off prematurely resulting in reduced yield. Favorable conditions: High humidity, drizzling, wind favors disease development and spread. Survives in infected crop debris.

Management

- Seed treatment with Carbendazim @2g/kg of seed.
- Spraying Mancozeb @ 2 g/lit or Copper oxychloride @ 2.5 g/lit.
- For purple blotch of onion, spray Tebuconazole @ 1.5 ml/lit. or Mancozeb @ 2g/lit. or Zineb @ 2g/lit.

Virus diseases: Mosaic and Leaf curl

Mosaic: Transmitted by aphids. Affected plant appears stunted with light and dark green mottling on the leaves that becomes distorted, puckered and smaller than normal leaves. This disease is common in Tomato, Chillies, Brinjal, Gourds

Leaf curl : Transmitted by white fly. Leaves are curled have margins that curl upward, giving them a cup-like appearance ,reduced in size ,yellowing between the veins ,shortened internodes giving the plant a stunted appearance . This disease is common in Tomato and Chillies

Management

- Protected nursery in net house or green house.
- Placing yellow sticky traps @ 12/ha to monitor the vectors
- Raising barrier crops, cereals around the field . Raise two rows of Maize or Sorghum for every 5 rows of chilli.
- Removal of weed host regularly
Spray Imidacloprid @ 0.5 ml/lit. or Dimethoate @ 0.5 ml/lit. or @1.5 ml/lit. or Acephate @1g/lit. at 15, 25, 45 days after
- transplanting to control vector.
- Virus perpetuates in cucurbits, legumes, pepper, tobacco, tomato and weed hosts so care should be taken.

DISEASES OF TOMATO

(refer previous page for damping off, wilt, Leaf spot and virus diseases)

1. Early blight : *Alternaria solani*

Symptoms: Small, black spots enlarge and concentric rings in a bull's eye pattern can be seen in the center of the diseased area. Tissue surrounding the spots may turn yellow. Lesions on the stems may occur and girdle. On fruits, dark brown concentric rings are seen that affects the market quality. Shedding of immature fruits occur

Favourable conditions: Survives in seeds and soil. High soil moisture creates high humidity that favors disease development initially on lower leaves.

Management

□ Removal of infected plant debris. Use of disease free seeds . Crop rotation with non solanaceous crops. Spraying Mancozeb @ 2g/lit. or copper oxychloride @ 2.5 g/lit twice at 15 days interval.

2. Late blight: *Phytophthora infestans*

Symptoms: Leaves stem and fruits are attacked Lesions appear as purplish to brown colour which leads to blighting under humid conditions. Marbled areas on green fruits which later becomes brown and completely shriveled.

Favorable conditions: Pathogen survives in infected debris. Disease occurs in rainfed crops under irrigation where dew is frequent and develops quickly in rainy season accompanied with high humidity.

Management

- Crop rotation
- Over head irrigation to be avoided. Spray with mancozeb 0.2% or captan @0.2% or Metalaxyl 0.2% or copper oxychloride @ 0.2%

3. Bacterial wilt: *Burkholderia solanacearum*

Symptoms: Young seedling show yellowing and wilt. Curling of leaves occurs. More adventitious roots are formed. Later black discoloration of vascular tissues with gummy bacterial ooze is the characteristic symptom of severely infected plant.

Favorable conditions: Survives in soil and in infected plant debris. . spreads through irrigation water and farm implements.

Management

- Crop rotation. Spraying with Agrimycin-100 @ 0.1g /lit. thrice at 10 days intervals effectively controls the disease.

4. Peanut bud necrosis disease : Groundnut bud necrosis virus

- Numerous small, dark, circular spots appear on younger leaves, bronzing of leaves that later turn dark brown and wither. Plants affected at early stages do not flower , those affected at later stages show reduced flowers and poor fruit set and the growing shoots shows necrosis and finally death of plants
- Fruits show numerous spots with concentric, circular markings.
- On ripe fruit, these markings alternate with bands of red and yellow.
- The spotted wilt virus is transmitted by thrips

Management

- Selection of healthy seedlings and roguing of infected plants up to 45 days of planting.

- Apply Carbofuran 3 G @1 kg a.i./ha in nursery at sowing and second application at 1.25 kg a.i./ha 10 days after transplanting in mainfield and 3 sprays of Dimethoate @1 ml/l or Methyl demeton @1 ml/l or Phosphomidan @ 1.0 ml/l at 25, 40 and 55 days after transplanting.
- Spraying *Pseudomonas fluorescens* @ 5g/l at 25th and 45th day after planting
- The affected plants should be periodically removed and destroyed.
- Alternate or collateral hosts harboring the virus have to be removed.
- Raise barrier crops – Sorghum, Maize, Bajra at 5-6 rows around the field one month before planting

DISEASES OF CHILLIES

1.Fruit Rot and Die Back: *Colletotrichum capsici* (refer previous page for damping off , wilt, leaf spot and virus diseases)

Symptoms: Necrosis of tender twigs from the tip backwards, profuse shedding of flowers. Drying up spreads from the flower stalks to the stem and subsequently causes die-back of the branches and stem which later on wither. Partially affected plants bear few fruits of low quality. Fruits rot appears on ripe fruits where small circular spots initially appear and spreads as oblong black greenish colour or markedly delimited by a black or straw colored area. Badly diseased fruits turn straw coloured with less pungency. The diseased fruit later shrivels and dries up.

Favorable conditions: Seed borne and secondary spread by wind during [periods of high humidity accompanied with rain. Disease appears after rains has stopped and when there is prolonged deposition of dew on plant. \

Management

- Use disease free seeds
- Seed treatment with Thiram or Captan @ 4g/kg
- Spray Mancozeb @ 2 g/lit or Copper oxychloride @ 2.5 g/lit thrice at 15 days interval starting from noticing the die-back symptoms or at
- 60 days after planting .

2. Powdery mildew: *Leveillula taurica*

Symptoms : White powdery growth on lower side of leaves leads to shedding of foliage causing severe reduction in fruit yield.

Management

- Spray Wettable sulphur @ 3 g/lit or Carbendazim @ 1 g/lit, 3 sprays at 15 days interval from the first appearance of symptom

3. Bacterial leaf spot: *Xanthomonas campestris pv. Vesicatoria*

Symptoms: The leaves exhibit small circular or irregular, dark brown or black greasy spots that form irregular lesions. Severely affected leaves become chlorotic and fall off. Stem infection leads to formation of cankerous growth and wilting of branches. On the fruits round, raised water soaked spots with a depression in the centre where in shining droplets of bacterial ooze is observed.

Management

Field sanitation and crop rotation

Spray seedlings with Bordeaux mixture @ 1% or copper oxychloride @ 2.5g/

1. DISEASES OF BRINJAL (refer previous page for damping off ,leaf spot diseases)

Bacterial wilt: *Pseudomonas solanacearum*

Symptoms: Lower leaves may droop, yellowing of the foliage, stunting ,wilting and finally collapse of the entire plant .The vascular system becomes brown and bacterial ooze comes out from the affected parts.

Favourable conditions: Presence of root knot nematode *Meloidogyne incognita* increases the disease incidence. Survives in soil and in infected plant debris. . Spreads through irrigation water and farm implements.

Management

- Crop rotation with cruciferous vegetables such as cauliflower
- Fields should be kept clean and affected parts are to be collected and burnt.
- Spray 2% Bordeaux mixture or Spraying with Agrimycin-100 @ 100 ppm (0.1g/litre) thrice at 10 days intervals effectively controls the disease.

2. Phomopsis Fruit Rot: *Phomopsis vexans*

Symptoms: Initially seen as blight on young seedlings. And girdle the plant as a result plant topples. On mature plant, stem lesion appear as dark brown and dreads to e tire stem , colaeses nad spreads to fruits . Fruits show soft watery lesion and later become mummified with minute black structure called pycnidia and remains dried.

Favorable conditions: Survives in soil in infected plant debris. Spreads though irrigation water and farm implements

Management

- Deep summer ploughing, crop rotation.
- Spraying Carbendazim + Mancozeb @ 0.1% or copper oxychloride @ 2 0.2
- % or difolotan 0.2%

Little leaf of Brinjal: Caused by Phytoplasma. Transmitted by Leaf hopper *Hishimonas phycitis*.

Symptoms: Reduction in leaf size. As disease progresses leaves become smaller, croded and the petioles become shorter . Later leaves become thin narrow and glabrous. Plant gives bushy appearance. Floral parts are modified in to green structures and fail to produce fruit, If at all fruits are produced, fruits never mature and remain mummified.

Management :

- Removal of weed hosts.
- Spraying 100 ppm of Tetacycline or copper hydroxide @ 500 ppm

DISEASES OF WATER MELON (refer previous page for *Fusarium* wilt disease)

1. Gummy Stem Blight : *Mycosphaerella melonis*

Symptoms: Infected stems are water-soaked and then become dry, coarse and tan with small black fruiting bodies. Large lesions girdle stems and plants wilt. Stem lesions on melons exude a gummy, red-brown substance

Management

- Use of disease free seed.
- Drenching / spraying with Mancozeb @ 2g/lit. to cover the affected area.

2. Bacterial Wilt: *Erwinia tracheiphila*

Symptoms: Leaves turn dull green and finally wilting. Cut ends of stem exudate white ooze which are carried by beetles to near by plants\

Favorable conditions: Survives in soil and in infected plant debris. . spreads through irrigation water and farm implements.

Management

- Field sanitation and crop rotation
- Removal of affected plants

Spray Streptomycin sulphate (400ppm) @ 0.4g/l

3. Downy mildew: *Pseudoperonospora cubensis*

Symptoms: This disease occurs less frequently on watermelons. Small, yellowish areas occur on the upper leaf surface and a downy, white-gray-light blue fungus growth can be seen on the underside of individual lesions. Usually spots are angular because they are restricted by leaf veins.

Favorable conditions: High humidity with drizzling , low temperature of 15 to 25 °C accompanied with drizzling and dew favours disease.

\Management : Spraying with Metalaxyl @ 500 g/ha or Metalaxyl + Mancozeb @1 kg/ha or Mancozeb 1 kg/ha.

4. Angular Leaf Spot: *Pseudomonas lachrymans*

Symptoms: Small, angular, water-soaked lesions on the leaves that turn

gray or tan, die, and may tear away leaving irregular holes. Water-soaked spots may also appear on the fruit

Favorable conditions: Survives in soil and in infected plant debris. . spreads

through irrigation water and farm implements.

Management: Use disease-free seed .Crop rotation

DISEASES OF GOURDS

Downy mildew: *Pseudoperonospora cubensis*

Symptoms: Disease affects pumpkin, Snake gourd, Ribbed gourd, Bottle gourd, Bitter gourd and Ash gourd. Whitish growth of fungus is seen on lower surface of leaves and corresponding upper leaves show pale green areas separated by dark green areas The entire leaf dries up quickly.

Favorable conditions: High humidity with drizzling , low temperature of 15 to 25 °C accompanied with drizzling and dew favours disease.

Management

- Seed treatment with Metalaxyl @ 2 g/kg.seeds
- Spraying with Mancozeb @ 2g/lit. or Chlorothalonil @ 2 ml/lit. or Metalaxyl + Mancozeb @ 1g/lit.

Powdery mildew: *Erysiphe cichoracearum*

Symptoms; Disease occurs in Pumpkin, Snake gourd, Ribbedgourd ,Bottle gourd, Bitter gourd and Ash gourd.White or brown growth on upper and lower surfaces of leaves and stems and leads to drying

Favorable conditions: Dry season and high temperature. Favours disease development. Survives in infected plant debris.

Management

- Spray Dinocap @1 ml/lit. or Carbendazim @ 0.5 g/lit.

Mosaic : *Cucumber mosaic virus*

Symptoms; Infected plants show cupping of leaves downward, severe mottling with alternating light green and dark green patches. Plants are stunted, and fruits are covered with bumpy protrusions. Severely affected cucumber fruit may be almost entirely white. The virus is readily transferred by aphids and survives on a wide variety of plants.

Management

- Removal of weed host.
- Spray Dimethoate @ 2ml/lit. or @ 1.5 ml/lit. or Acephate @ 1g/lit. to control insect vectors.
- Place yellow sticky traps @ 12/ ha .

DISEASES OF ONION

Basal Rot: *Fusarium oxysporum f.sp. cepae*

Symptoms: Leaves turn yellow and then drying of leaf tip downwards. The bulb of the affected plant shows soft rotting and the roots get rotted. Whitish mouldy growth on the scales may be seen. This disease begins in the field and continues in storage.

Favorable conditions: Survives in soil in infected plant debris. Spreads through irrigation water and farm. Stagnation of water and temperature of 28 to 32 C are favourable for disease development.

Management

- Treat bulbs with *Trichoderma viride* @ 4g/kg. and apply *T. viride* 2.5 kg/ha. basally along with VAM 12.5 kg/ha
- Soil drenching with Copper oxychloride @ 2.5g.lit

Purple blotch of onion : *Alternaria porri*.

Symptoms: Occurs mainly on top of leaves. Infection starts with minute white dots with irregular chlorotic spots on the tip of leaves which later turn circular to oblong concentric black velvety in the chlorotic area. Later spots coalesce and dry from tip downwards and hang down. Infection is also seen on outer scales of bulb. Premature drying of foliage results in poor development of bulbs.

Favorable conditions: Carried through seed bulbs collected from infected area. Spreads through air borne spores. Warm humid weather, rain and dew favors disease development.

Downy mildew: *Peronospora destructor*

Symptoms : White downy growth appears on the lower surface of the leaves with chlorotic areas on upper surface and finally the infected leaves are dried. The flowers are affected, dried and drop off. Entire plant is not killed only undersized bulbs are formed. Infected bulbs remain small and succulent. Fungus invades floral parts and hence a small portion of seeds are also affected.

Favorable conditions : Pathogen requires cool, moist nights and moderate warm temperature with cloudy day for disease development. Survives in infected bulbs and in soil as oospores.

Management : Three sprays with Mancozeb @ 2 g/lit. Spraying should be started 20 days after transplanting and repeated at 10-12 days interval

DISEASES OF BHENDI

Powdery mildew: *Erysiphe cichoracearum*

Symptoms: Greyish powdery growth occurs on the under as well as on the upper surface of the leaf, leads to leaf drying causing severe

reduction in fruit yield.

Favorable conditions: Survives in infected crop debris. Dry weather conditions with temperature of 15 to 30 °C especially during September to December favours disease.

Management

- Dust Sulphur @ 25 kg / ha or spray Dinocap @ 2 ml / lit. or Tridemorph @ 0.5 ml / lit. or Carbendazim @ 1 g / lit. or Wettable sulphur @ 2 g / lit. immediately after noticing the disease and repeat after 15 days if necessary.

Bhendi vein clearing virus:

Symptoms: Yellowing of the entire network of veins in the leaf blade and interveinal area becomes completely yellow or white. In severe infections the younger leaves turn yellow, become reduced in size and the plant becomes stunted. The affected plants produce fruits with yellow or white colour and they are not fit for marketing. The virus spreads by whitefly

Management:

Grow resistant/ tolerant varieties .Spraying @ 1.5 ml/lit. or Chlorpyrifos@ 2.5 ml + neem oil 2 ml/ lit. to control vector. Place yellow sticky trap @12 nos./ha

Integrated disease management in vegetables

Nursery

- Protected nursery in net house or green house.
- Provide raised seed bed in nursery
- Seed treatment with Carbendazim 2g/kg of seed or Thiram (3 g/kg of seed) or *Trichoderma viride* @ 4 g / kg or *Pseudomonas*

fluorescens @

- 10 g /kg of seed 24 hours before sowing.
- Drench with 1% Bordeaux mixture or Copper oxy chloride 2.5 g/lit for
- damping off

Main field

- Apply *Pseudomonas fluorescens* through soil @ 2.5 kg/ha mixed with 50 kg of FYM as basal or at 30th and 45th day after planting
- Seedling dip with *Pseudomonas fluorescens* @5g/lit. for 10-15 min.at the time of transplanting
- Spray Mancozeb @ 2 g/lit or Copper oxychloride @ 2.5 g/lit. or combination of a fungicide containing Mancozeb and Carbendazim @ 3g/lit. to control leaf spot . Repeat spray at 10 days interval based on severity.
- Spot drench with Carbendazim @ 1g/lit. for wilt affected plants
- Follow crop rotation to minimise the soil borne disease incidence
- Keep yellow sticky traps @ 12/ha to trap /monitor the vectors
- Raise barrier crops-cereals around the field to avoid entry of vectors
- Spray Imidacloprid @ 0.5 ml/lit.% or Dimethoate @ 0.5 ml/lit. or @1.5 ml/lit. or Acephate @1g/lit. 15, 25, 45 days aftertransplanting to control vector.
- Removal of virus affected plants
- Virus causing mosaic disease perpetuates in cucurbits, legumes,
- tobacco, tomato, chilly and weed hosts so care should be taken.

DISEASES OF TURMERIC

1. Rhizome rot : *Pythium graminicolum* or *P. aphanidermatum*.

Symptom : The collar region of the pseudostem becomes soft and water soaked, resulting in collapse of the plant and decay of rhizomes is common. Root is very much reduced. In advanced stages rhizome rot disease may appear in patches.

Favorable conditions: Pathogen is soil borne. Spreads through infected rhizomes and through irrigation water from diseased plants.

Management

- Light soil with good drainage facilities to be selected.
- Selection of disease free rhizomes.
- Dipping rhizomes in metalaxyl 0.25 % for 40 minutes and soil drenching with 0.01% copper oxy chloride 0.25% or Bordeaux mixture 1%.
- Soil application of 2.5 kg / ha each of *P. fluorescens* and *T. viride* in 50 kg of
- FYM as basal and top dressing on 150 days after planting.
- Treat the seed rhizomes with 0.3% Copper oxychloride for 30 min before storage

2. Leaf spot: *Colletotrichum capsici*

Symptoms : Appears as brown spots with white or grey centre. Later the spots coalesce and eventually dry up. The rhizomes do not develop well.

Favorable conditions: Survives in infected plant debris. Relative humidity of 80 % and temperature of 21 to 25 °C favors disease development.

Management

Spray with Copper oxychloride @ 2.5 g/lit. or combination of a fungicide containing Carbendazim and Mancozeb @ 3g/lit or Propiconazole @ 1ml/ litre

Leaf blotch: *Taphrina maculans*

Symptoms : Small, oval, rectangular or irregular brown spots on either side of the leaves which turn yellow and affect the rhizome yield.

Favorable conditions: Survives in infected plant debris. Relative humidity of 80 % and temperature of 21 to 23 °C favors disease development.

Management

Spraying Mancozeb @ 3gm / lit. or combination of a fungicide containing Carbendazim and Mancozeb @ 2g/lit. or Propiconazole @ 1ml/ lit.

DISEASES OF PEPPER

Phytophthora* foot rot/ Quick wilt : *Phytophthora palmivora

Symptoms: Affected vines exhibit four types of symptoms. Symptoms appear either individually or in combination.

Leaf infection: Water soaked lesion starts from tip or from centre of leaf or from margins. Lesions expand in concentric manner and affects spikes that shed away.

Die back: Branches exhibit dark brown lesions that spread up wards resulting in die back of branches.

Foot rot / Collar rot: Wet water soaked lesions appear at the collar region and necrosis progresses downwards to under ground stem. Affected portion emits foul smell.

Root rot: Yellowing of foliage, drooping of leaves, lateral roots are affected. Which progresses to main roots and vines die.

Favorable conditions: Survives in soil and spreads through infected soil and irrigation water and farm implements. Disease is prevalent during rainy season in poor drainage soils. High humidity accompanied with rain with shorter sun shine hours during July to August with temperature of 20 to 24° C favours disease

Management

- Adequate drainage facilities in high rainfall areas
- Removal of dead shoots.
- Nursery:** Apply *Trichoderma viride* @ 1 g / kg of pot mixture. Mulch the pot mixture with 150 gauge polythene sheet for 30 days

Main field : Any of the following formulation can be drenched in the soil twice (May– June and October - November).Neem cake 1/2 kg per vine + Swabbing of Bordeaux paste upto 1 m from the ground level. Or

Trichoderma

viride @ 20 g/vine + FYM or Bordeaux mixture 1 % or Metalaxyl

Mancozeb

@ 2 g / lit. or • Neem cake 2 kg per vine + 0.1% Metalaxyl (pre monsoon foliar spray and soil application) or *Pseudomonas fluorescens* (50 g) (pre and post monsoon) + neem cake (2 kg)(post monsoon) + metalaxyl 0.1 % . Soil drenching with 1% Bordeaux mixture or copper oxy chloride 0..25 % or metalaxyl 0.25% Spraying with 1% Bordeaux mixture or copper oxy chloride 0..25 % or metalaxyl 0.25% during premonsoon periods

Swabbing main stem up to 1 metre from ground level with Bordeaux paste.

Anthracnose/ Pollu disease: *Colletotrichum gloeosporioides*

Symptoms: Symptoms are seen on leaves and stems as circular or irregular grey spots on leaves. Spots expand in concentric rings which kills the stem. The Rotting of tissues takes place in leaf axils that leads to dropping of spikes. Berries become hollow and get dried.

Favorable conditions: Disease normally occurs during July to August . Rains with slightly warm temperature of 22 to 25° C and high relative humidity spreads the disease

Management

Three rounds of spray with Bordeaux mixture 1% during June – July followed by June to late July , and late August reduces the disease.

DISEASES OF FLOWERS AND THEIR MANAGEMENT

DISEASES OF ROSE

I. Powdery mildew *Sphaerotheca pannosa* var. *rosae*

Symptoms: The disease appears as slightly raised blister-like areas on the young leaves. Soon leaves are covered with a greyish white, powdery fungal growth, become curled and distorted. On older leaves, large white patches of fungal growth appear.. Buds may also be attacked and covered with white mildew before they open. Diseased buds fail to open. The infection spreads to the flower parts and they become discoloured, dwarfed and dried.

Favourable conditions : The fungus overwinters as mycelium in dormant buds and shoots spread is through wind-borne conidia. The disease is favoured by dry weather with maximum day temperature of 20 to 25°C with cool nights.

Management:

- The diseased and fallen leaves should be collected and burnt.
- Four sprayings at 10 days interval with wettable sulphur 0.3 per cent or dinocap 0.07 per cent or carbendazim 0.1 per cent or Azoxystrobin @ 1ml/ litre controls the disease effectively.
- Sulphur dust can be used at 25 kg/ha. Wettable sulphur or sulphur dust should not be used when the temperature is above 30°C as it may cause scorching.
- Resistant Varieties like Aawliver, Abisharika, Adolf Morstman, African Star, Ambika, Angeles, Anvil Sparks, American Pride, Apollo, Arizona, Ashwini, Baby Masquerade, Banjaran-9, Barbara, Bewitched, Blue Moon, Bon Soir, Bon Accord, Bonnie Scotland, Boque Dayal, Belle Vue, Bovinchor, Bulls Red, Canasta, Careless Love, Carcusar, Celebration, Crimson Glory, Dame De Cour, Deep Secret, Dutch Gold, Dwarf Queen, Dearest Durina, Eiffel Tower, Priti, Paradise, Queen Elizabeth, Royal Ascot, Red Master Piece, Red Dene, Rachel Grawshey, Ranjana-1 0, Sonia, Spartan, Super Star, Summer Days, Starina can be grown. Excess fertilization especially with nitrogenous fertilizers and crowding of plants should be avoided.

2. Die-back- *Diplodia rosarum*

Symptoms: The pruned surface of the twig dries from tip downwards. Twigs become brown to dark brown or black. The disease passes from the branch twig to the main stem and from where it spreads to the roots. Finally it kills the whole plant. Stem and roots show browning of the internal tissues.

Favourable conditions : The fungus persists in dead twigs and the stalks of the withered blooms. Older plants and neglected and weak bushes are more frequently attacked. Disease spread is faster at 30 to 32°C.

Management:

- Pruning should be done so that the lesions on the shoots are eliminated. Partially diseased twigs should be pruned atleast 3 to 5 cm below the visible symptoms of the disease. In all cases, the pruned ends should be immediately coated with Chaubattia paint (4 parts of copper carbonate, 4 parts of red-lead and 5 parts of linseed oil .
- Application of fertiliser should be delayed atleast 10 days after pruning. Spraying with copper oxychloride 0.2 per cent or difolatan 0.2 per cent or chlorothalonil 0.2 per cent or mancozeb 0.2 per cent once in early September and again in late October is recommended for the control of this disease.
- The varieties which are resistant include Bhim, Blue Moon, Red Gold, Quebec, Summer Queen, Red, Ressolute, Samba, Velhiteen Sign and Whitten Sign. Agnasia, Christian Doir, Confidence, Crimson Glory, Fantal Blue, Faryentee, Kiss of Fire, Pascali, Royal Ascot, Vienna Charm and White Christmas

3. Black spot : *Diplocarpon rosae*

.Symptoms: The disease is characterized by the presence of black spot on the leaves. These spots are more or less circular in outline. They have a very irregular fibrillose border due to the radiating strands of mycelium which occur beneath the leaves and leaf buds which open late in the season. The plant blossoms poorly. They may not flowers in the

following season. On the stem the infected areas present a blackened, blistered appearance, dotted with ustules.

Favourable conditions : The fungus survives in the infected leaves on the plants.: The disease is favoured by high humidity and low temperature (21°C). Winter frosts favour the disease.

Management:

- As the fungus perpetuates on old diseased leaves and stems it is necessary to collect and destroy them at the end of the season..
- Diseased plants should be pruned carefully and should be burnt. Spraying with tridemorph 0.025 per cent or captan 0.2 per cent or or Azoxystrobin 0.1% ferbam or benomyl 0.1 per cent at weekly intervals starting with the sprouting of the plants till the appearance of the new foliage and continuing during humid weather effectively controls the disease. Captan sprays at 15 days interval is effective in the control of black spot.
- Shade and excessive irrigation should be avoided.
- Hybrid Rugosa rose, 'Martin Frobisher'¹ is immune to black spot. Rose cultivars viz., Belaya (*Rosa alba*). John Cabot and Carefree Beauty are resistant. Among the HT cultivars Show Girl, Buccaneer, Gold Crown Mc-Gredy's Sunset and Perfecta are less susceptible.

4. Rust *Phragmidium mucronatum*

Symptoms: The under-side of the leaves, stems show orange to lemon yellow pustules (1.0 mm in dia) which increase in size as the season advances. In the mid-summer, the orange yellow spots on the leaves are replaced by brick red spots .Later in the season, the same leaves show minute black, hair-like tufts on the under surface. The affected leaves

turn yellow, deformed and fall prematurely to the ground. Some times blossoms develop badly or not at all. The diseased bushes are greatly weakened and may die back.

Favourable conditions : Maximum rust infection occurs at a temperature which ranges from 18 to 21°C. Temperature between 20 and 25°C is favourable for uredospore production.

Teleutospores which are produced in autumn helps in overwintering and causing fresh infection through basidiospore in the next spring. The fungus also overwinters as perennial mycelium in the stem. Secondary spread is through wind-borne uredospores.

Management:

- Diseased, fallen leaves should be collected and burnt.
- Stems harbouring perennial mycelium should be cut out and burnt.
- Three sprayings during Mar-Apr at 15 days interval with mancozeb 0.2 per cent or carboxin 0.1 per cent.. The disease is controlled by spraying with ferbam 0.2 per cent or wettable sulphur 0.3 per cent or captan 0.2 per cent.

Botrytis bud and twig blight : Botrytis cinerea

Symptoms: The disease is also known as **petal fire** or **Botrytis mold**. Infection starts from the sepals as black-brown specks that cover the flower in due course. The buds turn brown and decay. Sometimes partially opened buds are attacked, and the individual petals turn brown and shrivel.. In cool moist weather the flower is covered with greenish-grey or darkish growth of the fungus.

Management:

- Picking and destroying old blooms and overwintered canes help in reducing the disease.

- Avoiding excessive irrigation helps to check the disease.
- Fungicidal spray with with ferbam 0,2 per cent or captan 0.2 per cent or benomyl 0.1 per cent or mancozeb 6.2 per cent or carbendazim 0.2 percent.
- The following rose varieties viz., Anieval Sparks, Bonnienuit, Chantare, Charleston, Devine, Elizabeth, Glimpses, Golden Giant, Joseph's Coat, Picture, Purna, Rakat Gandha, Sharella, Spartan and Zenium Mukhatis are free from the disease. Buds and twig blight by *Phomopsis gulabiah* from Uttar Pradesh has also been reported.

DISEASES OF JASMINE

Leaf spots: *Alternaria* leaf blight : *Alternaria jasmine*

***Alternaria* leaf spot:** *Alternaria alternata*

***Cercospora* leaf spot :** *Cercospora jasminicola*

Symptoms: On the affected leaves dark brown spots in concentric rings or circular to irregular reddish brown spots of 2 to 8 mm dia appear on upper leaf surface. are noticed. During humid conditions, the spots in each leaflet enlarge very quickly and coalesce. Later, blighted leaflets dry and easily fall off. They are also brittle. In a severely affected, garden, large number of fallenleaves can be easily seen on the ground near the base of the diseased vine. Oval to elongated light brown spots develop on petioles, stem, calyx and even on tubular corollas. In severe cases of infection vegetative buds and young branches dry up. The disease spreads through wind-borne conidia.

Favourable conditions : The disease is severe during winter months (Oct - Dec). In certain areas the disease is noticed even upto February.

High humidity, drizzling and low temperature favours disease development.

Management:

- Diseased and fallen leaves should be collected and burnt.

Spraying mancozeb 0.2 % or Azoxystrobin 0.1% Spraying can be repeated at 7 to 10 days interval covering all the foliage in the vines

Collar rot and Root rot – *Sclerotium rolfsii*

Symptoms : Plants at all stages are infected. First the older leaves become yellow followed by younger leaves and finally death of the plant. In the root black discoloration can be seen. On the infected tissues and stem surface white strands of mycelia and mustard like sclerotia are seen.

Management

- Soil drenching with Trifloxystrobin + Tebuconazole @ 0.75 g / lit or Difenconazole @ 0.5 ml / lit.
- Soil application of *Pseudomonas fluorescens* @ 25 g / m² and foliar application of *P. fluorescens* @ 5 g / lit at monthly intervals after planting. Soil drenching with Copper oxychloride 0.25% or 1% Bordeaux mixture or application of FYM with *Trichoderma viride* @ 10 g + 100g FYM / plant

Phyllody: Phytoplasma

Symptoms: Leaves become small malformed and bushy. In the place of flowers green leaf like malformed flowers are formed. The disease is transmitted by grafting and whitefly, *Dialeurodes kirkaldii*.

Management : Selection of cuttings from healthy plants. Spraying insecticide to control the vector.

Powdery mildew: *Oidium jasmini*

Symptoms: The disease appears as white powdery patches on the upper

surface of the leaves. Later, these patches coalesce and cover the entire surface and blight the leaves.

Management : Spray with Weatble suplur 0.2 % or Chlorothlonil 0.1% or Azoxystrobin @ 1ml / lit.

DISEASES OF CHRYSANTHEMUM

1. Blotch/Leaf spot: *Septoria chrysanthemella*

Symptoms: Blackish-brown, circular to irregular spots surrounded by a yellow halo. They coalesce with one another and form large patches coalesce to form blotches covering major portion of the leaf. The dead leaves hang on the stem for sometime.

Favourable conditions: Infected debris in the soil appeared to be the primary source of infection. The disease is particularly severe during and after monsoon and is favoured by cool weather. Warm weather is not conducive for its development.

Management: Diseased plant debris should be collected and burnt. Irrigation should be regulated. Fortnightly spraying with carbendazim 0.1 per cent or benomyl 0.1 per cent or mancozeb 0.2 per cent or copper oxychloride 0.3 per cent or 0.1% azoxystrobin, or 0.2% chlorothalonil, thiophanate methyl @ 0.1% .Chrysanthemum cultivars viz., Alpana, Aparjito, C.L. Philips, Flirt, Liliput, Phillies and Sarad are highly resistant.

2. White Rusts: *Puccinia horiana*

Symptoms: Infection by first noticed as yellow to tan spots on the upper surface of the leaves, up to 5 mm diameter; the centers of the spots later turn brown. On the underside of the leaves raised buff, pinkish, waxy pustules develop which later become whitish and quite. Severe infections

can lead to complete loss of the crop.

Control

Regulations require that infected plants be destroyed to prevent disease establishment in this country. Protect healthy plants with fungicides with the active ingredients 0.1% azoxystrobin, or Difenconazole 0.05 % or chlorothalonil 0.2% , or thiophanate methyl @ 0.1%

3.Vascular Wilts:

Chrysanthemums are subject to two vascular wilt diseases caused by *Fusarium oxysporum* f.sp. *chrysanthemi* and *Verticillium dahliae*. Both pathogens persist in the soil for many years.

***Fusarium* Wilt:** yellowing of foliage, stunting, and wilting often along one side of plant. Plants may appear water stressed and foliage may brown and die. Stems - reddish brown discoloration of the vascular system. spread in contaminated soil and infected cuttings and is favored by warm temperatures

***Verticillium* Wilt:** Symptoms of *Verticillium* wilt often appear only after blossom buds have formed; young vigorous plants may be symptomless. Foliage becomes yellow and wilted, sometimes only along leaf margins and on one side of the plant. Leaves begin to die from the base of the plant upward and often remain attached. Stems exhibit dark streaks in the vascular system. Favored when cool weather is followed by hot temperatures. pasteurized growing media and pathogen-free cuttings. Most cultivars are resistant. Avoid susceptible cultivars including 'Bright Golden Ann', 'Echo', 'Glowing Mandalay', 'Mountain Peak', 'Paragon', 'Pert', 'Puritan', and 'Wedgewood'. high relative humidity, overwatering, and poor drainage.

Management :

Pathogen free cuttings or plants and pasteurized growing media. Adjust pH to 6.5 to 7.0 and use nitrate nitrogen fertilization. Soil drenching with Copper oxychloride 2.5 g / lit or Trifloxystrobin +Tebuconazole @ 0.75 g / lit or Difenconazole @ 0.5ml / lit. Avoid highly susceptible cultivars such as 'Bravo', 'Cirbronze', 'Illini Trophy', 'Orange Bowl', 'Royal Trophy', and 'Yellow Delaware'.

5. Powdery mildew: *Oidium chrysanthemi*

Symptoms: The leaves get covered with a whitish, ash-grey powdery growth on the upper surface. Infected leaves turn yellow and dry. Severely infected plants remain stunted and do not flower. The disease is favoured by dry hot weather.. Shade and overcrowding of plants should be avoided to reduce the disease. Spraying with wettable sulphur 0.2 per cent or triforine 0.03 per cent or thiophanate-methyl 0.05 per cent or dinocap 0.025 per cent or dinocap 1.0 kg/ha or cabendazim or benomyl 0.1 per cent at 10 to 15 days interval controls the disease.

DISEASES OF CROSSANDRA

1. Wilt : *Fusarium solani*

Symptoms: Disease is observed one month after transplanting. Leaves of infected plants become pale and droop. Margin of the leaves show pinkish brown discolouration. The discolouration spreads to the midrib in a period of 7 to 10 days. Stem portion gets shrivelled. Dark lesions are noticed on the roots extending upto collar region which result in sloughing off the cortical tissue.

Favourable conditions: The disease is formed in both air black and

sandy loam soil and losses upto 80 per cent of plants has been reported. Pathogen survive in soil and they are spread by irrigation water. Incidence is more in the presence of root lesion nematode, *Pratylenchus delatrei* and *Helicohylenchus dihystra*.

Management: Affected plants should be pulled out and destroyed to reduce the disease. The nematode can be controlled by soil application of phorate at the rate of 1g/plant on 10th day of transplanting. Soil drenching with carbendazim 0.1 per cent or copper oxychloride 0.25 per cent on 30 days

2. Alternaria leaf spot : *Alternaria amaranthi* var. *crossandrae*

Symptoms: This disease was first reported from Tamil Nadu during 1972. Infected leaves show small, circular or irregular yellow spots on the upper surface.

They soon enlarge turn brown and develop dark brown concentric rings. Infected leaves become yellow and drop off prematurely.

Management: Spraying with Mancozeb 0.2% (or) Carbendazim 0.1%

3. Leaf blight : *Colletotrichum crossandra*

Symptoms :The symptoms of leaves consist of the development of brownish, depressed necrotic areas surrounded by reddish and slightly raised margins. Initially the spots appear as brownish specks but become darker as they expand. The lesions are more prominent on lower leaves and confined to the margins. Infected leaves roll up, shrivel and drop off, leaving a barren stem with a whorl of young leaves at the top.

Management

Spraying with Mancozeb 0.2% (or) Carbendazim 0.1%

DISEASES OF MARIGOLD

1. Rust : Uromyces dianthi

Symptoms: on leaves, stems, or flower buds are small, slightly raised blisters that eventually rupture, forming pustules filled with powdery reddish-brown spores .A yellow margin surrounds the pustules and, when infections are severe, entire leaves turn yellow and die. Stems may be girdled when several pustules develop around the shoot, resulting in decreased flower production and quality.Plants may be attacked at any stage of development.

Favorable conditions: .Survives in infected cuttings. Disease is favored by cool nights alternating with warm humid days. This induces dew at night and the formation of a film of water on the leaf surface. More severe in open air culture and in plastic film greenhouses, where dew formation is common

Management : Spraying with 0.1% or 0.25 % chlorothalonil, or thiophanate methyl @ 0.1%

2. Alternaria leaf Blight- *Alternaria dianthi*, Flower blight - *A.diathicola*

Alternaria dianthi -Tiny purple spots enlarge, in to large lesions with a purple margin and a yellow-green border surrounding a gray-brown center covered with black spores Several lesions may expand and coalesce to form large, irregular necrotic areas that eventually kill the entire leaf. The branches are most frequently infected at the nodes and branch base. These infection centers enlarge to form cankers, which eventually girdle the stem, causing the branch to wilt and the girdled portion to turn yellow and die

A.diathicola : Tan to dark brown lesions on sepals and petals . These lesions are covered with dark brown powdery spores that are disseminated by wind and rain. Extended wet periods with light night rains favor outbreaks of this disease.

Management : spray with Mancozeb 0.2% or Copper oxy chloride@ 0.2% or Propiconazole 0.1%

DISEASES OF TUBEROSE

1. Blight / Leaf and flower spot: *Botrytis elliptica*

Spots are orange to reddish brown and oval on the leaves. They coalesce and blight the leaf. Infection starts from the lower leaves. If the disease occurs early, the entire apical growth of the plant is killed. Flower buds rot or open to distorted flowers with irregular brown flecks.

Favourable conditions: The disease spreads by rain, air currents and gardeners. The fungus survives as sclerotia in fallen flowers and leaves. Optimum temperature for spore germination is 15.6°C. The disease development is favoured at 21°C.

Management :Dense planting, shady or low spots with little air circulation should be avoided. The diseased plant parts should be removed .Spraying with Bordeaux mixture 1.0 per cent for every 15 days controls the disease.

DISEASES OF CARNATION

1. Fusarium wilt: *Fusarium oxysporum* f. sp. *dianthi*

Symptoms: In young plants, the first sign of the disease is fading or greying of the normal colour of the leaves with wilting of the leaves and

young stems. It is followed by eventual collapse of the whole plant. When older plants are infected, similar symptoms are produced but the older leaves may show chlorosis followed by an indistinct purple-red discolouration. The vascular tissues of infected stems is stained dark brown. Mature plants show wilt symptoms over a period of several months before they die and eventually become straw coloured.

Favorable conditions: The pathogen is soil-borne and survives and spreads through irrigation water. Warm temperature favours the disease.

Management: The diseased plants should be removed immediately after noticing the disease. Soil drenching with Carbendazim @ 1 g / lit or Difenoconazole @ 0.5 ml / lit at weekly intervals. *Pseudomonas fluorescens* as soil application @ 15 g / m² and foliar application @ 5 g / lit at monthly intervals. Soil drenching with *Bacillus amyloliquefaciens* @ 5 ml / lit at monthly intervals. Grafting of susceptible cultivars like Alice, Fulvio Rosa, Gus Royalette and Johy. on to resistant rootstocks i.e. Arancio 25D, Exquisite, Heidi and May Britt and growing in soil naturally infested with fungus was also found to reduce the incidence of disease.

2. Alternaria leaf spot: *Alternaria dianthi*

Symptoms: The chief symptom is blight or rot at leaf bases and around nodes, which are girdled. Spots on leaves are ashy white. The centre of old spots are covered with dark brown to black fungal growth. Leaves may be constricted and twisted and the tip may be killed. Branches die-back at the girdled area and black crusts of conidia are formed on the cankers.

Favorable conditions : Conidia are spread during watering or in rains.. The conidia are carried by on cuttings. The disease is widespread in humid weather.

Management: To reduce the disease incidence, humidity may be kept low by providing proper air circulation. Disease-free planting material should be used. Spray Tebuconazole @ 2 ml / lit or Propiconazole @ 2 ml / lit. • *Bacillus subtilis* as soil application @ 15 g / m² followed by foliar application @ 5 g / lit at monthly intervals.

3. Cottony rot: *Sclerotinia sclerotiorum*

Symptoms: Stems rotted; flower rot is similar to gray mold. Cottony, white fungal mass may occur on rotted tissues. Black sclerotia may form inside or outside the stem.

Favorable conditions Survives in soil and in infected plant debris .Favored by high humidity.

Management : Spray foliage with iprodione or thiophanate-methyl@ 0.1%

FUNGICIDES AND BACTERICIDES FOR PLANT DISEASE MANAGEMENT

1.SEED TREATING FUNGICIDE

S.No	Name of the Fungicide	Dose
1.	Captan	5 g/Seed
2.	Thiram	5 g/ Seed
3.	Carbendazim	5 g/Seed
4.	Metalaxyl	5 g/ Seed

2. Damping off

S.No	Comman Name	Concertration	Trade name	Dose
1.	Bordeux Mixture	50 % WP		
2.	Copper oxy Chloride	50 % WP	Fytolan, Blue Copper	1% of 2.5 g/L
3.	Metalaxyl	35 % WP	Apron, Kiralaxyl	0.5 g/L
4.	Metalaxyl +Mancozeb	8%+ 64 % WP	Apron, Kiralaxyl, Ridomil, Unilax, Assult, Master	1% of 2.5 g/L

3. Anthracnose ,Fruit Rot ,Die Back and Scab

S.No	Comman Name	Concertration	Trade Name	Dose
1.	Chlorothalanil	75% WP	Kavach	2 g/L
2.	Carbendazim	50% WP	Bavistin	1 g/L
3.	Benoyml	50% WP	Benofit, Benolet	1 g/L
4.	Thiopenate methyl	70% WP	Roko Mildivip	2 g/L
5.	Difenaconazole	10% EC	Score	0.75 g/L

6.	Captan	50 % WP	Kohicap	2 g/L
7.	Difolatan	80 % WP	Foltaf	2g/L
8.	Carbendazim +Mancozeb	12 % +63 % WP	Campanion Sap	2g/L
9.	Zineb	75 % WP	Z78 (Indofil Z 78)	2 g/L
10 .	Ziram	27 % SL	Cuman-L	2 g/L
11.	Copper Hydroxide	77 % WP	Kocide 101	1.5 g/L
12.	Propineb	70% WP	Antracol	2 g/L
13.	Hexaconazole	5 % EC	Contaf	2 g/L
14.	Iprodione + Carbendazim	25% WP+25% WP	Quintol	2g/L
15.	Metiram	70% WG	Polyram	2 g/L
16.	Captan +Hexaconazole	70 % WP+5% WP	Taqat	2g/L
17.	Fenomidone +Mancozeb	10%+50% WP	60 WG Sectin	2g/L
18	Bittertanal	25% WP	Baycor,daycor	1.5- 2.0 g/L
19.	Triedimefon	25% WP	Bayleon	1.5- 2.0 g/L

4. Leaf Blight

5. Late blight & *Phythium, Phytophthora*

S.No	Comman Name	Concertrations	Trade Name	Dose
1.	Wettable Sulphur	80% WP	Black Sulphur ,Thiovit,Sultaf	3g/L
2.	Copper Hydroxide	77% WP	Kocide 101	1.5 g/L
3.	COC	50% WP	Fytolan	2 g/L
4.	Zineb	27% SC	Indofil Z 78	2 g/L
5.	Propiconazole	25% SC	Tilt	1.5 ml/L
6.	Hexaconazole	5EC	Contaf	1.5ml/L
7.	Tridemorph	80% EC	Calixin	1.5ml/L
8.	Propineb	70% WP	Antracol	2g/L
9.	Penconazole	10% EC	Topas	1.5 ml/L

5. Late blight & *Phythium, Phytophthora*

S.No	Comman Name	Concertrations	Trade Name	Dose
1.	Metalaxyl+Mancozeb 64% WP	8% +64% WP	Ridomil,Unilax, Assault,Master	2g/L
2.	Cyamoxanil+	8%	Curzet	2g/L

	Mancozeb	+64% WP		
3.	Fosetyl -AL	80 % WP	Aliette	1.5g/L
4.	Dimethomorph	50% WP	50% WP	0.5g/L

6. Wilt and Root Rot

S.No	Common Name	Concentration	Trade Name	Dose
1.	Wettable Sulphur	80% WP	Black Sulphur, Thiovit, Sultaf	3 g/L
2.	Copper Hydroxide	77% WP	Kocide 101	1.5 g/L
3.	Carbendazim	50% WP	Bavistin	1.5 g/L
4.	Ziram	27% SC	Cuman L	2 ml/L
5.	Benomyl	50 % WP	Benlate, Bonofit	1.5g/L
6.	Thiram	75% WP	Thiride, Arasaan	1.5 g/L
7.	COC	50% WP	Fytolan, Blue Copper	3 g/L
8.	Copper hydroxide	77% WP	Kocide 101	2 g/L
9.	Ethoxy Methyl Mercuric Chloride		Emissan, Agalal, Bagalal	2g/L

7. Leaf Spot

S.No	Comman Name	Concertrations	Trade Name	Dose
1.	Carbendazim	50% WP	Bavistin	1 g/L
2.	Thiopenate Methyl	70% WP	Roko, Mildivip	2 g/L
3.	Chlorothalanil	75% WP	Kavach	2g/L
4.	Propiconazole	25% EC	Tilt	1.5 g/L
5.	Mancozeb	75% WP	Diethane indofil M45	2g/L
6.	Difenaconazole	25% EC	Score	2 ml/L
7.	Metiram	70% WG	Polyram	2g/L

8. Powdery Mildew

S.N o	Comman Name	Concertratio ns	Trade Name	Dose
1.	Wettable Sulphur	80% WP	Black Sulphur, Thiovot, Sultaf	2g/L
2.	Difenoconazole	25% EC	Score	1.5ml/L
3.	Dinocap	48% EC	Karathene	1 ml/L
4.	Propiconazol	25% EC	Tilt	1.5 ml/L

	e			
5.	Penconazole	10%EC	Topas	1.5ml/L
6.	Tridemorph	80%EC	Calixin	1.5 ml/L
7.	Mycobutanil	10 % WP	Systhene,Index	1.5 g/L
8.	Tradimefon	25% WP	Bayleton	1.5 g/L
9.	Fenarimol	10%EC	Rubigan	1.5 g/L
10.	Flusilazole		New Star	5 g/L
11.	Tebuconazole	25.9% m/m EC	Folicur	0.75-1 ml/L

9.Rust

S.N	Comman Name	Concertratio ns	Trade Name	Dose
1.	Chlorothalanil	75% WP	Kavach	2g/L
2.	Wettable Sulphur	80% WP	Black sulphur,Thiovot, Sultaf	2g/L
3.	Difenaconazole	25%EC	Score	1.5 ml/L
4.	Propiconazole	25%EC	Tilt	1.5 ml/L
5.	Benomyl	75% WP	Benomyte	1.5 g/L
6.	Bitertanol	25% WP	Baycor,Apple Scab	2 g/L
7.	Triadimefon	25% WP	Bayleton	2g/L

10. Smut

S.No	Comman Name	Concertrations	Trade Name	Dose
1.	Thiram	75% WP		3g/1 kg of seed
2.	Captan	50% WP		4g/seed
3	.Difenaconazole	25% EC	Score	1 ml/L
4.	Triadimenol			2g/L
5.	Metalaxyl	35%	Apron,Kir alaxil	0.5 g/L

11. Blast

S.N o	Comman Name	Concertrati ons	Trade Name	Dose
1.	Edifenphos	50% EC	Hinosan	1.5 ml/L
2.	Iprofenphos	48% EC	Kitazan	1.5 ml/L
3.	Tricyclozole	75% WP	Beam,SIVIC,g ain	1.5 ml/L
4.	Carbendazim	50% WP	Bavistin	3 g/L
5.	Isoprothioline	40% EC	Fuji 1	200ml/L

12. Downy Mildew

S.N o	Comman Name	Concertrat ions	Trade Name	Dose
1.	Bordeux Mixture			1%
2.	COC	50% WP	Fytolan,Blue Copper	2g/Tree
3.	Captan	50% WP	Captan	2g/L
4.	Metalaxyl+Manc ozeb	8% WP+64% WP	Ridomil,Unila x,Assault,Mast er	2 g/L
5.	Cyamoxnil+Man cozeb	8% WP+64% WP	Curzate	2g/L
6.	Dimethomorph	50% WP	Acrobat	0.5 g/L
7.	Fosetyl -AL	80% WP	Aliette	2g/L

13. SCAB

S.N o	Comman Name	Concertration s	Trade Name	Dose
1.	Dodine	65% WP	Syllit,Supersta r	2g/L
2.	Iprodione+Carben dazim	25% WP+25% WP	Quintol	2g/L

Bacterial Diseases

1. Bacterial Leaf Blight ,Canker , Scab& Soft Rot

S.No	Comman Name	Concertrations	Trade Name	Dose
1.	Copper oxy Chloride+Strepto mycin Sulphate+Tetracycline		Fytolan	2g/L or 6g/50 litter

2. Bacterial rot and Wilt Disease

S.No	Comman Name	Concertrations	Trade Name	Dose
1.	Ethoxy Methyl Mercuric Chloride		Emissan Agalal Bagalal)	2g/L