

Diagnostic Pocket Guide for Ornamental Crop Diseases and Pests



भाकृअनुप-पुष्पविज्ञान अनुसंधान निदेशालय
ICAR-Directorate of Floricultural Research



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कृषि महाविद्यालय परिसर, शिवाजीनगर, पुणे-411005, महाराष्ट्र, भारत
College of Agriculture Campus, Shivajinagar, Pune-411005, Maharashtra



Overall Guidance by:

Dr. T. Janakiram
Assistant Director General (HS I)
ICAR, New Delhi

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Sreelatha, U., College of Horticulture, Kerala Agricultural Univeristy; Dr. P. Prasanth, Senior Scientist (Hort.) & Head; Dr. Zehra Salma, Scientist (Floriculture); Dr. S. Praneeth, Scientist (Crop Physiology), Floricultural research station, Rajendranagar, Hyderabad.

Edited by:

Prabha K and K.V. Prasad, ICAR-Directorate of Floricultural Research, Pune.

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Division of Horticulture
Krishi Anusandhan Bhawan - II
New Delhi - 110 012



Dr. A.K. Singh
Deputy Director General
(Horticultural Science Division)

Foreword

The manifestations are distinct due to insect pests, diseases, nematodes and nutritional disorders. However, some of the symptoms often overlap with each other resulting in inaccurate diagnosis and equally erroneous remedy. Such problematic situations could be avoided, if the stakeholders are aware of the typical manifestations of various pests. It is often difficult for the farmers, students to diagnose a problem described in text book. There is a need for a handy guide at the farm level to impart much needed awareness among the stakeholders.

An attempt has been made by ICAR-Directorate of Floricultural Research, Pune to equip the farmers, students and researchers with concise information on pests that damage ornamental crops. Such handy publications are scanty in India. This publication entitled *Diagnostic Pocket Guide for Ornamental Crop Diseases and Pests* with brief description on the manifestation with the help of relevant photographs aims to fill the void. I compliment the authors for their sincere efforts in presenting the contents in a succinct form with simple terms for easy comprehension.

I believe that *Right Diagnosis Always Leads to Right Solution*. The publication, I am sure would of great relevance for all the stakeholders who are involved in floriculture.


(A.K. Singh)

Preface

Pests and diseases always pose threat to crop plants and floriculture crops are not an exception. Many a times lack of knowledge on appropriate identification of the pests and diseases often results in more input costs and losses as the right management is not opted. Identification of a pest and disease involves many processes and diagnostic tests. The first and foremost of any of those, is the visual assessment based on predominant symptoms at the field or location of incidence. Symptomatology remains the most important tool for adoption of right interventions for a pest or disease whether for management or quarantine or breeding programme.

Keeping this in view, we have attempted to bring out Diagnostic Pocket Book on Ornamental Crop Pests a ready recknor for identification of major manifestations in open field flower crops. This book has been divided into three parts which includes a session on plant pathogens and nematodes causing various manifestations, a session on insect pests and last one describing nutrient deficiency symptoms in flower crops. Attempts have been made to include photographs of the major striking symptoms of infections or infestations.

We would like to express our sincere gratitude to our Honourable Secretary DARE and Director General, ICAR for his constant encouragement, guidance and support. We are equally indebted to our Deputy Director General (Horticultural Science and Crop Science) Dr. A.K. Singh for his overall leadership, guidance and cooperation from time to time. We place on record our sincere appreciation and gratitude to Dr. T. Janakiram, Assistant Director General (HS I) for his constant involvement and support in all our endeavours. We would to thank those AICRP centres who have quickly responded to our requests for photographs and their details are given in Photo credit section. We acknowledge the support and help rendered by the scientific and administrative staff of ICAR-Directorate of Floricultural Research. We sincerely hope that Diagnostic Pocket Book on Ornamental Crop Pests would become a handy reference book to all those involved in floriculture.

(Authors)

Introduction

Floriculture flourished as an important sector of agriculture in the last few decades. Rapid urbanization, increased income levels, changes in life styles and social values resulted in increase in domestic & world market for flower crops significantly. Floriculture products of around 22,500 MT worth 45,600 Lakhs are exported from our country every year. The increase in international trade resulted in movement pests and pathogens across the globe. India loses 15-25 per cent of potential crop output due to pests, weeds and diseases. Most of the cases, failure to identify the right cause is resulting in major crop loss and heavy chemical inputs in agriculture in general and floriculture in particular. Many of the morphological manifestations of pest and diseases are often misunderstood as novel variations in case of ornamental crops and they are multiplied and distributed across the country.

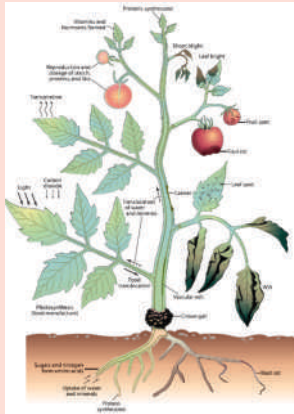
Any pest and disease attack alter the normal physiology of the plant and sign of the attack is reflected through various symptoms. In case of insects the causal organisms are visible and plant part attacked will show the damage or malformation. In case of diseases and nematodes the causal agent is microscopic or submicroscopic and symptoms are the only indicators. While wilting of a plant indicates roots and the vascular system is affected, leaf spots indicates foliar pathogen infection. Systemic symptoms will be reflected in remote location away from point of attack. Thus right identification of a pest or disease attack or a nutrient deficiency in the right time is imperative for undertaking right interventions for saving the crop from damages.

This diagnostic pocket book gives guidance for identification of major pests, diseases and nutrient deficiencies to reach conclusions for choosing correct management options for open field grown flower crops.



Identification of Diseases

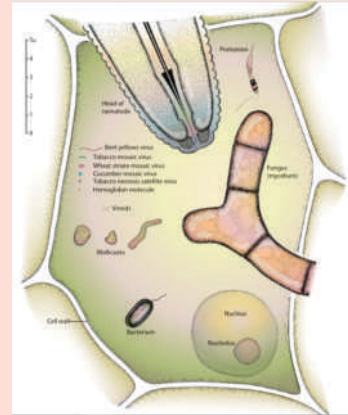
Disease in plants, can be defined as the series of invisible and visible responses of plant cells and tissues to a pathogenic organism or environmental factor that result in adverse changes in the form, function, or integrity of the plant and may lead to partial impairment or death of plant parts or of the entire plant.



Plant Disease

Representation of basic functions of plant parts and interference by diseases.

Source: G.N. Agrios,
Plant Pathology 5th Edition



Plant Pathogens

Schematic diagram of the shapes and sizes of certain plant pathogens in relation to a plant cell. Bacteria, mollicutes, and protozoa are not found in nucleated living plant cells.

Source: *Plant Pathology*;
G.N. Agrios

Collection of Plant Samples for Disease Identification

Collection of right and representative sample is the first step towards the accurate identification of a pest or disease. The following points need to be considered while collecting the samples.

- Obtain fresh material in reasonable quantity. Be certain to include as many identifiable stages of the disease as possible.
- Most recently developed symptoms usually afford the best material for diagnosis. Be sure to include suitable plant material for botanical identification, since occasionally field identifications may be in error or the host plant identity may not be known.
- The sample should be a representative of the whole.
- Place samples in appropriate bags with a desiccant to keep samples from further rotting.
- Keep samples cool and moist, protected from crushing, freezing and heat.
- Label the samples properly with, name of the grower, Date of collection, crop name, variety, problem explanation in detail

with symptoms, stage of the plant, part of the plant, date of first appearance of symptoms and contact details for further interaction.

- Include information on Package of practices followed.
- Keep a note of environmental conditions preceding and during disease development
- Also note if any control measure was attempted before
- In case of viral and phytoplasmal diseases keep a note of the insects present in the field.

Field Kit for Sample Collection

Plastic and paper bags, Paper towels, silica gels, pruning shears, gloves, rubber bands, labels, marker pen, hand lens 5-10X, aspirators, vials/jars with lids, camera, cooler, disinfectant, Field manual, forceps, scissors, GPS, soil probe, cooler, disinfectant, sweeping nets, spade etc.



Phytopathometry : Disease and Loss Assessment

Measurement of disease is very important to know the prevalence of the disease, varietal behaviour against the disease and for developing efficient management strategies..

Disease Incidence

Disease incidence is the percentage of diseased plants or diseases parts in the sample or population of plants.

$$\text{Disease incidence} = \frac{\text{No. of infected plants} \times 100}{\text{Total number of plants}}$$

This is applicable for systemic diseases affecting the whole plant like viral and phytoplasmal diseases, wilt etc.

Disease Severity

Severity is the measurement of percentage of relevant host tissues or organ covered by symptom or lesion or damaged by the disease. Severity results from the number and size of the lesions.

This measurement of disease is appropriate in diseases like rusts, downy and powdery mildews, leaf spots and other similar diseases.

$$\text{Disease severity or Percent Disease index} = \frac{\text{Sum of all disease rating} \times 100}{\text{Total no. of rating} \times \text{maximum disease grade}}$$

Crop Loss Assessment

Disease epidemics results in crop losses. Crop loss is the reduction in either quantity or quality of yield where yield is the measurable produce of a crop. Operational definition of crop loss is the difference between actual yield in the absence of disease and yield obtained in disease.

General Symptoms of Plant Diseases

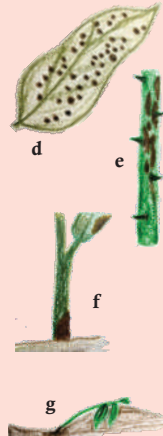
The morphological manifestation of a disease or infection expressed by plant that is visible to us are symptoms. The symptoms of diseases vary according to the plant part affected and metabolism and physiology of the plant intercepted. The most common and general symptoms of plant diseases are given below.



A. Spot : Well defined, self limiting lesion on arial plant parts are called spot. They are often named after the plant part on which they are present, for instance on the leaves are called Leaf spot. These maybe of various shapes such as round , circular, angular, etc. and are often light to dark brown or black in colour. It is worthy to note that in angular leaf spots, veins and vein lets normally restrict the spread of infection.

B. Blotch : Large areas of discoloration on leaves, fruits etc. are called blotches. There spread on the leaves is not restricted by veins.

C. Anthracnose : Black or charcoal like, slightly sunken lesion on leaves, stems or fruits result in a disease.



D. Scab : A rough, crust like lesion on a plant part, showing surface layer thickening ; or the disease condition in which such areas form is termed scab.

E. Canker : A necrotic, often sunken lesion, on a stem, branch or twigs of plants is called a canker.

F. Rot : Softening, discoloration and decay of succulent plant tissue as a result of infection is called rotting. Root rot, foot rot, crown rot, bulb rot, collar rot, soft rot, rhizome rot, sett rot, stem rot etc. are some common types of rots.

G. Damping off : Death and collapse of seedling at or near the soil line is normally



referred to as damping off. It is very common in the nursery and they often result in heavy seedlings mortality.

H. Gummosis : External or internal production of exudates or gum by the plants tissue is referred to as gummosis.

I. Dieback : Death, decay or drying of twigs or branches from tip downwards is called dieback. Discolouration or darkening of the bark is a very common feature.

J. Wilt : A diseased condition that result in dropping of plant parts generally caused by insufficient transport of water in the plants is called wilting. It may occurs due to pathological or a physiological cause.

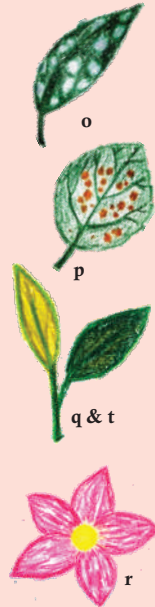
K. Shot hole : A disease symptoms in which leaf lesion becomes cicatrized and fall away drop off and leave small holes in their place, is called shot hole.



L. Mould : A disease in which the mycelium or spores of the fungus are seen as a blackish, brownish, bluish or grayish growth on the host surface. The term also refers to fungal growth, which may be present on the non living substrate, too. Sooty mould is common disease affecting plants and is caused by saprophytic fungi. It is appears as a sooty or black coating on plants and is commonly associated with honeydew secreted by insect such as aphids, mealy bugs, scales and white flies.

M. Gall : A swelling or overgrowth on plant due to infection by certain pathogen or pest.

N. Mosaic : Presence of dark and light green or yellow areas on leaves of virus affected plants, there may be thickening, puckering or distortion as well as ring, line and streak patterns may also be associated.



O. Mildews : Mycelium and spores of the fungus are seen as a whitish or greyish growth on the host surface. If growth develops mainly on the lower surface of the leaves named downy mildew; growth develop on upper surface named powdery mildew.

P. Rust : A disease representing a “rusty “look to a plants is called rust. Orangish spore masses seen on the surface of leaves and stem.

Q. Vein clearing or vein banding: In vein clearing vein appears yellow with interveinal area dark green in colour while in vein banding leaves turn yellow leaving the vein dark green.

R. Colour break : Narrow elongated streaks or stripes of indefinite or restricted length on flower petals often result in variegation in flower colour.



S. Witches Broom : Broom- like growth or massed proliferation is caused by dens clustering of branches of plants. In such plants the internodes get shortened and the numbers of stems is greatly increased.

T. Chlorosis : Yellowing of normal green tissue due to destruction or failure of chlorophyll to form.



U. Necrosis : Death and discoloration of tissue is called necrosis.

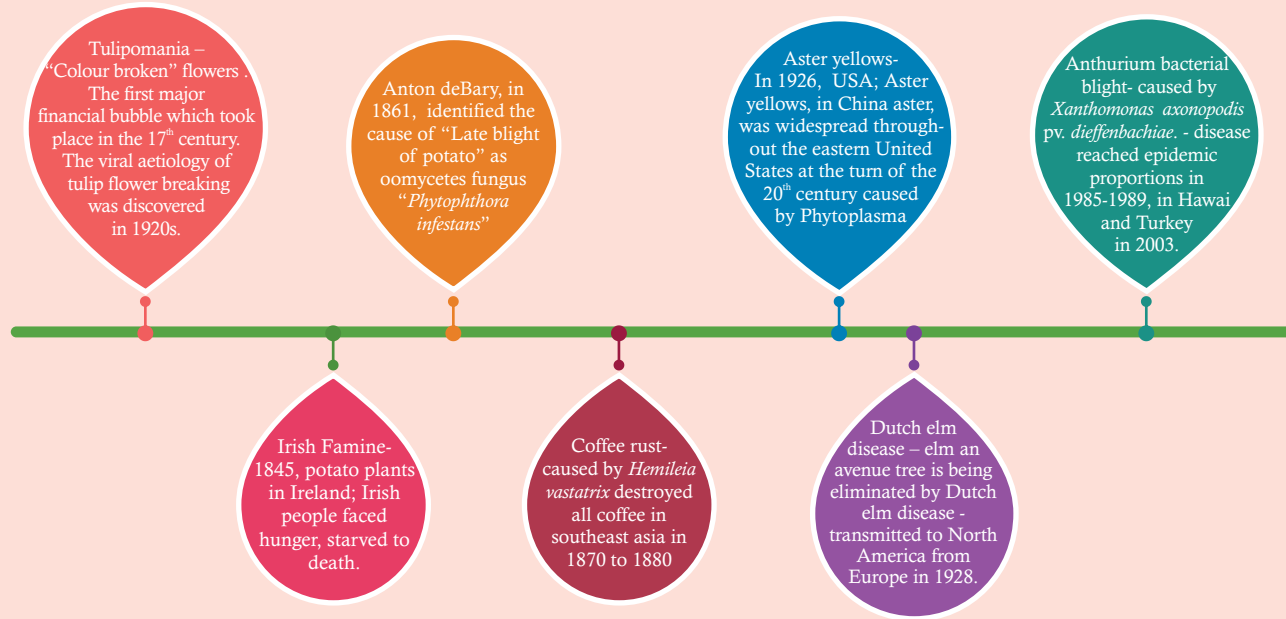
V. Scorching : Appears as burning of margin or nearly whole leaves as a result of infection or unfavourable environmental conditions.



W. Stunting or dwarfing : It is reduction in the size of plant.



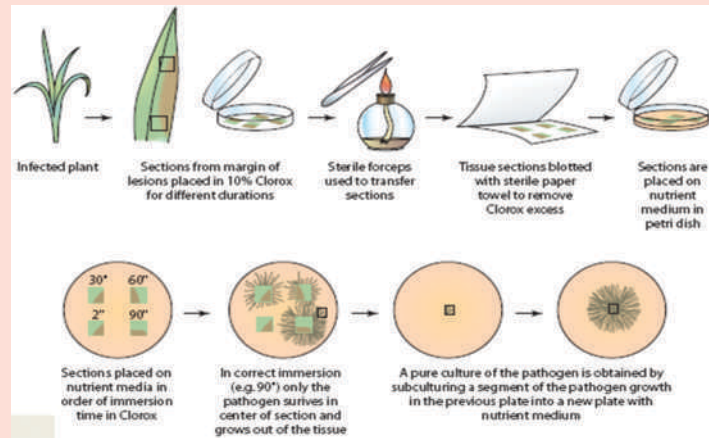
Some Major Plant Diseases in the History



Fungi as Plant Pathogens

Fungi are small, generally microscopic, eukaryotic, usually filamentous, branched, spore-bearing organisms that lack chlorophyll. Fungi have cell walls that contain chitin and glucans (but no cellulose) as the skeletal components.

Fungi are among the dominant causal agents of plant diseases. They are able to infect various plant parts such as roots, stems, leaves, flowers and fruits, inducing characteristic visible symptoms like spots, blights, anthracnose, wilts, rots etc.



Isolation of Fungi from Infected Plant Tissue

- Isolated fungi has been further studied for their mycelial and spore morphology for identification through microscopy
- Further molecular identification and barcoding has been done through molecular markers.
- Pure cultures are used for pathogenicity tests to prove pathogenicity on various hosts.
- Pure culture can be stored through Sterile water storage, Periodic serial subcultures, Freezing, Freeze drying, Sterile mineral oil overlay and Cryopreservation

Source: G.N. Agrios,
Plant Pathology 5th Edition

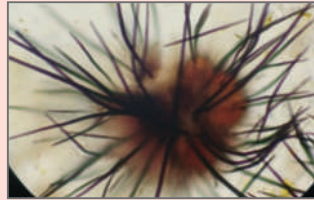


Fungal Morphology

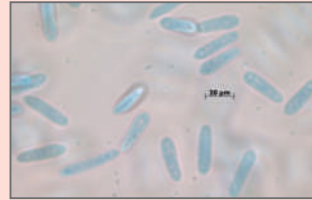
The Spore morphology of various fungal pathogens of flower crops deciphered through microscopy are given below:



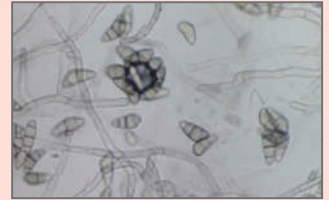
Alternaria sp.



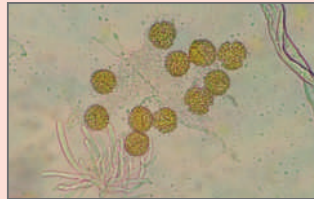
Acervuli and Spores of Colletotrichum sp.



Curvularia sp.



Fusarium sp. *Micro*
and Macrospores



Rust fungi



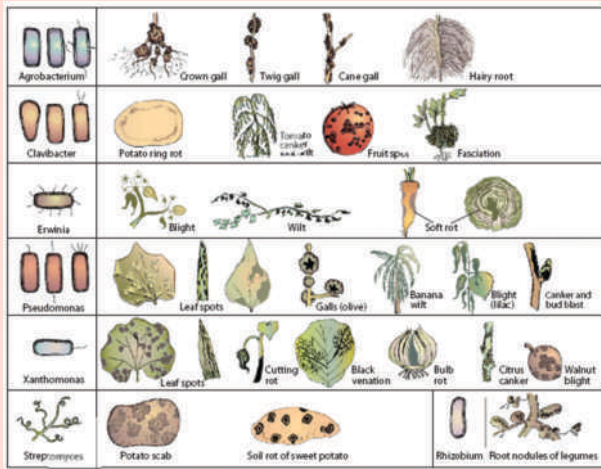
Pestalotiopsis sp.



Stagnospora sp.

Bacteria as Plant Pathogens

Bacteria and mollicutes are prokaryotes. These are generally single-celled microorganisms whose genetic material (DNA) is not bound by a membrane and therefore is not organized into a nucleus. Bacteria may be rod shaped, spherical, spiral, or filamentous (threadlike). Most Plant pathogenic bacteria are rod shaped.



Source: G.N. Agrios, Plant Pathology

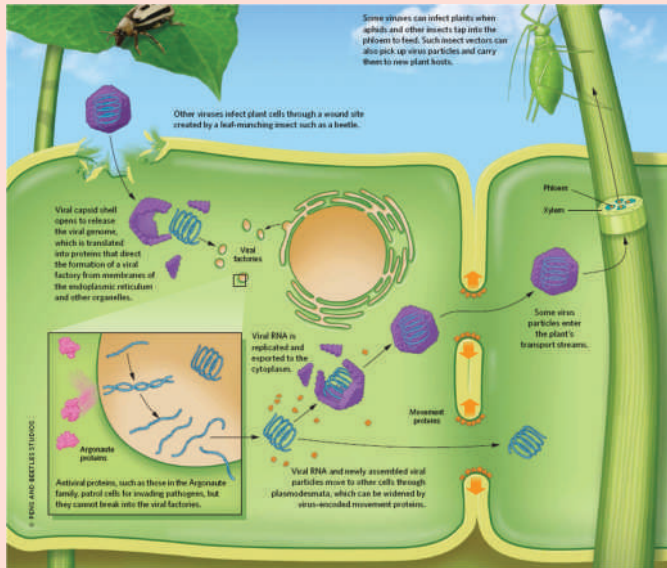
Important Genera of Plant pathogenic bacteria and symptoms they cause.

Identification:

- ❖ Gram's staining : Differentiates bacteria into gram-positive and gram-negative types. Bacteria fixed on a glass slide treated with crystal violet solution for 30 seconds, rinsed gently, treated with iodine solution, and rinsed again with water and then alcohol. Gram-positive bacteria retain the violet-iodine stain. Gram-negative bacteria have no affinity for the stain therefore removed by the alcohol rinse, remain as nearly invisible as before.
- ❖ Bacteria are also distinguished by the substances that they can or cannot use for food and by the kinds of enzymes produced when the bacteria are grown on certain media.
- ❖ Phytopathogenic bacteria are also tested for their pathogenicity on various species and varieties of host plants.



Viruses as Plant Pathogens



Source: Claire Asher (2018), *How Viruses Attack Plants*, *The Scientist*

- Plant viruses are widespread and economically important plant pathogens. A virus is a set of one or more nucleic acid template molecules, normally encased in a protective coat or coats of protein or lipoprotein, that is able to organise its own replication only within suitable host cells. Within such cells, virus replication is dependent on the host's protein-synthesising machinery.
- Most plant viruses are transmitted by insect vectors that cause damage to the plant and create an entry point for pathogens, or that tap into the phloem to feed. Once inside, viruses use the handful of genes in their tiny genomes to orchestrate the plant cells' machinery, while evading the plant's defenses.
- Once introduced inside the cell, viral capsid shell opens to release the viral genome, which translated into proteins that direct virus replication.
- Newly assembled viral particles move to other cells through plasmodesmata, and transmitted to other plants through vectors.

Nematodes as Plant Parasites

Nematodes are thread-like microscopic, multicellular, unsegmented, bilaterally symmetrical roundworms belonging to pseudocoelomate animals. Phytonematodes have specialized structure called stylet that is used to puncture the host cell. Most of the nematodes inject enzymes into a host cell before feeding to partially digest the contents. The nematode feeding process damages the plant's root system and reduces the plant's ability to absorb water and nutrients.

General Symptoms of Nematode Infestation

Above Ground Symptoms

- Stunting and chlorosis (yellowing)
- Deformed or distorted foliage (crinkling, curling and twisting)
- Infected rows appear thinner- patchy appearance
- Reduced number of spikes (tuberose)
- Reduced length of flower stalk, flower size, no. of flowers/plant, and productive life of the plant

- Wilt more readily than healthy plants and slower recovery from wilting.
- Failure to respond to fertilizers.

Below Ground Symptoms

- Root knots
- Formation of distinctive swelling called root galls (root-knots)
- Appear in various size and shape.
- Galls tend to fuse together so that large areas or entire root may be swollen.
- Root lesions
- Lesions of necrotic tissue on the roots of infected plant
- Root necrosis resulting in severe root pruning and dwarfing
- Plants may be easily pulled from the ground
- Fibrous or feeder roots are mostly attacked - reduces the absorption ability of plants



The most common symptoms associated with each pathogen group.

Symptom	Description	Plant Pathogen Groups					
		Fungi	Bacteria	Viruses	Nematodes	Phytoplasmas	Parasitic Plants
Blight	Rapid discoloration, wilting and death of plant tissue	X	X				
Blotch	Blotch or large spot on leaves, shoots, or fruit	X	X				
Bronzing	Leaves or needles develop a bronze color	X			X		
Canker	Dead region on bark of twigs, stems, or trunks, often discolored and either raised or sunken	X	X				
Chlorosis	An abnormal yellowing of plant parts	X	X	X	X		
Damping-off	Decay of seeds in soil or young seedlings shortly after emergence	X					
Decline	Gradual, often uniform, decline of plant health or death of plant tissue	X	X	X	X		X
Dieback	Progressive death of shoots, branches, or roots, generally starting at tips	X	X	X	X		
Distortion	Irregular shaped plant parts	X	X	X		X	
Flagging	Decline of a shoot or branch, while nearby branches remain healthy	X	X				
Gall	Abnormal, localized swelling on leaf, stem, or root tissue	X	X		X		
Gummosis	Production of a sticky gum that is exuded by the plant	X	X				
Leaf spot	Lesion on a leaf, may vary in color, shape and size	X	X	X			
Mosaic	Non-uniform foliage coloration, normally an intermingling of green color variations and yellowish patches			X			
Mottle	Irregular pattern of light and dark areas			X			

Symptom	Description	Plant Pathogen Groups					
		Fungi	Bacteria	Viruses	Nematodes	Phytoplasmas	Parasitic Plants
Mummy	Hard, dried, diseased fruit	X					
Necrosis	Death of plant tissue	X	X				
Ring spot	A lesion with a dark outer ring and lighter center			X			
Rot	Decomposition and destruction of tissue	X	X				
Rugose	Wrinkled appearance to plant tissue	X		X			
Scab	Crust-like disease lesion	X	X				
Scorch	Browning and necrosis of leaf margins	X	X				
Shot-hole	Lesions where centers have fallen out	X	X				
Tip blight	Death of tissue at the tip of a shoot	X	X				
Vein clearing	Leaf veins become yellow or clear			X			
Water-soaking	Wet, dark, or greasy lesions, usually sunken and/or translucent	X	X				
Wilt	Drooping of leaves or other plant parts	X	X		X		
Witches' broom	Abnormal brush-like shoot development			X		X	X
Tip blight	Death of tissue at the tip of a shoot	X	X				
Vein clearing	Leaf veins become yellow or clear			X			
Water-soaking	Wet, dark, or greasy lesions, usually sunken and/or translucent	X	X				
Wilt	Drooping of leaves or other plant parts	X	X		X		
Witches' broom	Abnormal brush-like shoot development			X		X	X



Rose



Powdery Mildew (*Podosphaera pannosa*)

What Causes It

- High relative humidity, moderate temperatures and low light intensities

What It Looks Like

- White powdery growth appears all over the leaves. Gradually leaves dry up

What You Can Do

- Shift plants to bright sun
- Take care to maintain low humidity and good aeration
- Use of sulfur fungicides reduces powdery mildew incidence
- Bavistin or Benlate (0.1%), Wettable sulphur (0.2%), propiconazole (0.1%) and Karathane (0.05%) may be used

Rose



Black Leaf Spot (*Diplocarpon rosae*)

What Causes It

- ❖ Fungi under humid wet conditions

What It Looks Like

- ❖ Circular black spots appear generally on upper sides of leaves. The spots are frequently surrounded by a yellow halo

What You Can Do

- ❖ Remove diseased leaves on the ground and ground should be raked. Diseased canes should be pruned off to prevent overwintering of pathogen
- ❖ Spray of Bavistin (0.1%) followed by Benlate (0.1%) at 15 days interval has been found to be highly effective in checking the diseases. Dithane M-45 and Dithane Z-78 (0.2%) are also useful.
- ❖ Propioconazole fungicides are reported to control leaf spots.



Rose



Botrytis Bud and Twig Blight (*Botrytis cinerea*)

What Causes It

- Extended periods of cloudy, humid, and wet weather

What It Looks Like

- Occur on petals, leaves, as brown, water-soaked spots. Infected plant parts covered with gray to brown powdery masses of spores. The infected buds droop down.
- The sunken grayish black lesions extend to the stem from the base of the bud.

What You Can Do

- Remove and dispose of fallen leaves and debris around plants, avoid overhead irrigation, chemicals like Azoxystrobin, Chlorothalonil and Mancozeb fungicides found effective against the pathogen

Rose



Die Back (*Diplodia rosarum*)

What Causes It

- ❖ Disease appears in maximum severity following pruning of canes after monsoon.

What It Looks Like

- ❖ Die back is one of the major diseases of rose. The disease causes death of the plant from tip downwards. Older plants are more prone to attack as compared to younger ones. Brown discoloration is conspicuous when affected stems are split open.

What You Can Do

- ❖ Cut away the affected plants and burn it.
- ❖ Disinfect secateur and other pruning tools
- ❖ Cut ends to be immediately coated with chaubatia paste containing 4 parts of copper carbonate, 4 parts of red lead and 5 parts of linseed oil.



Rose



Source: Ludwig's roses

Rust (*Phragmidium* spp.)

What Causes It

- Mild winter temperature and rainfall are most suitable conditions for rust epidemics

What It Looks Like

- Presence of reddish-orange pustules on leaflets and sometimes on petioles. The colour of these pustules changes to black when teleutospores are formed. In severe cases of infection, defoliation occurs. The production of flowers from diseased plants is drastically reduced..

What You Can Do

- Fallen affected leaves should be collected and destroyed.
- Spring pruning and dormant spray of Copper oxy chloride (0.3%) is effective in controlling the disease. The disease can be effectively controlled by spraying Dithane M-45 (0.2%), Vita vax (0.1%).

Rose



Phytoplasma Diseases

What Causes It

- Bacteria like organism

What It Looks Like

- Reduced size of leaves, 'Witches' broom appearance, leafy structures arise instead of flower (phyllody) and flower colour turns green (Virescence).

What You Can Do

- Clean planting material, removal of weeds and alternate hosts



Rose



Rose Mosaic

What Causes It

- ✿ Rose mosaic virus

What It Looks Like

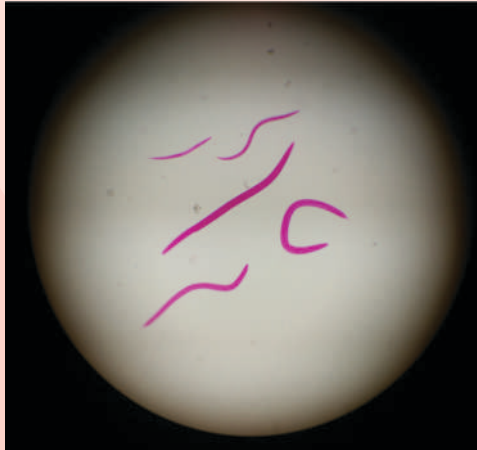
- ✿ Chlorotic bands or ring spots, wavy lines, yellow vein banding, oak-leaf pattern

What You Can Do

- ✿ Use virus free cuttings from certified mother stock
- ✿ Clean cultivation
- ✿ Management of insect vectors

Rose

**Root-knot Nematodes (*M. incognita* and *M. javanica*)
Dagger Nematode (*Xiphinema diversicaudatum*) and
Root-lesion Nematode (*Pratylenchus* spp.)**



What Causes It

- Nematodes

What It Looks Like

- Stunted growth with yellowing of leaves and wilting of plants.

What You Can Do

- Use nematode-free planting material
- Hot water treatment of roots of plants at 45.5 °C for an hour



Chrysanthemum



Pythium Root Rot

What Causes It

- ✿ Fungi under highly moist condition.
- ✿ Poor surface or subsurface drainage
- ✿ Over-irrigation, heavy rainfall

What It Looks Like

- ✿ Stunting, wilting and necrosis of the main, lateral and feeder rootlets.
- ✿ Black necrotic lesion girdling of the lower stem can be observed in some diseased plants.

What You Can Do

- ✿ Among cultural practices soil solarization, removal of infected plants and good drainage facility are important.
- ✿ Fungicides recommended against the disease are: Metalaxyl, Mancozeb, Captan, and Fosetyl-Al.

Chrysanthemum



Powdery Mildew (*Erysiphe cichoracearum*)

What Causes It

- ❖ Fungi under conditions of high relative humidity, moderate temperatures and low light intensities.
- ❖ Large differences between day and night temperatures; Temperature between 21 – 27 °C and high relative humidity during night time

What It Looks Like

- ❖ White powdery growth appears all over the leaves, gradually leaves dry up and the whole plant may die

What You Can Do

- ❖ Spraying with Karathane (0.025%), Bavistin (0.1%) or sulphur based fungicide (0.2%)
- ❖ Providing a dry environment helps to check this disease.



Chrysanthemum



Ray Blight (*Didymella ligulicola* or *Ascochyta* sp.)

What Causes It

- Fungi under wet condition

What It Looks Like

- Tiny dark-pink spots form on the petals. Starts on one side of the flower.
- Fungus spreads quickly from these initial areas of infection and the petals brown and rot.
- Grow from the flower down into the stem and cause the flower stem to weaken and droop.

What You Can Do

- Avoid overhead irrigation
- Azoxystrobin, chlorothalonil, fludioxonil, iprodione, mancozeb, myclobutanil, propiconazole, pyraclostrobin, or thiophanate methyl may be applied

Chrysanthemum



Leaf Spot (*Septoria chrysanthemi*, *S. chrysanthemella*, *Alternaria* species, and *Cercospora chrysanthemi*)

What Causes It

- Fungi under wet conditions

What It Looks Like

- Symptoms first appear as yellow spots which turn brown to black. Spots often occur on lower leaves first and can coalesce into large necrotic areas and finally death of the entire leaf.

What You Can Do

- Regularly clean up and destroy infected plant debris and hand pick symptomatic leaves from lightly infected plants.
- Avoid splashing water onto plant foliage and water early in the day to allow foliage to dry quickly.
- Azoxystrobin, chlorothalonil, fludioxonil, iprodione, mancozeb, myclobutanil, propiconazole, pyraclostrobin, or thiophanate methyl can be applied



Chrysanthemum



Fusarium Wilt (*Fusarium oxysporum*)

What Causes It

- ✿ Incursion and proliferation of the fungal pathogen into vascular tissues.
- ✿ Dry weather and low soil moisture encourage this plant disease.

What It Looks Like

- ✿ Drooping, yellowing and loss of turgidity of leaves; Stunted growth and failure in production of normal buds and flowers.
- ✿ Disintegration and discoloration in the roots
- ✿ Vascular tissues blocked
- ✿ At early stages of the infection, plants shows recovery at night due to low temperature

What You Can Do

- ✿ Soil treatment with Thiophanate methyl has been found effective in minimizing the disease.

Chrysanthemum



Botrytis Blight (*Botrytis cinerea*)

What Causes It

- ✿ Damaging when rainy, drizzly weather continues over several days.

What It Looks Like

- ✿ Occur on petals, leaves, or stem cankers as brown, water-soaked spots.
- ✿ Infected plant parts covered with gray to brown, powdery masses of spores. Botrytis blight can be particularly

What You Can Do

- ✿ Provide better ventilation and good aeration by providing adequate planting distance.
- ✿ Spraying with Bavistin (0.1%) and Copper oxychloride (0.2%) gives good results.



Chrysanthemum

White Rust (*Puccinia horiana*)



What Causes It

- A fungal disease of the foliage, spread by airborne spores during cool, wet weather conditions

What It Looks Like

- Sunken yellow or brown spots on upper leaf surface, buff/white pustules on lower surface
- Severely affected leaves shrivel and turn brown

What You Can Do

- Report immediately it is a quarantine pathogen with limited distribution
- Check plants regularly and remove and dispose of affected leaves and heavily infected plants
- Do not take cuttings from affected plants
- Fungicides tebuconazole, tebuconazole with trifloxystrobin and triticonazole control rust diseases; regular applications at seven day intervals may be required to control white rust

Chrysanthemum



Soft Rot (*Erwinia chrysanthemi*)

What Causes It

- Bacteria

What It Looks Like

- Wilting of plants on bright days.
- Stem tips turn brown, brittle and collapse.
- Stem becomes hollow with brownish streaks extending up to base.

What You Can Do

- Destruction of affected plants
- Soil sterilization, using disease free cutting and avoiding contamination during pinching.
- Spray of Streptomycin (0.01%) has been found to be effective.



Chrysanthemum



<https://content.ces.ncsu.edu/leaf-spotting-bacteria-on-ornamentals>

Bacterial Leaf Spot (*Pseudomonas cichorii*)

What Causes It

- Bacteria under humid climate.
- Bacteria survive in non-susceptible host plants, in water, and in the soil near plant and enter the plants through injuries

What It Looks Like

- Small dark brown to black spots on lower leaves enlarge and become irregular in shape.
- When infected leaves dry, the spots become brittle and crack.
- The disease often spreads up plants in one side of the pot, eventually to the flowers.

What You Can Do

- Destruction of affected plants, soil sterilization, using disease free cutting and avoiding contamination during pinching.
- Spray of Streptomycin (0.01%) has been found to be effective.

Chrysanthemum



Phytoplasma

What Causes It

- A kind of bacteria, spread through infected cuttings and leafhoppers

What It Looks Like

- Little leaves where size of leaves reduced,
- Withches' broom appearance where branches looks like a 'broom'
- Leafy structures arise instead of flower (phyllody)
- Flower colour turns green (Virescence)

What You Can Do

- Clean planting material
- Removal of weeds and alternate hosts (Cuscuta, brinjal, partheniums)
- Cleaning the tools
- Control of leaf hopper vectors
- Use of tetracycline derivatives reduces the disease incidence



Chrysanthemum

Stem and Bud Necrosis

(Groundnut bud necrosis virus and Tomato spotted wilt virus)



What Causes It

- A virus

What It Looks Like

- Veinal necrosis, necrotic spots on leaves, browning of petals, and stem necrosis.
- Under severe conditions, extensive necrosis leads to complete drying and death of the plants

What You Can Do

- Use virus free planting material
- Avoid taking cuttings from infected plants
- Removal of weeds and alternate hosts
- Control of thrips vectors
- Monitor the field regularly and destroy the plants infected completely to avoid them acting as virus reservoirs

Chrysanthemum



Chrysanthemum Stunt Viroid

What Causes It

- A virus like pathogen

What It Looks Like

- Stunting, chlorosis of leaves, premature blooming and lack of root formation in cuttings.
- Shortened stems, different response time, uneven flowering, irregular size of flowers, irregular size of parts within single flowers, smaller than normal foliage, and uneven maturation of parts within single flowers

What You Can Do

- Chrysanthemum Stunt viroid is highly mechanically transmissible. Sterilize the tools and equipment used during cultivation, crop maintenance or harvest.
- Use Chrysanthemum Stunt-free cuttings from certified mother stocks



Marigold



Wilt, Stem Rot, Collar Rot (*Phytophthora* sp.; *Pythium* sp.)

What Causes It

- Cool and wet summer

What It Looks Like

- The fungus affects the collar portions of the plants.
- In nursery the infection results in damping-off and is aggravated by soil moisture.
- In the field the infected plants show wilting.

What You Can Do

- Avoid over irrigation
- Soil Steriization of nursery bed
- Soil solarization in field
- Use of biocontrol agents during land preparation
- Apply Metalaxyl in soil

Marigold



Leaf Spot and Blight (*Alternaria*, *Cercospora* and *Septoria* sp.)

What Causes It

- Fungi during wet times of the year

What It Looks Like

- Brown necrotic spots develop on leaves, which get enlarged at the later stage of infection.
- The entire foliage gets damaged and results in poor vegetative growth.

What You Can Do

- To keep the disease under check the marigold crop should be sprayed with Dithane M-45 @ 0.2% or Carbendazim (.05%) at fortnightly intervals starting from the first appearance of disease symptoms.



Marigold



Powdery Mildew (*Oidium* sp. *Leveillula taurica*)

What Causes It

- Fungi; Temperature between 21 – 27 °C and high relative humidity during night time

What It Looks Like

- Whitish, tiny superficial spots appear on leaves which later on result in the coverage of whole aerial parts of plant with whitish powder

What You Can Do

- The disease can be controlled by spraying with Karathane @ 0.05% or Sulfex (3g/l of water) at fortnightly intervals

Marigold



Flower Bud Rot (*Alternaria dianthi*)

What Causes It

- Fungi under Humid hot conditions

What It Looks Like

- The fungus infects the young flower buds.
- Infected buds shrivel and become dark brown in colour.
- Pathogen also infects leaves causing blight.
- Infection is visible in the form of brown necrotic spots on margins and tips of older leaves

What You Can Do

- Avoid crowded planting
- Spraying of Dithane M-45, Chlorathalonil should be followed.



Marigold



Phytoplasma

What Causes It

- A bacteria like pathogen called Phytoplasma transmitted by Leafhoppers

What It Looks Like

- Reduced leaf size, bunching of leaves and branches, stunting, flower malformations, greening of flowers, phyllody, bronzing of leaves and gradual death of the entire plant.

What You Can Do

- Healthy planting material
- Remove alternate hosts from field
- Control of leafhopper vectors
- Dipping of seedlings or rooted cuttings in Tetracyclin before planting

Jasmine



Leaf Blight (*Cercospora jasminicola* and *Alternaria jasmini*)

What Causes It

- Caused by Fungi, spreading rapidly in the rainy season

What It Looks Like

- Reddish brown circular spots on the upper surface of the leaves later coalesce to form blight

What You Can Do

- Spraying with Bavistin (0.1%) or Copper oxychloride (0.3%) at monthly interval commencing from May onwards up to pruning helps to control the disease.
- Diseased leaves should be collected and burnt.



Jasmine



Rust on Jasminum auriculatum
Photos by Dr Parthasarathy Seethapathy, TNAU

Rust (*Uromyces hobsoni*)

What Causes It

- July – August during monsoon rains

What It Looks Like

- The leaves show the presence of orange coloured aecial cups on both sides, but predominantly on the lower surface

What You Can Do

- Affected plant and plant parts should be removed.
- Disease can be controlled by dusting Sulphur

Jasmine



Graymold or Botrytis Blight (*Botrytis cinerea*)

What Causes It

- Cool, rainy spring and summer weather

What It Looks Like

- Blossom blight, bud rot, stem canker, stem and crown rot, cutting rot, leaf blight, and damping-off or seedling blight

What You Can Do

- Remove and dispose of fallen leaves and debris around plants
- Avoid overhead irrigation
- Chemicals like Azoxystrobin, Chlorothalonil fungicides found effective against the pathogen



Jasmine



Source: Wikee et al., 2010

Anthracnose (*Colletotrichum jasminicola*)

What Causes It

- Cool, wet weather

What It Looks Like

- Large, circular, distinct, brownish to greyish spots outlined with brown to yellowish haloes appears on the upper surface of the leaves

What You Can Do

- Bordeaux mixture (1%), Copper oxychloride (0.25%), Carbendazim (0.15%) and Thiophanate methyl (0.15%) are effective in inhibiting the disease.

Jasmine



Powdery Mildew (*Oidium jasmini*)

What Causes It

- High relative humidity, moderate temperatures, and low light intensities

What It Looks Like

- Foliage and stems look as if they have been sprinkled with powder

What You Can Do

- Use of sulfur fungicides reduces powdery mildew



Jasmine



Phyllody (*Phytoplasma*)

What Causes It

- Phytoplasma

What It Looks Like

- Leaves become small malformed and bushy
- Flowers turn green and floral parts turn to leafy structures.

What You Can Do

- Clean planting material
- Removal of weeds and alternate hosts
- Selection of cuttings from healthy plants.
- Spraying insecticide to control the leaf hopper vector.

Tuberose



Foot and Tuber Rot and Sclerotial Wilt (*Sclerotium rolfsii*)

What Causes It

- Moist humid conditions

What It Looks Like

- Characteristic fan shaped mycelia strand of the fungus appear at the base of the infected plants
- Later stage brown mustard like round sclerotia develop on the mycelia growth
- Further Flaccidity and drooping of leaves followed by yellowing and drying of leaves

What You Can Do

- Drenching the soil with 0.3% Zineb is effective in controlling the disease



Tuberose



Leaf rot and Flower rot
Source: Priyadarshini et al., 2019

Botrytis Spot and Blight (*Botrytis cinerea*)

What Causes It

- Cool (60°F or 15°C), rainy weather

What It Looks Like

- Dark brown spots on leaves coalesce to form blighted patches later covered with mycelia
- Flowers also shows spots later covered by mycelium and rotting occurs and entire inflorescence dries up

What You Can Do

- Spraying the plants with Carbendazim @2g/litre of water effectively controls the disease. The treatment should be repeated at 15 days interval.

Tuberose



(Naga Lakshmi et al., 2018)

Alternaria Leaf Spot (*Alternaria polyantha*)

What Causes It

- Shady condition, Rainy season

What It Looks Like

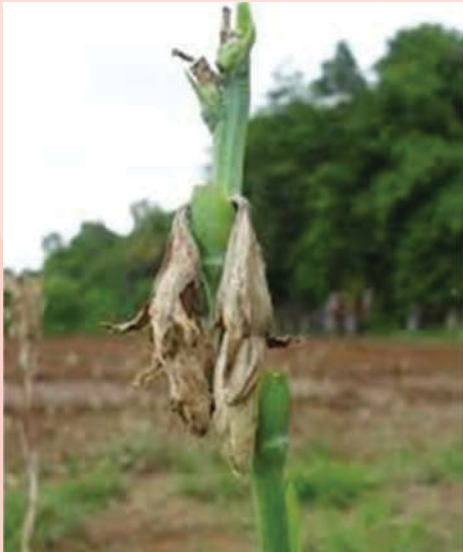
- Faint concentric rings on midrib and rarely on the margins of the leaves
- Leaves and peduncles become necrotic and dry up

What You Can Do

- Application of systemic fungicides - Hexaconazole (Contaf 5 EC), propiconazole (Tilt 25 EC), tebuconazole (Folicur 25 EC) and pyraclostrobin (Cabriotop 60 WG) (0.1%) or non-systemic fungicides, chlorothalonil at 2000 ppm,



Tuberose



(Durgadevi et al., 2012)

Peduncle Blight (*Lasiodiplodia theobromae*)

What Causes It

- Rainy season

What It Looks Like

- Peduncle dieback starting from the tip
- Leaf blight at the tips
- Flowers show dark brown spots and ultimately the entire inflorescence dries up

What You Can Do

- Foliar application of carbendazim 0.1% at 60, 90 and 110 Days After Planting (DAP)

Tuberose



By Aravamudan, Bangalore Mirror ; Jun 2016

Bud Rot (*Erwinia* sp.)

What Causes It

- High moisture condition

What It Looks Like

- Dry rotting of buds with brown scorched necrotic discolouration of peduncles

What You Can Do

- Proper aeration - Avoid crowded planting
- Good drainage and soil conditioning
- Prophylactic foliar spray of *Pseudomonas fluorescence*
- Spray of Streptomycin (0.01%)
- Aeration in packaging after harvest



Tuberose



Root-knot Nematodes (*Meloidogyne* spp.)

What Causes It

- *Meloidogyne* sp. exists in soil in areas with hot climate and short winter

What It Looks Like

- Stunting and chlorosis
- Short and thin floral stalks
- Yellowing of leaves, reduction in the length of the spike and flower yield
- Root-knot galls on the roots

What You Can Do

- Use nematode free bulbs for planting
- Soak mother bulb of tuberose in Carbosulfan (2000ppm) for one hour before planting
- Soil application of carbofuran @ 20-25 kg + 500 kg neem, pongamia/ mahua cake per acre at the time of land preparation
- If possible, grow marigold for 2-3 months before planting

Tuberose



Foliar Nematode (*Aphelenchoides besseyi*)

What Causes It

- This nematode is more serious during rainy season

What It Looks Like

- “Floral malady symptoms Prickle on the scape in early age, Stunted, crinkled, and distorted flower stalk”
- Hardy flower with shortened pedicel and twisted bract
- Brown streaks/rusty brown spots on leaf bracts and petals
- Partially bloomed and unopened flower

What You Can Do

- Soak bulbs in 5% neem-seed-kernel-extract for overnight or dip bulbs in monocrotophos 36SL at 500-750ppm for 6 hours before planting.
- Clean cultivation of tuberose, remove and burn nematode infested plant parts.
- Grow tolerant tuberose cultivars (Prajwal, Phule Rajani and Sringar)



China Aster



Root or Stem Rots and Wilts (*Fusarium* sp. and *Verticillium* sp)

What Causes It

- Soil borne pathogens

What It Looks Like

- Stunted growth, yellowing of leaves followed by withering of plant and subsequent rotting of the collar region. When the stem is cut, the vascular ring is found to be brown, especially on the most affected side.

What You Can Do

- Seeds collected from diseased plants must be disinfected as well as the soil in which they are to be planted.
- Soaking of seeds for 30 minutes in a 0.1% solution of Mercuric chloride and steam sterilization of soil has proved very effective to prevent the disease.

China Aster



Graymold or Botrytis Blight (*Botrytis cinerea*)

What Causes It

- ✿ Favoured by extended periods of cloudy, humid, and wet weather

What It Looks Like

- ✿ Blossom blight, bud rot, stem canker, stem and crown rot, cutting rot, leaf blight and damping-off or seedling blight

What You Can Do

- ✿ Remove and dispose of fallen leaves and debris around plants
- ✿ Avoid overhead irrigation
- ✿ Chemicals like Azoxystrobin, Chlorothalonil fungicides found effective against the pathogen



China Aster



Source: Back et al., 2014

Rusts (*Coleosporium asterum* or *Puccinia* sp.)

What Causes It

- Warm temperatures and moisture, humidity, dew or rain

What It Looks Like

- On the lower surface of the leaves bright yellow orange spots appear on young plants. Initially these spots are covered with thin layer of spores but on maturity they become erumpent exposing orange red colour powdery spore masses.

What You Can Do

- Inform Authorities– Not reported from Aster in India
- Infected plant parts should be collected and destroyed.
- Sprinkler irrigation of plants should be avoided.
- Spraying of wettable sulphur during the growing season is effective to control the disease.

China Aster

Southern Blight (*Sclerotium rolfsii*)



(Mahadevakumar et al., 2018)

What Causes It

- Post rainy season favourable

What It Looks Like

- Water-soaked lesions on leaves, stems and on the lower stem surfaces followed by quick wilting of the whole plant with abundant production of sclerotia near the stem-soil interface

What You Can Do

- If observed report to authorities
- Destroy the infected plants and sterilize the soil
- Seedling Dip in Trihoderma/Bacillus before transplanting
- Soil Solarization
- Use of propiconazole 25% EC and thiram 75% SD, Tebuconazole and carboxin



China Aster



Leaf Spot

(*Ascochyta asteris*, *Septoria callistephi*, *Stemphylium callistephi*)

What Causes It

- Hot humid conditions, Moist and Cloudy weather

What It Looks Like

- The spots are first yellowish, and then become dark brown and black, increasing in size.
- The lower leaves are infected first.
- In case of severe infection spots coalise and turn blighted and leaves fall on the ground.

What You Can Do

- Diseased leaves should be collected and burnt.
- Seed should be treated with Thiram (0.2%) or
- Carbendazim (0.1%) before sowing.
- Disease can be effectively controlled by spraying with Dithane M-45 (0.2%) at weekly interval.

China Aster



Yellows (*Phytoplasma*)

What Causes It

- Is a bacteria, spread from infected plant to healthy plants through leafhoppers

What It Looks Like

- Infected plants show yellowing of whole plant in seedling stage, later stages Withches' broom appearance where branches looks like a 'broom', leafy structures arise instead of flower (phyllody) and flower colour turns green (Virescence)

What You Can Do

- Time to time removal of weeds and alternate hosts (*Cuscuta*, brinjal, partheniums)
- Cleaning the tools
- Control of leaf hopper vectors
- Use of tetracycline derivatives reduces the disease incidence



China Aster



Root-knot Nematode (*Meloidigyne* spp.)

What Causes It

- Hot temperature and short winter

What It Looks Like

- Stunted vegetative growth, yellowing of leaves and wilting of plant
- Medium to large size galls on the root

What You Can Do

- Use nematode-free planting materials
- Use of varieties like Shashank (resistant) and Poornima (moderately resistant).
- Treat the nursery bed with formulations of *T. harzianum* / *Pseudomonas fluorescens* and *Paecilomyces lilacinus* (each 50g/sq.m) along with application of Neem cake or Pongamia cake or Castor cake @ 500g/sq.m or carbofuran @ 50g / sq.m.
- In the main field, apply carbofuran @ 20-25 kg + 500 kg neem, pongamia/ mahua cake per acre at the time of land preparation

Crossandra



Wilt (*Fusarium solani*)

What Causes It

- Soil borne fungus

What It Looks Like

- Leaf margins show pinkish brown discolouration and the stem shrivelled

What You Can Do

- Infected plants should be pulled out and burnt.
- Soil drenching with Carbendazim 0.1 per cent or Copper oxychloride 0.25 per cent on 30 days interval controls the disease.
- The treatment may be repeated after 3 to 4 weeks if needed.



Crossandra



Stem Rot (*Rhizoctonia solani*)

What Causes It

- Fungus infection in stem

What It Looks Like

- The brown to black lesions on stem

What You Can Do

- Provide good drainage and avoid overcrowded planting.
- Remove and destroy the diseased plants.
- Drenching with Fosetyl-A1 has been found effective in the control of the disease.

Crossandra



Leaf Blight (*Colletotrichum crossandrae*)

Leaf Spot (*Alternaria amaranthi* var. *crossandrae*)

What Causes It

- High humidity and temperatures of 25° to 30° C

What It Looks Like

- Small brownish speck appears on leaves. As it expands turn darker. The spot turns necrotic in centre with reddish colour around in case of Blight.
- *Alternaria* spot characterized by small, circular or irregular yellow spots on the upper surface later enlarge and turn brown and develop dark brown concentric rings.

What You Can Do

- Use Benomyl 0.1% (or) Mancozeb 0.2% (or) Carbendazim 0.1% foliar spray



Crossandra



Root-knot Nematode (*Meloidogyne spp.*)

Root-lesion Nematode (*Pratylenchus spp.*)

What Causes It

- Juveniles and adults of the nematode feed on the plant

What It Looks Like

- Stunted growth with pinkish to purple and yellow coloured leaves
- Reduced size of inflorescence
- Root-knot galls or brown to black lesions on the roots

What You Can Do

- Raise the nursery in nematode free area or treat nursery bed with bioformulations or carbofuran @ 50g/sq.m.
- Use nematode free planting materials
- Soil application of carbofuran @ 20-25 kg per acre.

Gladiolus



Botrytis Blight and Flower Rot (*Botrytis gladiolorum*)

What Causes It

- Fungi under extended periods of cloudy, humid, and wet weather

What It Looks Like

- Brown, water-soaked spots; spots coalesce to form necrotic patches on leaves leading to blight
- Infected plant parts covered with gray to brown, powdery masses of spores

What You Can Do

- Remove and dispose off fallen leaves and debris around plants.
- Avoid overhead irrigation.
- Chemicals like Azoxystrobin, Chlorothalonil fungicides found effective against the pathogen.



Gladiolus



Curvularia Leaf Spot (*Curvularia trifolli f. sp. gladioli*)

What Causes It

- Soil borne disease caused by fungi under warm humid weather

What It Looks Like

- Brown oval spots in petals, young leaves with small clumps of black spores
- Spots appear scattered all over the leaves later make the whole leaf turn yellow and dry

What You Can Do

- Use Antracol (dithiocarbamate fungicides)/ score (Difenoconazole) /tilt (Propiconazole)/ Dithane-M 45/ Kavach (Chlorothalonil) fungicides

Gladiolus



Fusarium Wilt, Yellows or Corm Rot (*Fusarium oxysporum* f. sp. *gladioli*)

What Causes It

- ✿ Incursion and proliferation of the fungi into vascular tissues

What It Looks Like

- ✿ Drooping, yellowing and loss of turgidity of leaves
- ✿ Stunted growth and failure in production of normal buds and flowers

What You Can Do

- ✿ Pre storage and pre planting of corms treatment with captan 0.2% + carbendazin 0.2% for 30 min. + Soil drenching either with captan 0.2% + carbendazim 0.2% or *T. harzianum* @ 10 gm in 1 kg FYM for 10 m²
- ✿ Disease can be effectively controlled by dipping of corms in 0.1 per cent Carbendazim before planting.



Gladiolus



Source: British Gladiolus Society

Gladiolus Rust (*Uromyces transversalis*)

What Causes It

- Warm humid climate; spread of airborne spores
- Spread through contaminated cut flowers and corms

What It Looks Like

- First symptoms are small, yellowish spots later turns to pustules full of yellowish-orange spores on both sides of leaves
- Eventually the pustules coalesce and form larger patches of damaged tissue.
- “Typical rust” with orange sori (small blisterlike elevations of epidermis formed when spores have emerged)

What You Can Do

- Report immediately to nearby KVK or Agriculture University or any ICAR institute
- Systemic fungicide oxycarboxin, sprayed weekly starting soon after emergence, provide good control
- Preventative control strategy is to combine a contact product (e.g., mancozeb) with a systemic fungicide (e.g., tebuconazole)

Gladiolus



Photo source: Melww at English Wikipedia, CC BY 3.0,
<https://commons.wikimedia.org/w/index.php?curid=38443222>

Scab (*Burkholderia gladioli* pv. *gladioli*) (formerly *Pseudomonas gladioli* pv. *gladioli*)

What Causes It

- Warm rainy weather

What It Looks Like

- On the leaves, brownish yellow specks.
- On the corms, circular, brown, sunken lesions with raised margins.
- Neck rot type of symptoms -numerous, brown to black, small spots near the base of the plants

What You Can Do

- Report immediately to nearby agriculture university or ICAR institutes
- Since the disease can be transmitted by mites, nematodes and other soil insects, insecticides such as Thimet, Furadan or Temik may be applied in open furrows at planting before covering the corms with soil.
- Corms and cormels should be soaked in Formaldehyde (0.5%) for 2 hours then in 200 ppm Streptomycin for 2 hrs just before planting.



Gladiolus



Leaf Mottling

(Bean yellow mosaic virus and Cucumber mosaic virus)

What Causes It

- ✿ Virus infection
- ✿ Spread from plant to plant by aphids

What It Looks Like

- ✿ Small light greenish spots appear in between the veins gradually appear like streaks of light and dark green
- ✿ Colour breaking of flowers

What You Can Do

- ✿ Use of virus free planting material
- ✿ Control of aphids
- ✿ Removal of infected plants
- ✿ Crop rotation
- ✿ Plant immune boosters

Gladiolus



Root-Knot Nematode (*Meloidogyne incognita*)

What Causes It

- Nematodes; in areas with hot climate and short winter

What It Looks Like

- Stunted growth
- Short and thin floral stalks
- Yellowing of leaves, reduction in the length of the spike and flower yield
- Reduced root growth with medium sized galls.

What You Can Do

- Obtain planting stock from nematode-free nurseries.
- Apply carbofuran @ 20-25 kg + 500 kg neem, pongamia/ mahua cake per acre at the time of land preparation



Insects as Pests of Flower Crops

Various insects and mites can damage flower crops and ornamental plants at all stages of growth. Insects causes various degree of damage to the plant through chewing the leaves and buds, sucking the sap, mining the cambium, invading the buds, destroying the flowers, and devouring the fruit. The major insect pests of flower crops are aphids, thrips, bud borers, cutworms and spider mites. A description of some of the important insect pests, their damage and methods for controlling them are given in the following pages.



Rose



Aphids (*Macrosiphum rosae*, *Sitobion rosae* and *Wahlgreniella nervata*)

What Causes It

- Adults and Nymphs cause damage by sucking sap

What It Looks Like

- Pear-shaped, soft bodied, light green to dark blackish green aphids

What You Can Do

- Spray *Verticillium lecanii* at 3.0 g/l during evening hours

Rose



California Red Scale (*Aonidiella aurantii*)

What Causes It

- Both adults and young ones suck the sap from mature shoots

What It Looks Like

- scales are flat, circular and reddish in colour and measures about 2 mm in diameter
- Depleted vigor of the plant
- The infested plant bears a few small flowers

What You Can Do

- Selection of scale free planting material and cutting and burning of infested parts are the key operations to reduces the populations.
- Apply pongamia oil 10% to shoots after pruning to avoid scales infestation.



Rose



Thrips (*Scirtothrips dorsalis*)

What Causes It

- Nymphs and adults suck cell sap from tender leaves, buds and flowers.

What It Looks Like

- These thrips attack on new flush after pruning.
- Curled leaves with brown marks and deformed buds with burnt margins are the main symptom of damage

What You Can Do

- Spray acephate 75 SP @ 1.5 g/l or dimethoate 30 EC @ 2.0 ml/l followed with 1% pongamia oil, 2 – 3 times at fortnightly interval with onset of new flush.
- Spray with fipronil 5 SC @ 1.5 ml/l or imidacloprid 17.8 SL @ 0.4 ml/l or acephate 75 SP @ 1.5 g/l under severe infestation.
- Drench the soil with chlorpyrifos 20 EC @ 5.0 ml/l at fortnightly interval to kill pupae in soil.

Rose



Bud Borer (*Helicoverpa armigera*)

What Causes It

- Warm dry climate

What It Looks Like

- Yellowish-white eggs on the growing shoot or flower bud.
- Larvae vary from bluish green to brownish red
- Females are orange-brown and males yellowish-brown, light yellow or light brown.
- The larvae feed on the flower bud by making a large hole and excreta of larvae seen in damaged parts

What You Can Do

- Installation of pheromone trap for monitoring the activity of adults.
- Application of HaNPV @ 250 LE/ha followed by spray with any neem formulations at 1.0 – 2.0 ml/l.
- Spray indoxacarb 14.5 SC @ 1.0 ml/l or thiodicarb 75 WP @ 1.0 g/l, if the incidence is severe.



Rose



Two-spotted Spider Mite (*Tetranychus urticae*)

What Causes It

- Nymph and adults suck the sap

What It Looks Like

- Nymphs and adults are red in colour. Normally found on under surface of leaves.
- They live in silken webbing which provides protection to these mites.
- Adults are about 0.5 mm, females are yellowish-green, with two pronounced dark spots on the body.
- Due to continuous sucking of sap, leaves turn pale colored with white specks

What You Can Do

- Remove and destroy infested plant parts.
- Thinning of old and heavily infested leaves.
- Spraying *Verticillium lecanii* at 5.0 g/l during evening hours.
- Thorough spray of get of water to dislodge mites from their webs and plants followed by application of dicofol 18.5 EC @ 2.5 ml/l or wettable sulphur 80 WP @ 3.0 g/l.

Chrysanthemum

Red Spider Mite (*Tetranychus urticae*)



What Causes It

- Feeding by nymphs and adults

What It Looks Like

- Nymphs and adults are red in colour.
- Normally found on under surface of leaves.
- They live in silken webbing which provides protection to these mites.
- Discoloration of leaves, white specks on leaves and drying of leaves.
- Growth of the plant and flower production are severely affected.

What You Can Do

- Remove and destroy infested plant parts.
- Thorough spray of water on the plant dislodges the mites from their webs followed by spraying dicofol 18.5 EC @ 1.5 ml/l or wettable sulphur 80 WP @ 3.0 g/l.



Chrysanthemum

Aphid (*Macrosiphoniella sanborni*)



What Causes It

- Stunted growth and leaf curling due to continuous sucking of plant sap.

What it looks like

- Shiny, dark reddish-brown to blackish brown, insect.
- Appear during cooler months from October to January.
- At early stage they appear on tender shoots and new flush.
- At later stage the whole tender shoot will be covered with these aphids.

What you can do

- Installing yellow sticky traps for early detection of aphids.
- Encourage the activity of predatory Coccinellid beetles like *Cheilomenessexmaculata*, *Coccinellaundecimpunctata* and parasitoids like *Aphidiusabsinthii*, *Ephedrusdioscoreae*, *Toxaresmacrosiphophagum*.
- Apply 1.0 % neem oil or pongamia oil at weekly interval when infestation starts.

Chrysanthemum

Bud Borer (*Helicoverpa armigera*)



What Causes It

- The larvae feed on the flower bud by making a large hole.

What it Looks Like

- Yellowish-white eggs laid singly on the growing shoot or flower bud.
- Larvae vary from bluish green to brownish
- Females are orange-brown; males-yellowish-brown, light yellow or light brown.
- The larvae feed on the flower bud by making a large hole.

What you can do

- Installation of pheromone trap for monitoring the activity of adults.
- Application of HaNPV @ 250 LE/ha followed by spray with any neem formulations at 1.0 – 2.0 ml/l.
- Spray indoxacarb 14.5 SC @ 1.0 ml/l or thiodicarb 75 WP @ 1.0 g/l, if the incidence is severe.



Chrysanthemum

Cutworm (*Spodoptera litura*)



What causes it

- Brown coloured mature larvae damage growing buds and flowers during nights resulting in qualitative loss to flowers.

What it looks like

- Eggs are laid under surface of leaves in groups of 100 – 150 eggs and the egg mass is covered by tuft of hairs by the moth.
- Early instars are gregarious, feeds by scraping the leaves, affected leaves look like skeletonized.

What you can do

- Installation of pheromone trap for monitoring the activity of adults.
- Collect and destroy egg masses and gregarious early instar larvae.
- Application of SINPV@ 250 LE/ha followed by spray with any neem formulations at 1.0 – 2.0 ml/l.

Marigold



Thrips (*Neohydatothrips samayunkur*)

What Causes It

- Minute insects called Thrips

What It Looks Like

- Adult thrips are dark brown with 3 – 6 yellowish brown
- Affected leaves show silvery, distortion, purplish patches on infested leaves.
- Infestation is severe during seedling stage and flowering stage.

What You Can Do

- Spray acephate 75 SP @ 1.5 g/l or dimethoate 30 EC @ 2.0 ml/l with 0.5% pongamia oil.
- Apply fipronil 5 SC @ 1.5 ml/l in case of severe infestations.



Marigold



Bud Borer (*Helicoverpa armigera*)

What Causes It

- Larvae eats the floral parts

What It Looks Like

- Yellowish-white eggs are laid singly on the growing shoot or flower bud.
- Larvae vary from bluish green to brownish red depending of the growing stage.
- Females are orange-brown but males are usually yellowish-brown, light yellow or light brown.
- The larvae feed on the flower bud by making a large hole.

What You Can Do

- Installation of pheromone traps for monitoring the activity of adults.
- Application of HaNPV @ 250 LE/ha followed by spray with any neem formulations at 1.0 – 2.0 ml/l.
- Spray indoxacarb 14.5 SC @ 1.0 ml/l or thiodicarb 75 WP @ 1.0 g/l, if the incidence is severe.

Marigold



Red Spider Mite (*Tetranychus urticae*)

What Causes It

- Nymphs and adults

What It Looks Like

- Nymphs and adults are red in colour, found on under surface of leaves.
- They live in silken webbing which provides protection to these mites.
- Adults are about 0.5 mm, females are yellowish-green, with two pronounced dark spots on the body.

What You Can Do

- Regular inspection of crop and burn the infested plant parts to avoid further spread.
- Thorough spray of water on the plant dislodges the mites from their webs followed by spraying dicofol 18.5 EC @ 1.5 ml/l or wettable sulphur 80 WP @ 3.0 g/l.
- Spray propergite 57 EC @ 1.0 ml/l or abamectin 1.9 EC @ 0.5 ml/l or flufenoxuron 10 DC @ 1.0 ml/l or fenazaquin 10 EC @ 1.0 ml/l, if infestation is high.



Jasmine



Cut Bud Borer (*Hendecasis duplifascialis*)

What Causes It

- Larval stage eat the bud

What It Looks Like

- Larva is greenish with pale body hairs and black head.
- Adult is small white moth with black wavy lines on hind wings and abdomen.
- Adult lays egg on flower bud, larva after hatching bores into the flower bud and feed on internal content.

What You Can Do

- Collect and destroy the damaged buds with larvae.
- Use light trap to attract and kill the adult moths.

Jasmine



Whitefly (*Bemisia tabaci*)

What Causes It

- Moderately hot and humid conditions.
- Nymphs and adults suck cell sap from lower side of leaves resulting in discoloration, wilting and drying.

What It Looks Like

- White adults lay eggs on lower surface of young leaves.
- In case of severe infestation sooty mold develops on honeydew secreted by nymphs.
- Severely damaged plants produce small and deformed flowers with crooked stalks.

What You Can Do

- Install yellow sticky traps for managing adults.
- Remove and burn the heavily infested leaves.
- Spray with pongamia oil or neem oil @ 10.0 ml/l.; *Verticillium lecanii* @ 3.0 g/l
- Spray imidacloprid 17.8 SC @ 0.5 ml/l for nymph management.



Tuberose



Aphids (*Aphis craccivora*)

What Causes It

- Cool climate : Nymphs and Adults suck plants sap

What It Looks Like

- Small to medium sized dark green to almost black colored aphids.
- Nymphs are light green colored mottled with dark green bands.
- These aphids are often associated with ants. At early stage they appear on tender shoots and new flush.
- At later stage the whole tender shoot, flower bud and flowers will be covered with these aphids.

What You Can Do

- Encourage the activity of predatory Coccinellid beetles like *Brumoidessuturalis*, *Cheilomenessex maculata*, *Coccinellaseptempunctata*, *Coccinellaundecimpunctata*, *Cryptolaemusmontrouzieri* and parasitoids like *Aphelinusmali*, *Aphidiuscolemani*
- Apply 1.0 % neem oil or pongamia oil at weekly interval when infestation starts on the plant.

Tuberose



Bud Borer (*Helicoverpa armigera*)

What Causes It

- Larvae is damaging phase

What It Looks Like

- Adult females are orange-brown but males are usually yellowish-brown, light yellow or light brown.
- Yellowish-white eggs are laid singly on the growing shoot or flower bud.
- Larvae vary from bluish green to brownish red depending of the growing stage.
- The larvae feed on the flower bud by making a large hole.

What You Can Do

- Installation of pheromone trap for monitoring the activity of adults.
- Application of HaNPV@ 250 LE/ha followed by spray with any neem formulations at 1.0 – 2.0 ml/l.



Tuberose



Mealybug (*Phenacoccus solenopsis* and *Ferrisia virgata*)

What Causes It

- Newly hatched crawlers start sucking the plant sap and make plants weak.

What It Looks Like

- Body is covered with medium sized white waxy filaments and two dark stripes on either side of the middle ridge of the body
- Waxy filaments provide protection against natural enemies and pesticides.

What You Can Do

- Regular monitoring for mealybug infestation and ant activity on the plant.
- If natural enemies such as *Cheilomenessexmaculata*, *Scymnuscoccivora*, *Anagyruspseudococci* and *Leptomastixdactylopii* are observed better to avoid the insecticide spray.
- Spray with bio-pesticides such as *Verticillium lecanii* and *Beauveria bassiana*
- Under severe infestation, spray with dichlorvos 76 EC @ 2.0 ml/l or chlorpyrifos 20 EC @ 2.0 ml/l

Tuberose



Thrips (*Scirtothrips dorsalis*)

What Causes It

- Both nymphs and adults hide in the leaf sheath suck cell sap from tender leaves, growing spikes and flower buds.

What It Looks Like

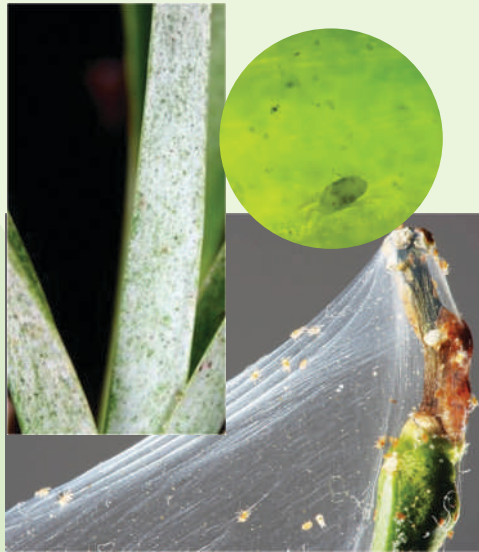
- These thrips attack on new flush and spike.
- Curled leaves with brown marks and deformed buds with burnt margins are the main symptom of damage.

What You Can Do

- Spray acephate 75 SP @ 1.5 g/l or dimethoate 30 EC @ 2.0 ml/l followed with 1% pongamia oil, 2 – 3 times at fortnightly interval with onset of new flush.
- Spray with fipronil 5 SC @ 1.5 ml/l or imidacloprid 17.8 SL @ 0.5 ml/l or acephate 75 SP @ 1.5 g/l under severe infestation.
- Drench the soil with chlorpyrifos 20 EC @ 5.0 ml/l at fortnightly interval to kill pupae in soil.



Tuberose



Two-spotted Spider Mite (*Tetranychus urticae*)

What Causes It

- Nymphs and adults feed on the plant

What It Looks Like

- Nymphs and adults normally found on under surface of leaves.
- They live in silken webbing which provides protection to these mites.
- Feeding leads to discoloration of leaves, white specks on leaves and drying of leaves.
- Growth of the plant and flower production is severely affected.

What You Can Do

- Remove and destroy infested plant parts.
- Thorough spray of water on the plant dislodges the mites from their webs followed by spraying dicofol 18.5 EC @ 1.5 ml/l or wettable sulphur 80 WP @ 3.0 g/l.

China Aster



Melon Aphid (*Aphis gossypii*)

What Causes It

- Cool and cloudy days, all stages are destructive

What It Looks Like

- Nymphs are light green colored mottled with dark green bands.
- At early stage they appear on tender shoots and new flush.
- At later stage the whole tender shoot, flower bud and flowers will be covered with these aphids.

What You Can Do

- Installing yellow sticky traps for early detection of aphids.
- Encourage the activity of predatory Coccinellid beetles like *Brumoidessuturalis*, *Cheilomenessexmaculata*, *Coccinellaseptempunctata*, *Coccinellaundecimpunctata*, *Cryptolaemusmontrouzieri* and parasitoids like *Aphelinusmali*, *Aphidiuscolemani*
- Apply 1.0 % neem oil or pongamia oil at weekly interval when infestation starts
- Under severe infestation spray with dimethoate 30EC @ 2.00 ml/l or profenofos 50EC @ 1.5 ml/l or acephate 75SP @ 1.0g/l



China Aster



Bud Borer (*Helicoverpa armigera*)

What Causes It

- Larvae feedings

What It Looks Like

- Yellowish-white eggs on the growing shoot or flower bud.
- Larvae vary from bluish green to brownish red
- Females are orange-brown and males yellowish-brown, light yellow or light brown.
- The larvae feed on the flower bud by making a large hole and excreta of larvae seen in damaged parts

What You Can Do

- A spray with imidacloprid 17.8 EC @ 0.4 ml/l will reduce the thrips infestation.
- Corm treatment with imidacloprid 17.8 EC @ 1.0 ml/l will kill any thrips on corms.

China Aster



Cutworm (*Spodoptera litura*)

What Causes It

- Larvae of Spodoptera

What It Looks Like

- Eggs laid in groups of 100 – 150 eggs and the egg mass is covered by tuft of hairs
- Early instars gregarious, feeds by scraping the leaves, affected leaves looks skeletonized.
- Brown coloured mature larvae damage growing buds and flowers during nights

What You Can Do

- Installation of pheromone trap for monitoring the activity of adults.
- Collect and destroy egg masses and gregarious early instar larvae.
- Application of SINPV@ 250 LE/ha followed by spray with any neem formulations at 1.0 – 2.0 ml/l.
- Spray indoxacarb 14.5 SC @ 1.0 ml/l or thiodicarb 75 WP @ 1.0 g/l, if the incidence is severe.



China Aster



Two-spotted Spider Mite (*Tetranychus urticae*)

What Causes It

- Nymphs and adults feed on the plant

What It Looks Like

- Nymphs and adults normally found on under surface of leaves.
- They live in silken webbing which provides protection to these mites.
- Feeding leads to discoloration of leaves, white specks on leaves and drying of leaves.
- Growth of the plant and flower production is severely affected.

What You Can Do

- Remove and destroy infested plant parts.
- Thorough spray of water on the plant dislodges the mites from their webs followed by spraying dicofol 18.5 EC @ 1.5 ml/l or wettable sulphur 80 WP @ 3.0 g/l.

Crossandra



Whitefly (*Bemisia tabaci*)

What Causes It

- Plant become weak due to continuous sucking of plant sap.

What It Looks Like

- These whiteflies occur in large number on the under surface of leaves.
- The nymphs are light yellowish colored.
- Heavy infestation leads to chlorosis of plants and development of sooty mold on honey dew secreted by the nymphs.

What You Can Do

- Removal and burning of heavily infested leaves checks pest build up.
- Clean cultivation and use of insect proof nets
- Install yellow sticky traps to monitor adult flies activities.
- Spray of *Beauveria bassiana* or *Verticillium lecanii* formulations @ 2.0 ml/l.
- If the activity of adults is more, spray with dichlorvos 76 EC @ 1.0 ml/l followed by lambda cyhalothrin 5 EC @ 1.0 ml/l or deltamethrin 2.8 EC @ 1.0 ml/l at 5 – 7 days interval.



Crossandra



Aphids (*Aphis gossypii* and *Aphis craccivora*)

What Causes It

- Insects suck plant sap

What It Looks Like

- Small to medium sized dark green to almost black colored aphids.
- Nymphs are light green colored mottled with dark green bands.
- These aphids are often associated with ants.
- At early stage they appear on tender shoots and new flush.
- At later stage the whole tender shoot, flower bud and flowers will be covered with these aphids.

What You Can Do

- Installing yellow sticky traps for early detection of aphids.
- Apply neem oil (1.0%) at weekly interval when infestation starts on the plant.
- Under severe infestation spray with dimethoate 30EC @ 2.00 ml/l or profenofos 50EC @ 1.5 ml/l or dichlorvos 76EC @ 1.00 ml/l

Gladiolus



Gladiolus Thrips (*Thrips simplex*)

What Causes It

- Adult and nymphs suck plant sap.

What It Looks Like

- Adult thrips are small, narrow, brownish-black insects and nymphs light yellow
- In severe infestation at early stage, the plants fail to produce flower spike.
- White flecks on foliage and flowers of gladiolus.
- Deformities and discoloration on corms, which become soft and are prone to decay.

What You Can Do

- A spray with imidacloprid 17.8 EC @ 0.4 ml/l will reduce the thrips infestation.
- Corm treatment with imidacloprid 17.8 EC @ 1.0 ml/l will kill any thrips on corms.



Gladiolus



Bud Borer (*Helicoverpa armigera*)

What Causes It

- Larvae vigorously feed on the flower buds

What It Looks Like

- Yellowish-white eggs on the growing shoot or flower bud.
- Larvae vary from bluish green to brownish red
- Females are orange-brown and males yellowish-brown, light yellow or light brown.
- The larvae feed on the flower bud by making a large hole and excreta of larvae seen in damaged parts

What You Can Do

- A spray with imidacloprid 17.8 EC @ 0.4 ml/l will reduce the thrips infestation.
- Corm treatment with imidacloprid 17.8 EC @ 1.0 ml/l will kill any thrips on corms.

Gladiolus

Cutworm (*Spodoptera litura*)



Egg mass



Larvae

What Causes It

- Larvae of *Spodoptera*

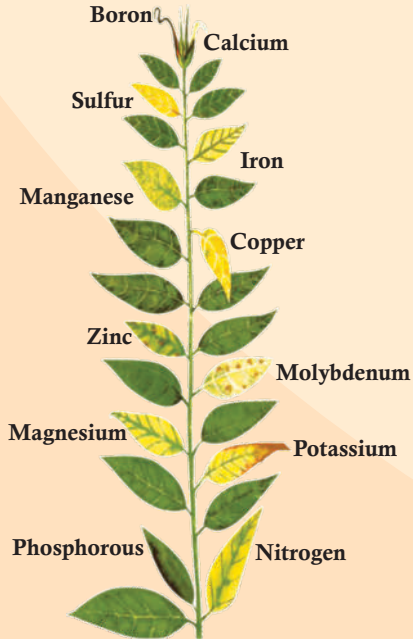
What It Looks Like

- Eggs laid in groups of 100 – 150 eggs and the egg mass is covered by tuft of hairs
- Early instars gregarious, feeds by scraping the leaves, affected leaves looks skeletonized.
- Brown coloured mature larvae damage growing buds and flowers during nights

What You Can Do

- Installation of pheromone trap for monitoring the activity of adults.
- Collect and destroy egg masses and gregarious early instar larvae.
- Application of SINPV @ 250 LE/ha followed by spray with any neem formulations at 1.0 – 2.0 ml/l.
- Spray indoxacarb 14.5 SC @ 1.0 ml/l or thiodicarb 75 WP @ 1.0 g/l, if the incidence is severe.

Nutrient Deficiency in Flower Crops



(Source: hortipray.com/page/nutrient-deficiency-in-plants)

Sixteen elements; carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, molybdenum, and chlorine are considered to be essential for plant growth and metabolism. The absence or excess of these elements results in abnormalities in the plants. To assess the deficiency or excess of these elements, three diagnostic tests can be used— soil testing, foliar analysis and visual diagnosis. Visual diagnosis is based on the symptoms developing on the plant due to various nutrient imbalances. Symptoms of deficiency of mobile nutrients like nitrogen, phosphorus, potassium and magnesium, appear in older tissue at the base of the plant while that of non-mobile nutrients calcium, iron, manganese, zinc, copper and boron, generally appear first at the top of the plant in young tissue. Symptoms of sulfur a semi-mobile nutrient appear across the whole plant, like uniform chlorosis of all leaves. A number of nutritional disorder symptoms also can be the symptoms of other causal agents, such as air pollution, pesticide damage, herbicides in or near the crop area, plant growth regulators and pathogenic diseases, particularly viruses and environmental extremes.



Nitrogen deficiency



Where to look for

- Due to high mobility in plants, nitrogen deficiency symptoms first appear on older leaves in the form of yellow discoloration.

What It Looks Like

- Nitrogen deficiency is characterized by poor plant growth rate, uniform chlorosis of older leaves.
- Necrosis of leaves occurs at a rather later stage under severe deficiency.

What You Can Do

- Foliar spray of urea at 10 g/L (1%) at fortnightly intervals till the symptoms disappear

Phosphorous deficiency



Where to look for

- Symptoms of phosphorous deficiency first appear on older leaves.

What It Looks Like

- Phosphorous deficiency, being associated with the accumulation of carbohydrates, results in production of dark green colored leaves.
- Severe restriction occurs in the growth of plant top & roots.
- Under conditions of continued deficiency, older leaves develop reddish purple coloration due to formation of anthocyanins.

What You Can Do

- Foliar spray of DAP 10 g/L (1%) twice at fortnightly interval



Potassium deficiency



Where to look for

- Symptoms of potassium deficiency first appear on older leaves.

What It Looks Like

- Chlorosis along the leaf margins is followed by scorching and browning of tips.
- Plants lodge rather easily because lignification of the vascular bundles is impaired by potassium deficiency.
- Plants become susceptible to drought, pest/disease attack.
- Potassium deficient seeds and fruits are shriveled.

What You Can Do

- 5 g of potassium chloride / L of water at 10 days intervals or Feeding with potassium sulphate @ 1.25 g/L (5 application) corrects the deficiency.

Calcium deficiency



Where to look for

- Symptoms of calcium deficiency first appear on growing tips.

What It Looks Like

- Top leaves turn chlorotic and bent down at margins.
- Roots will become short, densely branched & thick and death of roots occurs.
- Growing points usually damaged or dead (die back). Incomplete flower formation and opening of flowers will delay.

What You Can Do

- Calcium chloride at 5 g/L or Calcium nitrate at 5g/L as foliar spray at 10 days intervals.



Magnesium deficiency



Where to look for

- Deficiency symptom always appears first on older leaves.

What It Looks Like

- Interveinal chlorosis on older leaves, defoliation of the lower leaves at the advanced stage.

What You Can Do

- Foliar spray of magnesium sulphate 10 g/L (1%)

Sulphur deficiency



Where to look for

- Symptoms of sulphur deficiency first appear on younger leaves.

What It Looks Like

- Symptoms usually observed first on younger leaves as yellowing.
- Leaf tip remains green and with severe deficiency the whole leaf turns yellow and plant growth is stunted.

What You Can Do

- Foliar spray of calcium sulphate at 10 g/L (1%)



Iron deficiency



Where to look for

- Symptoms of iron deficiency first appear on young leaves.

What It Looks Like

- Younger Leaves become thin with interveinal chlorosis.
- Later the leaves become pale green color.
- Older leaves remain green.

What You Can Do

- Foliar spray of ferrous sulphate at 5g/L (0.5%)

Zinc deficiency



Where to look for

- Symptoms of zinc deficiency first appear on older leaves.

What It Looks Like

- Leaves reduced in size and misshapen causing rosetting or “little leaf.”
- Chlorosis (leaf mottling) of leaves leading to necrosis and premature leaf fall.

What You Can Do

- Foliar spray of zinc sulphate at 5g/L (0.5%).



Copper deficiency



Where to look for

- Symptoms of copper deficiency first appear on younger leaves.

What It Looks Like

- Reduced plant growth, malformed and shriveled leaves with bushy growth and necrosis of the apical meristem.

What You Can Do

- Foliar spray of copper sulphate at 2.5g/L (0.25%) at 15 days interval

Manganese deficiency



Where to look for

- Symptoms of manganese deficiency first appear on younger leaves.

What It Looks Like

- Interveinal chlorosis of leaves. Leaves show yellowish green background with fine nature of green veins. Leaves become thicker.

What You Can Do

- Foliar spray of manganese sulphate at 5g/L (0.5%) at 15 days interval



Boron deficiency



Where to look for

- Symptoms of boron deficiency appears on younger leaves.

What It Looks Like

- Death of the growing points, flower drying and flower drop, newly emerging leaves are malformed and plants show stunted growth.

What You Can Do

- Foliar spray of borax at 2g/L (0.2 %)

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भाकृअनुप-पुष्पविज्ञान अनुसंधान निदेशालय
ICAR-Directorate of Floricultural Research

कृषि महाविद्यालय परिसर, शिवाजीनगर, पुणे-411005, महाराष्ट्र, भारत
College of Agriculture Campus, Shivajinagar, Pune-411005, Maharashtra

Phone: 020-25537024, 25537025

E-mail: director.dfr@icar.gov.in, directordfr@gmail.com Website: <http://dfr.icar.gov.in>

