

# Field Identification and Management of Major Diseases of the Major Crops

## Plant Pathology Handbook

Naod Betesilassie  
and  
Melaku Degefu



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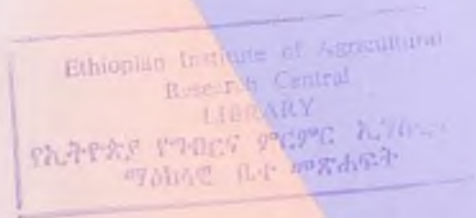
## Acknowledgment

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## Preface

This handbook is prepared with the objective of giving quick reference and field guide for peoples involved in plant pathology activities. The handbook has one section that deals with major diseases of major crops. Introductory notes on the general principles and practices of disease management options are given in brief. Glossary and appendices are also provided to give additional information on related issues.

Although this is an effort to summarize broader concepts and facts in few pages, maximum care has been taken not to miss relevant information. In order to make the handbook user friendly, we have tried to use simple English and avoid technical jargons. For any question or additional technical assistance the authors can be contacted with the addresses given on the last page of the hand book.

Technical handbooks are one means of transferring agricultural technologies to the end users. Hence, the authors believe that this handbook could play an important role in strengthening research-extension linkage in general and in upgrading the practical efficiency of professionals in particular.

Naod B. & Melaku D.

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## KARC profile

Kulumsa Agricultural Research Center (KARC) is located 167km of south-east of Addis Ababa, and 8 km north of Asella town, in Arsi zone. It is found at latitude of 8°01' N and a longitude of 39°10' E and at an altitude of 2200masl. KARC was established in 1996 through a bilateral agreement between the government of Ethiopia and the Swedish International Development Agency (SIDA). KARC was transferred to Institute of Agricultural Research (IAR) in 1987 to become the national wheat improvement center.

**Vision:** is To see more and more farmers use research technologies and change Arsi zone to a food self-sufficient region of the country.

**Mission:** To generate demand driven and target oriented agricultural technologies with relevant packages for all agro-ecologies found in Arsi zone, through need-based, participatory research approaches, and through creative, dedicated and committed research projects to change the livelihood of Arsi farmers in particular and Ethiopian farmers at large.

**Mandates:**

1. To increase production and productivity of the farmers through comprehensive research and generation of technologies on field, horticultural and forage crops.
2. To generate improved and sustainable agronomic practices.
3. To coordinate research projects.
4. To produce sufficient amount of pre-basic and basic seeds.
5. To generate and provide information on resources and production potential of the farming system, analyze the level of technology adoption and socio-economic, agricultural support services and policy constraints limiting the production and productivity of agriculture.
6. To improve research-extension-farmer linkage.

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## ESTA Profile

The Ethiopia Science and Technology Agency (ESTA) is a governmental institution established in December 1975 by Proclamation No. 62/1975. Following the change in government in 1991 and with the issuance of the new economic policy, the Agency was reestablished in March 1994 by proclamation No. 91/94. The Agency went into its 3rd phase of re-institution on the 24th of August 1995 by Proclamation No. 7/1995, following the establishment of the Federal Democratic Republic of Ethiopia. The agency is accountable to the Office of the Prime Minister.

### Vision

To see the living standard of the people improved through the application of science and technology for sustainable social and economic development.

### Mission

To build capacity for an efficient, effective and sustainable national S&T system through guidance, coordination and support to national S&T activities that would enhance the socio-economic development of the country.

### Objectives

- Encourage, enhance and support Science and Technology activities that enable realization of the country's socio-economic development objectives.
- Build-up national capability to enhance science and technology.
- Improve and enrich the peoples awareness, knowledge and culture of science and technology and the tradition of utilizing the results of Science and Technology
- Make the Science and Technology system more productive, efficient and development oriented.

### Structure and Collaboration

The Agency is headed by a Director General appointed by the Government. The highest policy body of the Commission is the National Science and Technology Council. The council is composed

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of representatives drawn from relevant ministries. Three Prominent scientists designated by the then Commission are also members.

Under the aegis of the Agency, scientific and technological service organizations such as the Ethiopian Intellectual Property Office, National Radiation Protection Authority and National Scientific Equipment Center are established to render services to the national science and technology system and the development sectors.

In addition, demand driven and problem oriented projects namely; the Southern Tsetse Eradication Project and the Ethiopian Cleaner Production Center are established under the Agency to promote appropriate technology and /or efficient Production Processes and techniques.

The Agency has established productive-working relations with national and international institutions engaged, in the fields of science technology development and has made significant contribution to the national S&T capacity and capability development efforts of the country.



## 1.1 Diseases and their management options

**Diseases** are caused by living or non living factors, when a disease is caused by living factors such as fungi, bacteria, virus, nematode, parasitic weed etc... it is called **infectious or transmittable disease** When a disease is caused by non living or environmental factors such as nutrient deficiency, chemical toxicity, high soil moisture, high temperature, frost, etc..., the disease is called **non-infectious or non-transmittable**

Micro organisms that cause diseases are called **pathogens**. They infect different parts of a plant. Some infect above ground parts of a plant such as leaves, stems, flowers or fruits, while some infect below ground parts such as roots, tubers. When a plant is infected with a pathogen, it shows physical or chemical changes. Any visible abnormal change on an infected plant is called **Symptoms**. Symptoms could be a color change or malformation of tissues. **Every disease has its own unique Symptoms** hence Symptoms are used to identify which pathogen has infected the plant.

For a disease to occur three conditions have to be fulfilled at the same time. This is commonly known as **disease triangle**

1. A virulent pathogen should be present
2. A plant should be susceptible
3. The environment should be suitable

If one of the three appears late, or early or missing, the **disease will not occur**. Therefore, any practice which disturbs any of the three conditions or break the triangle will be considered as a **disease management method**.

Susceptible  
plant

The choice of management method will depend on the nature of the pathogen, the plant and the growing environments. The objective of the methods could be i) Preventive: protecting the entrance of the pathogen into a plant tissue ii) Inoculum reduction: reducing the amount or number of pathogen infesting a plant iii) Host protection: protecting an exposed plant parts from the pathogens iv) Pathogen eradication: destroying the pathogen or its inoculum v) Adjustment of environments: make the environment less suitable for a disease to occur vi) Increasing plant resistance: breeding resistance /tolerance plants.

In general, disease management methods can be grouped as follows:

1. Regulatory: Quarantine measures.
2. Cultural: Crop rotation, early or late planting, intercropping, weeding, destruction of alternate hosts, mixed cropping, use of trap crops, proper spacing, using disease free seeds.
3. Biological: Use of parasites and predators to kill pathogens
4. Physical or mechanical: Treating seeds, plant parts or soils with heat or sun light.
5. Chemical: Use of fungicides
6. Resistant varieties: Use of varieties with good disease resistance
7. Integrated method: Using a combination of the above two or more methods to control diseases effectively and efficiently.

## 1.2 Diseases of Cereal Crops

### Yellow rust (*Puccinia striiformis f.sp. tritici* Westend)

Hosts: Wheat, barley and other grasses

Pathogen: Fungi

Infected plant parts: Leaves and spikes

Symptoms: Spores develop in narrow, yellow stripes mainly on leaves and spikelets. When the heads are infected, pustules appear in the inner surface of glumes and lemmas, occasionally invading the developing kernels. The uridiospores are yellow to orange in color.

Source of inoculum: Infected hosts

Dispersal: Wind-borne

Management options: Resistant varieties, fungicides

### Stem rust (*Puccinia graminis f.sp. tritici* Eriks. and Henn)

Hosts: Wheat, barley and other grasses

Pathogen: Fungi

Infected plant parts: Stems, leaves and spikes

Symptoms: Symptoms commonly appear on the stem and leafsheath, but leaf blade and spikes may also become infected. When pustules rupture a mass of reddish brown spores is exposed. Spores appear on both lower and upper sides of the leaves.

Source of inoculum: Infected hosts

Dispersal: Wind-borne

Management options: Resistant varieties, fungicides

### Yellow rust of Wheat



A



B

A= Infected leaf

B=Infected spike

### Stem rust of wheat



Infected stem and leaves of wheat

### Leaf rust ( *Puccinia triticina* f.sp.tritici)

Hosts: Wheat, barley and other grasses

Pathogen: Fungi

Infected plant part: Stem, leaves and spikes

Symptoms: Leaf rust appears as small, oval shaped dark red pustules, scattered on leaf sheaths and the upper surface of leaf blades. The spores are orange red to dark.

Source of inoculum: Infected hosts

Dispersal: Wind-borne

Management options: Resistant varieties, fungicides

### Septoria leaf blotch (*Mycosphaerella graminicola*/ (*Septoria tritici*))

Hosts: Wheat and rye

Pathogen: Fungi

Infected plant parts: Leaf

Symptoms: Brown elongated necrotic lesions with irregular margins appear on the leaves. Black fruiting bodies (Pycnidia) of the fungus appears as tiny black spots dispersed on the surface of the lesions. The Pycnidia are more evident in the morning following heavy dew or after rain, the Symptoms appear first on lower leaves and move upward.

Source of inoculum: Infected crop debris

Dispersal: Rain splash

Management options: Resistance varieties, crop rotation, plant seed in wider row spacing, fungicides.

## Leaf rust of wheat



Wheat leaf covered by leaf rust pustules

## Septoria leaf blotch



A



B

A=Infected leaves

B=Pycnidia on infected leaf

### **Take-All** (*Gaeumannomyces graminis f.sp.tritici*)

**Hosts:** Wheat, Triticale and several related grasses

**Pathogen:** Fungi

**Infected plant parts:** Roots and lower stems

**Symptoms:** The fungus causes rotting of the roots and lower stem, and leaf sheath tissue. It may turn a shiny black color. Severe disease development is indicated by stunted plant growth and white heads (spikes). Finally crops lodge easily and break at the point of infection.

**Source of inoculum:** Infected crop debris

**Dispersal:** Rain splash

**Management options:** Crop rotation, minimum tillage, resistant varieties

### **Eye spot** (*Pseudocercospora herpotrichoides* (Fron)

**Hosts:** Wheat, barley, rye, oats and other cereals and grasses

**Pathogen:** Fungi

**Infected plant part:** Lower stem

**Symptoms:** Initially, Symptoms appear as diffuse brown areas on the lower leaf sheaths. Later, ellipsoid eyespots develop on the stem. As the fungus penetrates the stem, it forms an eye-shaped lesion with black dots. Severe infection of the stem causes crop lodging in all directions. Spikes ripen prematurely producing 'white heads' containing shriveled grains like Take-All.

**Source of inoculum:** Infected crop debris

**Dispersal:** Rain splash

**Management options:** Crop rotation, minimum tillage, resistant varieties

## Take-All



A= Infected culms and roots



B= White head and damaged roots

## Eye spot



A= Infected culms



B= Different stages of eye spot infection



### **Scald** (*Rhynchosporium secalis* (Oudem.) Davis)

Hosts: Barley, oats, rye and wheat

Pathogen: Fungi

Infected plant parts: Leaf and spikes.

Symptoms: Pale gray water soaked lesions that develop into brown irregular shaped areas on the leaf. As infection advances, the centers of lesions dry out and bleach, becoming light gray or white while the edges are dark brown.

Source of inoculum: Infected crop debris, infected seeds

Dispersal: Wind and rain splash

Management options: Resistant varieties, clean seeds, crop rotation, remove volunteer plants, improve plant nutrition, fungicides.

### **Net blotch** (*Pyrenopeziza teres* Drechsler)

Hosts: Barely, oats, wheat, maize

Pathogen: Fungi

Infected plant part: Leaves, inflorescence, and seeds

Symptoms: It has two forms. Net and Spot form. Initially, lesion appears as small tiny dark brown spots. Then, it expands to form brown streak that produce the characteristic of netted appearance. Strips with irregular margins may extend to the length of the leaf. As the disease progresses on the plant a gradient of symptoms is observed from lower to upper leaves.

Source of inoculum: Infected crop debris and infected seeds

Dispersal: and rain splash

Management options: Resistant varieties, clean seeds, crop rotation, remove volunteer plants, improve plant nutrition, fungicides.

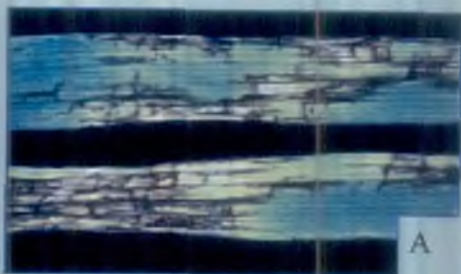
## Scald



A=Infected Leaf (see dark brown edge and white center)

B = Infected leaves and spikes

## Net blotch



A= Net form on leaves



B = Spot form on leaves

## **Barley leaf rust (*Puccinia hordii*)**

**Hosts:** Barley and close relatives

**Pathogen:** Fungi

**Infected plant parts:** leaves and leaf sheath

**Symptoms:** Small round light orange pustules are formed on leaves. As the crop matures the pustules turn black. They contain spores that are embedded in the old leaf blade and sheath tissues.

**Source of inoculum:** Infected hosts

**Dispersal:** Wind-borne

**Management options:** Use of resistant varieties and variety mixture.

## **Barley yellow dwarf virus (Barley yellow dwarf viruses)**

**Hosts:** Barley, maize, oats, rice, rye and wheat

**Pathogen:** Virus

**Infected plant parts:** Whole plant, and leaves

**Symptoms:** Bright yellowing or reddening of the leaves starting from the tip and developing towards the base. Stunting, excessive tillering, white sterile spikes and the presence of aphids are commonly observed features.

**Source of inoculum:** Infected hosts

**Dispersal:** Aphids

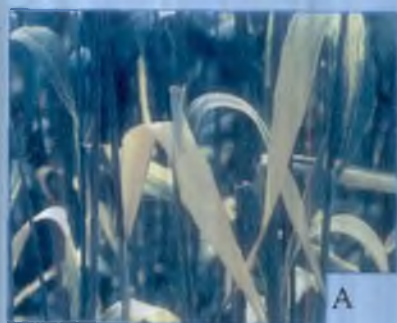
**Management options:** Resistance varieties, control of aphids.

## Barley leaf rust



A=Small light orange pustules on Resistant variety  
B = Pustules on a susceptible variety

## Barley yellow dwarf virus



A=Infected leaves

B = Infected seedlings

### **Covered smut** (*Ustilago hordei* (Pers.) Lagerh)

Hosts: Barley, oats, rye and wheat

Pathogen: Fungi

Infected plant parts: Head (spike) and leaves

Symptoms: First observed at spike emergence. Infected plant is usually shorter than the normal ones. Black spores that replace the barley kernels are covered by thin membrane. The membrane is easily broken at maturity and during threshing.

Source of inoculum: Infected seeds and soil

Dispersal: Seed borne and soil borne

Management options: Use of clean seeds, resistant varieties, roguing smutted spikes and bury or burn.

### **Loose smut** (*Ustilago nuda* (Schaffnit))

Hosts: Barley and wheat

Pathogen: Fungi

Infected plant part: Head (spike)

Symptoms: The symptom is visible at flowering and become clear at heading. Infected barley plants flower early and are usually taller than healthy ones. Diseased spikes (head) show a mass of dark brown powdery spores. Initially, the spores are protected by tiny thin membrane, which rupture after few days.

Source of inoculum: Infected seed and soil

Dispersal: Seed borne and soil borne

Management options: Use of clean seeds, resistant varieties, rogue smutted spikes, hot water and chemical treatment of seeds.

### Covered smut



A= Infected Barley

B = Infected Oat

### Loose smut



A=Infected Wheat

B = Infected Oat

C=Infected Barley

## **Ergot** (*Claviceps purpurea*)

**Hosts:** Oats, barley, lolium, rye, sorghum, wheat, millets and brome grass.

**Pathogen:** Fungi

**Infected plant parts:** Spikelets and seeds

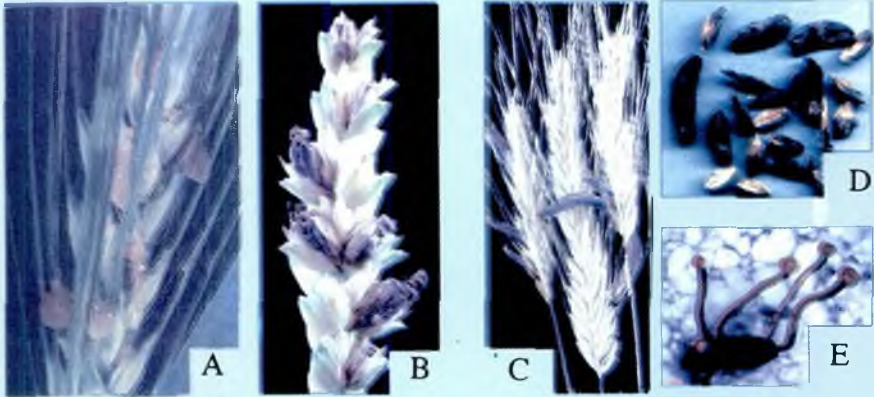
**Symptoms:** At flowering, yellowish sticky exudates appear on infected spikelets. As the plant matures, elongated, straight or curved, purplish-black bodies emerge from the glumes.

**Source of inoculum:** Infected soil surface and crop debris or hosts.

**Dispersal:** Soil borne, Seed borne

**Management options:** Use of healthy seeds, deep ploughing, stubble burning, resistant varieties, crop rotation.

### **Ergot**



**A=Infected s pike with yellow sticky exudates**

**B & C=Purple black sclerotium**

**D=Infected seeds  
E=Germinating sclerotium on the soil surface**

### Gray leaf spot of maize (*Cercospora zeae-maydis*)

Hosts: Maize

Pathogen: Fungi

Infected plant parts: leaves, stems, husks, and seeds

Symptoms: First, small sized spots or lesions surrounded by a yellow halo are observed on the lower leaves. These lesions become irregular or extended pale-brown streaks and run parallel with leaf veins. Further lesion expansion results in coalescing of lesions and blighting of entire leaves. With severe blighting, stalk deterioration and severe lodging may occur. Lesions are also found on both stalks and leaf husks, but are not as clearly defined as on leaf tissue.

Source of inoculum: Infected crop debris

Dispersal: Wind-borne

Management options: Resistant varieties, crop rotation, field sanitation, fungicides.

### Maize rust (*Puccinia sorghi* Schwein)

Hosts: Maize

Pathogen: Fungi

Infected plant part: Leaves, stems

Symptoms: Initially, small chlorotic areas are formed on infected plant part. Later, as pustules grow, epidermis split open and expose masses of powdery spores. The appearance of golden-brown to cinnamon-brown colored pustules on any above-ground plant part including leaves, husks, tassels and stalks is its typical Symptoms. Pustules appear on both upper and lower leaf surfaces in equal frequency. Late in the season, the pustules become blackish brown as teliospores produced.

Source of inoculum: Accessory hosts (*Oxalis Spp*), infected crop debris.

Dispersal: Wind borne

Management options: Resistant varieties and fungicides



## Gray leaf spot of maize



A

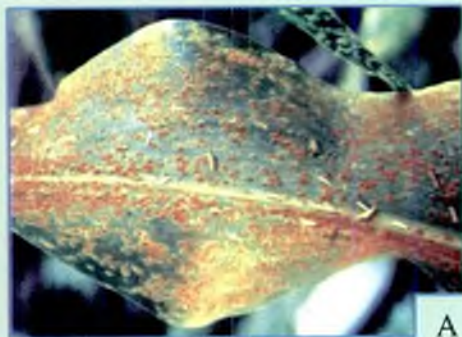
*A= Infected maize leaves*



B

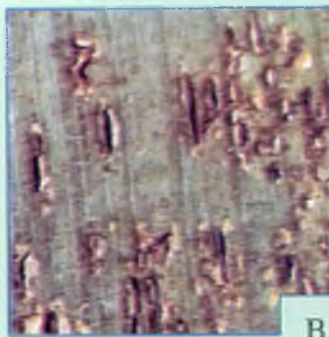
*B= Infected field*

## Maize rust



A

*A= Infected leaf*



B

*B= Pustules containing spores*

### **Leaf blight** (*Helminthosporium turcicum*/ *Setosphaeria turcica*)

Hosts: Maize and sorghum

Pathogen: Fungi

Infected plant parts: Leaves, husks and tassels

Symptoms: Appears as typically as long elliptical or lens shaped lesions which are at first water soaked and then run grayish green and tan. They may be up to 15cm or more in length and extended into the sheaths. They begin on the lower leaves and progress up the plant and coalesce under severe conditions leading to death of the leaves and frost-injured appearance.

Source of inoculum: Infected crops and debris

Dispersal: Wind borne

Management options: Crop rotation, field sanitation, resistant varieties, fungicides.

### **Eye spot** (*Kabatiella zeae* Narita & Hirats)

Hosts: Maize

Pathogen: Fungi

Infected plant part: Leaves

Symptoms: small round, translucent lesions with tan colored centers develop on the leaf. The spot is surrounded by black to purple rings, with a yellow halo around them, thus producing the characteristic eyespot.

Source of inoculum: crop debris, infected seed

Dispersal: wind borne, rain splash

Management options: Resistant varieties, crop rotation

## Leaf blight

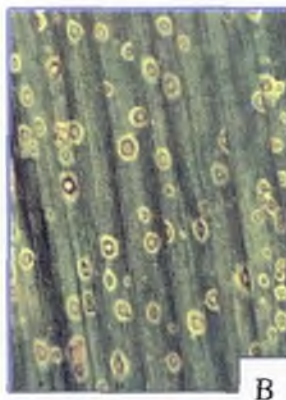


A= Long lesions on Infected leaf

## Eye spot



A= Infected leaf early stage



B= Eye spots on the leaf

## 1.3 Diseases of Pulse Crops

### Ascochyta blight of faba bean (*Ascochyta fabae* Speg)

Hosts: Faba bean

Pathogen: Fungi.

Infected plant parts: Leaves, stems, pods and seed.

Symptoms: Initially, lesions on the leaves are usually slightly sunken with a light brown to dark gray center surrounded by circular, dark brown chocolate colored margin. As the spots enlarge they become more irregular in shape and coalesce to cover larger areas of the leaf. Prominent dark pycnidia develop within the lesions. The lesions on the stem are usually smaller at the early stages of infection but they elongate up the stem and become markedly sunken

Source of inoculum: Infected seed & plant debris

Dispersal: Rain splash, wind borne

Management options: Resistant varieties, crop rotation, fungicides, seed treatment

### Black root rot (*Fusarium solani*)

Hosts: Faba bean

Pathogen: Fungi =

Infected plant parts: Stems and roots

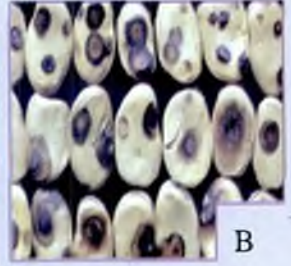
Symptoms: Initially, elongated reddish to purple lesions are produced on roots and stem tissues. Later, lesions will be changed to black color and merge to form large black area on hypocotyls. When severe, it covers the taproot and the stem below the soil line with out definite margin.

Source of inoculum: Infected crop debris

Dispersal: Air borne, irrigation, cultivation equipments

Management options: Crop rotation, uses of well drained seedbed, resistant varieties, seed treatment, fungicides.

## Ascochyta blight



A= Infected leaves, stem and pods

B= Infected seed

## Black root rot



A= Infected hypocotyls

B= Infected stems and roots

C= Infected plant

## **Chocolate spot** (*Bofrytis fabae* Sardina)

Hosts: Faba bean, field pea, lentil and soybean.

Pathogen: Fungi

Infected plant parts: Leaves, stems, flowers and pods

Symptoms: On leaves, Symptoms vary from small reddish brown dots to circular spots with reddish brown margin and tan centers. Stem lesions are usually reddish and may extend in streaks for several centimeters. Under optimum conditions lesions expand more rapidly and merge until the entire leaf surface is blackened and destroyed.

Source of inoculum: Infected soil or crop debris

Dispersal: Wind borne

Management options: Resistant varieties, crop rotation, plowing or burning crop debris, lower plant densities, early planting, fungicides.

## **Faba bean rust** (*Uromyces viciae fabae* (Pers.) J. Schrot.)

Hosts: Faba bean, field pea, lentil, lathyrus

Pathogen: Fungi

plant part infected: Leaves

Symptoms: Infection first appears as minute slightly raised, white to cream-colored spots on leaves. As spots enlarge the epidermis ruptures releasing masses of dark brown spores to form characteristic pustules. Severely infected leaves rapidly dry up and premature defoliation may occur.

Source of inoculum: Crop debris

Dispersal: Wind-borne

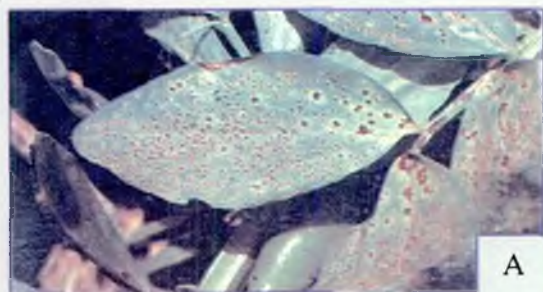
Management options: Resistant varieties, early planting, fungicides

## Chocolate spot

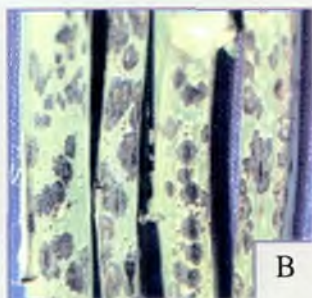


Chocolate spots on leaves

## Faba bean rust



*A= Infected leaves*



*B= Rust pustules on stems*

### **Powdery mildew** (*Erysiphe pisi* DC.var. *pisi*)

**Hosts:** Field pea, groundnut, lentil, faba bean and lupines

**Pathogen:** Fungi

**Infected plant parts:** Leaves, stems and pods

**Symptoms:** Whitish mycelium over the leaves, stems and fruits that is visible to the naked eye even from a distance. There may be some deformation of leaves, stems and fruits. There may also be some necrosis or premature leaf fall.

**Source of inoculum:** Infected seed and infected crop debris.

**Dispersal:** Seed borne, wind borne

**Management options:** Resistant varieties, fungicides

### **Ascochyta blight of field pea** (*Ascochyta pisi* lib)

**Hosts:** Field peas, lathyrus and vicia (Vetch)

**Pathogen:** Fungi

**Infected plant part:** Leaf, stem and Pod

**Symptoms:** Lesions are slightly sunken tan colored and surrounded by a distinct dark boarder. Spots are circular or irregular, dark brown and scattered on leaves and pods. Lesions appear purplish-black discoloration on stems usually having numerous pycnidia on the lesions

**Source of inoculum:** Infected debris and soil, infected seed

**Dispersal:** Irrigation, wind borne, rain splash

**Management options:** Avoid crop debris, volunteer hosts, crop rotation, disease free seeds and resistance varieties



## Powdery mildew



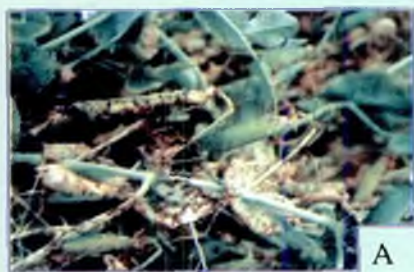
A



B

A= White fungal growth on leaves and pods  
B= Mildew on pod

## Ascochyta blight



A



B

A= Dark brown lesions on leaves

B= Infected stems

### **Chickpea wilt** (*Fusarium oxysporum* f.sp. *cicens* f. Padwick)

Hosts: Chickpea, pigeon pea and lentil.

Pathogen: Fungi

Infected plant parts: Whole plant and leaves

Symptoms: Chickpea foliage develops a grayish-green chlorosis, typically affecting lower leaves first and extending up the plant. Leaves eventually take on a dull-yellow colour, wilt and the plant collapses and dies. In some cases there may be leaf vein clearing before wilt begins.

Source of inoculum: Infected soil and crop debris

Dispersal: Rain splash and irrigation

Management options: Resistant varieties, fungicide and avoiding very early planting.

### **Ascochyta blight of chickpea** *Ascochyta rabiei* / *Didymella rabiei*

Host: Chickpea

Pathogen: Fungi

Infected plant parts: Whole plant, leaves, stems, pods and seeds.

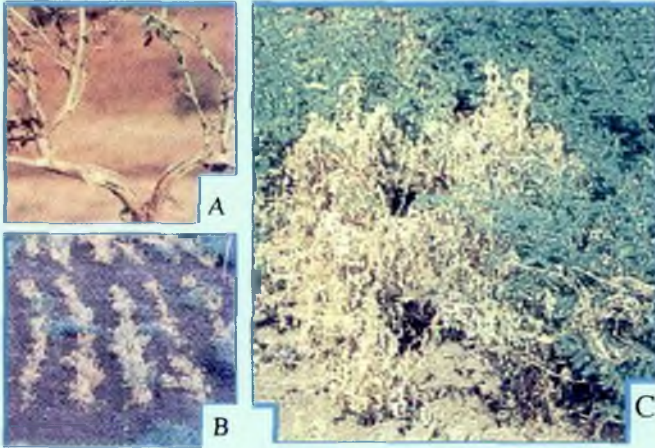
Symptoms: Disease in the field is often seen as patches of dead blighted plants. Circular, initially dark-brown, necrotic lesions appear on leaflets extending to a general blighting of the foliage under cool wet conditions. Older lesions develop a gray center in which dark pynidia of the pathogen may be seen, often arranged in concentric rings in older lesions. Lesions on stems are elongated or oval. They frequently girdle the stem causing a wilting and dieback of leaves and stems.

Source of inoculum: Infected crop debris, seeds and soil

Dispersal: Wind borne and irrigation.

Management options: Resistant varieties, rotation, deep ploughing, seed dressing with chemicals and fungicide.

## Chickpea wilt



A= Infected stems

B= Infected plot

C= Infected

## Ascochyta blight of chickpea



A= Infected leaves B= Infected stem

C= Infected seeds

## **Anthracnose**

(*Colletotrichum andemuthianum* Sacc. Magnus)

Host range: Haricot bean

Pathogen: Fungi =

Infected plant part: Leaves

Symptoms: First Symptoms appear on cotyledonary leaves, leaf petioles, and lower surface of leaves or leaf vein as small, dark brown to black spots or slightly sunken lesions. The lesions gradually enlarge longitudinally and form sunken lesions or eyespots.

Source of inoculum: ?

Dispersal: wind, rain splash

Management Options: Disease free seeds, crop rotation, removal of infected plant debris, resistant varieties and seed treatment with chemicals.

## **Ascochyta blight of Haricot bean**

(*Phoma exigula* / *Ascochyta phaseolorum*)

Host range: Haricot bean

Pathogen: Fungi

Infected plant part: Leaves, stems and pods

Symptoms: First, dark gray to black spots appear on leaves and latter become concentric ringed. When severe, they infect stem and nods become blackened. Premature defoliation of leaves and girdling of stem causes plant death.

Source of inoculum: Infected seed and crop residue

Dispersal: Soil borne

Management Options: Disease free seeds, field sanitation, seed dressing, resistant varieties.

## Anthracnose



A= Infected pod



B= Infected seedling stems

## Ascochyta blight



A= concentric rings on infected leaf



B= Infected Pods

## 1.4 Diseases of Oil Crops

### White rust (*Albugo candida* (Pers.) Kuntz)

**Hosts:** Rape seed, mustard and cabbage

**Pathogen:** Fungi

**Infected plant parts:** All parts of the plant except roots

**Symptoms:** Isolated pustules appear on the leaf and stems. The pustules are raised; white in color, variable in shape and size finally merge to form larger patches. In severe infection, flowers and stems are deformed and swell. Ovules and other reproductive organs get deformed and sterilized.

**Source of inoculum:** Infected soil, infected seed, perennial weeds

**Dispersal:** Irrigation, Wind-borne,

**Management options:** Clean cultivation and burning infected crop debris, crop rotation, resistant varieties, proper seeding rate, remove volunteer plants, fungicides.

### Downy mildew (*Peronospora parasitica*)

**Hosts:** Rape seed, mustard and cabbage

**Pathogen:** Fungi

**Infected plant part:** Leaves and flowers

**Symptoms:** Thin, grayish-white, growth develops in patches on the lower surface of leaves, upper surface marked by white spots corresponding to patch below. In severe infection, it causes distortion or malformations of the affected plants. It also causes systemic infection.

**Source of inoculum:** Infected soil, infected seed, perennial weeds

**Dispersal:** Irrigation, wind-borne

**Management options:** Field sanitation and crop rotation

## White rust



A

A=White pustules



B

B= deformed stem and reproductive organs

## Downy mildew



Symptoms on leaves of rapeseed.

## **Black leg** (*Leptosphaena maculans*)

Hosts: Rape seed, mustard, cabbages, cauliflowers

Pathogen: Fungi

Infected plant part: Leaves, roots, stems and whole plant

Symptoms: Light brown spot surrounded by chlorotic tissue or round to irregular shaped lesion on leaves. Oval, long and irregular lesions on stems. Pycnidia will develop on pod lesions. Stem cankers develop from stem lesions at the root collar or crown of the plant. Lesions become darker and crack open. Tap roots have blackened areas and may be constricted, and lateral roots appear blackened with little or no new root growth.

Source of inoculum: Infested crop residues, leaves, stems, pods, seeds

Dispersal: Wind-borne

Management options: Resistant variety, crop rotation, improved nutrition, deep ploughing stubble followed by minimal tillage the following year and sowing of non-brassica crops, fungicides.

## **Pasmo** (*Septoria linicola* / *Mycosphaerella linorum*)

Hosts: Linseed (Flax)

Pathogen: Fungi

Infected plant part: Whole plant, leaves, bolls, stems

Symptoms: Small brown lesions develop first on the primary leaves and then on the lower leaves of the seedlings. Lesions are generally circular. Later, the stem lesions develop into elongated spots and coalesced extending around the stem. Alternating brown and green banding of the stem is typical characteristic of severe disease. Lesions also occur on the bolls. All disease area contains dark pycnidia dotted over the surface.

Source of inoculum: Infected crop debris

Dispersal: Wind-borne

Management options: Disease free seeds, burning stubble



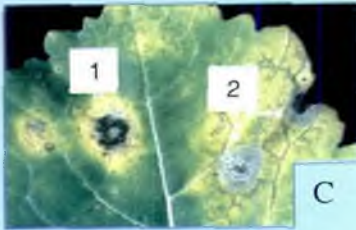
## Black leg



A



B



C

*A=Infected stem*

*B= Canker at crown*

*C= 1= Light brown lesion C=2= developed Pycnidia*

## Pasmo



*See brown and green bands on the infected stem*

## **Wilt** (*Fusarium oxysporum*)

Hosts: Linseed (Flax)

Pathogen: Fungi

Infected plant parts: Whole plant, and leaves

Symptoms: Wilting can occur at any stage of the crop. The tops of infected plants droop downwards, followed by death of upper leaves and growing points. Leaves turn brown and the entire plant appears to senesce prematurely. Pinkish dots are formed at the stem base.

Source of inoculum: Soil-borne

Dispersal: Wind-borne, irrigation

Management options: Resistant varieties

## **Flax rust** (*Melampsora lini*)

Hosts: Linseed (Flax)

Pathogen: Fung

Infected plant part: Leaves

Symptoms: Light yellow to orange-yellow sori containing spores appear on the leaves and stems early in the growing season. At later stages, reddish-yellow to orange spores on leaves, stems and capsules appear. When matured, brown to black spores will appear mostly on the stems.

Source of inoculum: infected crop

Dispersal: Wind borne

Management options: Resistant varieties bury infected crop residues and follow crop rotation when disease outbreaks occur.

## Linseed Wilt



*A= Wilting started*

## Flax rust



*A= Infected plant*

*B= Pustules on infected leaf*

*C= Pustules on flax inflorescence*

## 1.5 Diseases of Horticultural Crops

### Late blight (*Phytophthora infestans*)

Hosts: Potato and tomato

Pathogen: Fungi

Infected plant parts: Foliage, fruits, tubers on the field and in the store

Symptoms: Irregular or circular, water-soaked lesions. In cloudy or humid weather, the lesions increase quickly and form dark brown, blighted areas with indefinite borders. Under favorable conditions, all above ground parts of the plant are blighted and rot away rapidly; sometimes bad smell is released.

Source of inoculum: Infected tubers and plant parts left on the field, infected soil

Dispersal: Irrigation, wind-borne, rain splash

Management options: Field sanitation, fungicidal sprays, and resistant varieties.

### Bacterial wilt (*Pseudomonas solanacearum* / *Ralstonia solanacearum*)

Hosts: Tomato, potato, banana, tobacco and ground nut

Pathogen: Bacteria

Infected plant part: stems, roots, tubers, eyes, leaves, seeds

Symptoms: Wilting, stunting and yellowing of the leaves followed by collapse of the entire plant. During long rain, sudden drooping of leaves and rotting of stem from any point occur. If the infected stems or tubers are cut across and squeezed, grayish-white bacterial ooze comes out of the vascular ring. Eye buds of infected tubers will be blackened during severe infection.

Source of inoculum: Infected crop debris, infected soil and seed

Dispersal: Irrigation, wind-borne, rain splash

Management options: Resistant varieties, field sanitation, crop rotation.

## Late blight



A= Symptoms on leaves



B= Symptoms on stem

## Bacterial wilt



A



B

A= Wilted potato

B= Wilted tomato



C



D



E

### Infected tubers

C= Symptoms on the outer part of the tuber

D & E= Symptoms in the inner part on the tubers

Infected tuber eyes buds

Infected vascular rings

## **Bacterial canker** (*Corynebacterium michiganense* *Clavibacter michiganensis*)

Host: Tomato

Pathogen: Bacteria

Infected plant parts: Leaves, stems, fruits and seeds

Symptoms: Leaf veins turn brown, wilt and finally die out. Brown streaks develop on the stems which may crack to reveal brown discoloration of internal tissues. When infected stem is cut creamy white, yellow or brown line is seen under the phloem vessel. Infected fruits become brown and develop lesions. Green fruits develop water-soaked spots which soon surrounded with a white halo.

Source of inoculum: Infected crop debris, infected seeds

Dispersal: Rain splash

Management options: Field sanitation, crop rotation, resistant varieties, disease free seeds and transplants, hot water treatment.

## **Downy mildew** (*Peronospora destructor*)

Hosts: Onion, garlic, leek, shallot

Pathogen: Fungi

Infected plant part: Leaf and stem

Symptoms: At first, yellowish spots on the upper half of the leaves appear. When the humidity gets higher the fungus grows and appears as bluish-grey, hairy mildew. Spots lesions enlarge and merge together. Lesions may consist of alternating chlorotic and green layers of tissues on the leaf and stem. Finally, the affected leaves wilt and die.

Source of inoculum: Infected bulbs, soil and seed

Dispersal: Wind-borne

Management options: Clean cultivation, crop rotation, seed dressing, fungicides.

## Bacterial canker



A



D



B



C

A= Wilted Tomato  
B= Infected leaf

C= Spot lesions on fruit D= Cracked stem

## Downy mildew



A



B



A= Hairy fungal mildew & necrosis

B= Enlarged lesion

C= Dead leaves

## **Onion rust** (*Puccinia allii* / *Puccinia porri*)

Hosts: Onion, garlic, leek and shallot

Pathogen: Fungi

Infected plant part: Leaf and stem

Symptoms: Longitudinal pustules on the leaves which upon rupturing expose yellowish-brown spores. Black pustules are produced at later stages.

Source of inoculum: Volunteer onion crops

Dispersal: Wind-borne

Management options: Resistant varieties, crop rotation, soil drainage, rouging infected plants, fungicides

## **Purple blotch** (*Alternaria porri*)

Hosts: Onion, garlic and leek

Pathogen: Fungi

Infected plant parts: Leaves and stem

Symptoms: First, small white lesions with purple center appear on the leaves. Later the lesions enlarge rapidly, girdling leaf and stem which fall down. Bulb rotting will follow in the storage.

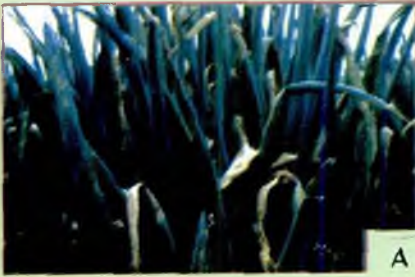
Source of inoculum: Crop debris, infected seeds and soil

Dispersal: Wind-borne, rain splash

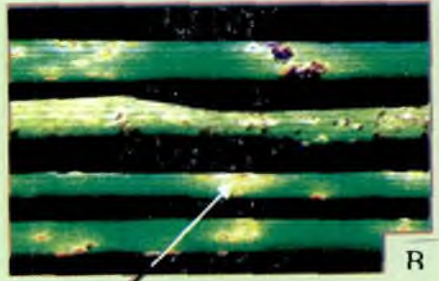
Management options: Field sanitation, seed dressing, resistant varieties, increase spacing, fungicides



## Onion rust



A



B

A=Infected onion leaves B= Orange rust pustules surrounded by Chlorosis

## Purple blotch



A=Infected stem



A B= Infected leaf (white lesion with purple center) B

# Bibliography

- Agrios, George, N. 1978. Plant Pathology (2<sup>nd</sup> ed.). Department of Plant Pathology, University of Massachusetts. USA.
- Allen, D.J., J.K.O. Ampofo and C.S. Wortmann. 1996. A field Guide: Pest, Disease and Nutritional Disorders of the Common Bean in Africa. Cali, Colombia. CTA.
- Amor, H. Y., E. Brahim, Mogens, and H. J. Ahmed, 2003. A Field Guide for Management: Disease of barley and wheat in Eritrea. Syria, Aleppo, ICARDA.
- Calude, C., Bernier, S. B., Hanounik, M. M. Hussein, and H. A. Mohamed. 1993. Field Manual: Common Faba bean Disease in the Nile Valley, Aleppo, Syria. ICARDA.
- Carlos, D. 1984. Maize Disease: A guide for field Identification Mexico D.F., CIMMYT
- Jones, D. Gareth, and Brain C. Clifford. 1983. Cereal Diseases: Their Pathology and Control (2<sup>nd</sup> ed). Basf United Kingdom Limited, UK.
- Malcolm, C. Shurtleff. 1980. Compendium of Corn Diseases 2<sup>nd</sup> ed. The American Phytopathological Society. Minnesota. USA.
- Salim, B.H. 1986. Screening techniques for disease resistance in faba beans. Syria Aleppo, ICARDA.
- Singh, J.P. 1983. Crop Protection in the Tropics: Plant Protection Marketing Division, IFFCO, New Delhi, India.
- William, E., 1982. Principles of Plant Disease Management: Department of Plant Pathology Cornell University, Ithaca, New York. USA.

## Glossary

- Alternate host:* A host plant on which a parasitic fungus (e.g. rust) develops to complete its life cycle
- Blade:* Flat portion of a cereal leaf above the stem
- Blotch:* A disease characterized by large and irregular lesions
- Blight:* A disease characterized by general and rapid killing of leaves, flowers and stems
- Chlorosis:* Yellowing of normal green tissue
- Coleoptile:* A protective sheath surrounding the shoot in cereal and grasses
- Damping off:* Distraction of seedling near the soil line resulting in the seedling falling over the ground
- Disease cycle:* The chains of events' involved in disease development. It includes the stage of the pathogen development and effects of the disease on the host
- Dissemination:* Transfer of inoculums from its initial source to healthy plants
- Defoliation:* Removal of leaves from plant part
- Eradication:* Control of plant disease by eliminating the pathogen often it is established by eliminating the plant that carry the pathogen
- Flag leaf:* The uppermost leaf on the stem
- Fleck:* A minute spot
- Fungus:* Undifferentiated plant lacking chlorophyll and conductive tissues
- Fumigant:* A chemical toxicant used in gaseous form
- Fungicide:* A compound toxic to fungi
- Gall:* Swelling or over growth produced on plant as results of infections by certain pathogen
- Glume:* A bract at the base of a spikelet of cereal or a grass
- Host:* A plant that is invaded by a parasitic and from which parasite obtains its nutrient
- Host range:* The various kinds of host plant that may be attacked by parasite
- Incidence:* Percent infected plants in a field
- Injury:* Damage of plants by animal, physical or chemical agents
- Inoculum:* The pathogen or its part that cause disease
- Infection:* The establishment of a parasite with a host plant
- Inoculation:* The arrival or transfer of pathogen on to the host

- Integrated control:* An approach that attempts to use all available methods of control of disease or pest for best control results
- Kernel:* The seed of a cereal plant
- Lesion:* A localized area of discolored, diseased tissue
- Leaflets:* Any of the divisions of a compound leaf
- Leaf spot:* A self limiting lesion on a leaf
- Life cycle:* The stage or successive stage in growth and development of an organism that occurs between the appearance and re-appearance of the same stage of organism.
- Malformation:* Abnormality in shape or structure
- Mosaic:* Symptoms of certain viral disease of plants characterized by intermingled patches of normal and light green or yellow color
- Membrane:* A thin flexible sheet of tissue separating various parts in plant bodies or forming the external wall of a cell
- Mycelium:* The thallus body of a fungus
- Necrotic:* Dead or discolored
- Ovule:* The plant part developing into seed or a small structure in seed plant that contains embryo sac and develops into a seed
- Pathogen:* Any organism that causes a disease
- Parasite:* An organism living on in other living organism and obtain food from the later
- Perennials:* plants that need more than two years to complete their life cycle.
- Pest:* Harmful organisms to crops (e.g. insects, pathogen, weeds)
- Pesticide:* Any chemical used to kill harmful organisms
- Phloem:* Food conducting tissue in plant transportation system
- Photosynthesis:* The process by which carbon dioxide and water are combined in the presence of light and chlorophyll
- Primary infection* The first infection of a plant by the over wintering or over summering pathogen
- Primary inoculum:* The over wintering or over summering pathogen, that causes primary infection.
- Pustule:* A spore mass developing below the epidermis, usually breaking through at maturity
- Pycnidia:* Flask shaped fruiting body producing spores
- Quarantine:* Control of import and export plants to prevent spread of disease and other pests
- Resistance:* The genetic characteristic of a plant that prevents or reduces pathogen or disease development

- Rot:** The softening, discoloration and often disintegration of succulent plant tissue as a result of fungal or bacterial infection
- Rotation:** Sequence of crop cultivation in the field
- Rouging:** Removal of diseased or unwanted plants from a cropped field
- Sanitation:** The removal and burning of infected plant parts, decontamination of tools, equipment and hands.
- Seed borne:** Disease resulting from the transmission of the pathogen by seeds
- Severity:** The proportion of the diseased area of a plant
- Sheath:** Lower part of a cereal leaf that clasps the stem
- Spike:** The head of cereals or grasses
- Spikelet:** The appendage of a spike that consists of florets and glumes
- Symptoms:** A visible response of a host plant to a pathogen
- Splashing:** Dispersion of rain droplets
- Spores:** The reproductive unit of fungi consisting of one or more cells; it is analogous to the seed of green plants
- Stubble:** Stem bases and crowns of harvested wheat or barley still rooted in soil.
- Stubble borne:** Disease resulting from transmission of pathogen by stubble.
- Stunting:** Reduced growth
- Susceptible:** Prone to infection by a pathogen
- Teliospore** Thick walled resting spore of rust and smut fungi
- Tiller:** A shoot of a of cereal plant arising from a crown bud at the crown level
- Tolerance:** The ability of a plant to sustain the effects of disease without dying or suffering serious or crop loss
- Uredium:** A pustule of a rust fungus containing urideospores
- Urediospore:** Spore of the rust fungi that spread disease
- Virus:** Sub microscopic obligate parasite consists of nucleic acid and protein.
- Veins:** The conducting strand of a leaf
- Volunteer plant:** Plants that grow in the field without the cultivation of man
- Water soaked:** Pertaining to lesions that appear wet, dark and translucent
- Wind borne:** Disease resulting from blown in inoculum of a pathogen
- Xylem:** A plant tissue consisting of tracheids, vessels, parenchyma cells, and fibers; wood.

## Appendices

### Appendix A Common and scientific names of major crops cited in the text

Common name	Scientific name
Barley	<i>Hordeum vulgare</i> L.
Cabbage	<i>Brassica oleracea</i> L.
Carrot	<i>Daucus carota</i> L.
Chickpea	<i>Cicer arietinum</i> L.
Egg plant	<i>Solanum melongena</i> L.
Faba bean	<i>Vicia faba</i> L.
Field pea	<i>Pisum sativum</i> L.
Flax (Linseed)	<i>Linum usitatissimum</i> L.
Garlic	<i>Allium sativum</i> L.
Groundnut	<i>Arachis hypogaea</i> L.
Leek	<i>Allium porrum</i> L.
Lettuce	<i>Lactuca sativa</i> L.
Linseed, Flax	<i>Linum usitatissimum</i> L.
Maize	<i>Zea mays</i> L.
Oat	<i>Avena sativa</i> L.
Onion	<i>Allium cepa</i> L.
Pepper or Chilies	<i>Capsicum annum</i> L.
Potato	<i>Solanum tuberosum</i> L.
Rape seed	<i>Brassica napus</i> L.
Soybean	<i>Glycine max</i> (L.) Merr.
Sweet potato	<i>Ipomoea batatas</i> (L.) Lam.
Tomato	<i>Lycopersicum esculentus</i> Mill.
Bread Wheat	<i>Triticum aestivum</i> L.
Durum Wheat	<i>Triticum durum</i> L.

Appendix B.

B.Fungicide

No.	Trade Name	Common Name	Approved Uses to Control
1	Baylaton 25 WP	Triadimefon 250g/l	Rust disease on wheat and barley
2	Benlate 50 WP	Benomyl 50% WP	Bean anthracnose on haricot beans
3	Daconil 2787 W 75	Chlorothalonil 75% WP	Coffee berry disease
4	Helcozeb 80 WP	Mancozeb 80% W/W	Cercospora leaf spot in static flowers
5	Kocide 101	Copper-hydroxide	Late blight of potato
6	Penncozeb 80 WP	Mancozeb 80% WP	Late blight on tomato
7	Ridomil 5G	Matelaxyl	Fungus spp. on pepper, tomato, orange and apples
8	Ridomil MZ 63.5 WP	Matelaxyl/Mancozeb	Fungus spp. on potato, tomato, pepper and onion.
9	Rova 500 FW	Chlorothalonil 50 FW	Coffee berry disease on coffee
10	Tilt	Propiconazole 25%	Fungus spp.on teff, wheat and barley

## **Melaku Degefu Mekonnen**

Plant Pathologist, Kulumsa Research Center

P.O.Box 489, Assela

Phone Cellular: +251-0911-841535

Tel Office: +251-022-33115537

Fax: +251-022-3311508

E-mail: [melakudegefu@yahoo.com](mailto:melakudegefu@yahoo.com)  
[naodbd12@yahoo.com](mailto:naodbd12@yahoo.com)



Ethiopian Institute of Agricultural Research  
Kulumsa Agricultural Research Center  
P.O.Box 489, Arsi, Assela  
E-mail: [karc@ethionet.et](mailto:karc@ethionet.et)



Ethiopian Science and Technology Agency  
P.O.Box 2490, Addis Ababa  
E-mail: [estc@ethionet.et](mailto:estc@ethionet.et)

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# Field Identification and Management of Major Diseases of the Major Crops

## *Plant Pathology Handbook*

*Naod Betesilassie and Melaku Degefu*



Ethiopian Institute of Agricultural Research (EIAR)  
Kulumsa Agricultural Research Center  
P.O.Box 489, Arsi, Asella,  
Ethiopia  
Tel: 251-022-3311422  
Fax: 251-022-3311508  
E-mail: [karc@ethionet.et](mailto:karc@ethionet.et)



Ethiopian Science and Technology Agency  
P.O.Box 2490, Addis Ababa  
Ethiopia

Tel:- 251-011-1573434  
Fax: 251-011-1572715  
E-mail: [estc@ethionet.et](mailto:estc@ethionet.et)

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