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Mango (*Mangifera indica*)

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- Amaranth
- Avocados
- Bananas
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- Brassicas
- Carrot
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- Eggplant
- Green gram
- Groundnut
- Maize
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- Millet
- Okra
- Onion
- Papaya
- Passion fruit
- Peas
- Peppers
- Pigeon pea
- Pineapple
- Potato



© A. M. Varela & A.A. Seif, icipe

Powdery mildew on young mango leaves



Pumpkin

Rice

Sesame

Sorghum

Soybean

Spider plant

Spinach

Sugarcane

Sweet

potato

Tea

Teff

Tomato

Wheat

Yam

Zucchini/Courgette

**Pests/
diseases/
weeds**

**Medicinal
plants**



© A. M. Varela & A.A. Seif, icipe

Powdery mildew on mango



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www.ecoport.org set invisible

Fruit and vegetable processing

Natural pest control

Cultural practices

Powdery mildew on mango fruitlet



© A. M. Varela & A.A. Seif, icipe

Flower stalk and young fruit affected by powdery mildew.





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Mango panicle affected by powdery mildew. Note white powdery growth and low fruit set.





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Bacterial black spot
(*Xanthomonas campestris* pv.
mangiferaeindica) on mango
leaves



© Jürgen Kranz, Courtesy of EcoPort

Bacterial black spot symptoms on mango fruit. Note star-like cracks on the fruit.



© A.A.Seif, icipe

Mango seed weevil adult, after emerging of a mango. Realsize: 8 mm long.



© Monique Hunziker, Biovision

Typical fruit damaged by mango seed weevil larva.





© Peter A. Follet. Reproduced from the
Crop Protection Compendium, 2005
Edition. © CAB International, Wallingford,
UK, 2005.

**Egg of mango seed weevil on mango fruit.
The very small egg laying scars are barely
discernable at harvest.**



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Australia, Department of
Primary Industries and
Fisheries, 2007. Reproduced
with permission. Contact
ipcu@dpi.qld.gov.au.

**Soft brown scale (*Coccus
hesperidum*). Scales are small,
they attain a length of 1-7mm.**



© Jeffrey W. Lotz, Florida Department of
Agriculture and Consumer Services,
Bugwood.org

Mango stem end rot



© A. M. Varela & A.A. Seif, icipe



Mango rose flower beetle feeding on panicle.



© A. M. Varela, icipe

Mango fruits and farmers inspecting mango tree





© A. M. Varela & A.A. Seif, icipe



Anthracnose damage on young mango fruits

© A.M.Varela, icipe

Mango leaf damaged by leaf gall

fly.



© A. M. Varela, icipe

Close-up of galls caused by gall flies on mango leaf.



© A.M.Varela, icipe

Mango leaves showing symptoms of leaf-coating mite attack.





© A. M. Varela, *icipe*

Mealybugs on a mango fruit.





© A. M. Varela, icipe



Close-up termites on mango stem.



© A. M. Varela, icipe



Damage caused by tip wilt on young mango shoot.

© A. M. Varela, icipe

Fruit fly maggot in mango fruit.





© A. M. Varela, icipe

Fruit fly pupae.





© A. M. Varela, icipe

Grub of mango seed weevil.





© A. M. Varela, icipe

Mango seed weevils



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Onion bulbs

© Oregon State University, Dept of

plants

Cocoa

Coconut

Coffee

Cotton

Cowpea

Cucumber

Eggplant

Green gram

Groundnut

Maize

Mango

Millet

Okra

Onion

Papaya

Passion fruit

Peas

Peppers

Pigeon pea

Pineapple

Nutrition & Food Management.
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Compendium, 2005 Edition. © CAB
International, Wallingford, UK, 2005.



Onion nursery

© A.A.Seif, icipe

Thrips symptoms on onion -
typical silvering and blotching of
leaves.

Potato

Pumpkin

Rice

Sesame

Sorghum

Soybean

Spider plant

Spinach

Sugarcane

**Sweet
potato**

Tea

Teff

Tomato

Wheat

Yam

Zucchini/Courgette

**Pests/
diseases/
weeds**

Medicinal



© Whitney Cranshaw
(www.ecoport.org)

Purple blotch on onion. Leaf-tip dieback is a typical symptom of infection by *Alternaria porri* on onion and shallot.

plants

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vegetable
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© Gerlach W.
(www.ecoport.org)

Onion smudge. Small, round, dark blotches develop on bulbs, with a zonate pattern on the outer scale leaves.



**© Denis Persley and Tony Cooke,
Department of Primary Industries
and Fisheries, Queensland,
Australia (Courtesy of EcoPort,
www.ecoport.org)**

Rust on onion



© A.M. Varela, icipe

Fusarium basal rot on onions



© David B. Langston, University of Georgia, Bugwood.org

Downy mildew on onion



© Cornell University, Courtesy of EcoPort
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Sour skin of onion.



© David B. Langston, University of Georgia, Bugwood.org

White (bulb) rot (*Sclerotium cepivorum*). Symptoms on onion bulbs. Infected onion bulbs displaying sclerotia (black) and hyphae (white) on the base.



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Crop Protection Compendium, 2006
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UK, 2006.

Purple blotch on onions.



© A. M. Varela

Close-up of advanced purple blotch spot.



© A. M. Varela.

Thrips damage on onions. Note silverying and blotching of leaves.



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Sweet potato

© French B., Courtesy of Ecoport
(www.ecoport.org)

Mild mottle virus symptoms on
sweet potato leaf

- Cowpea**
- Cucumber**
- Eggplant**
- Green gram**
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- Pigeon pea**
- Pineapple**
- Potato**
- Pumpkin**
- Rice**
- Sesame**
- Sorghum**



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Sweet potato butterfly (*Acraea acerata*) with orange and black wings with brown margins; 3-4 cm wingspan

Soybean

Spider plant

Spinach

Sugarcane

Sweet

potato

Tea

Teff

Tomato

Wheat

Yam

Zucchini/Courgette



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Natural pest



Sweet potato vine borer larva on sweet potato (2.5-3 cm long)

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control

Wallinford, UK.

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Sweet potato hornworm larvae (*Agrius convolvuli*).

**© Matthew Cock.
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Protection Compendium
2006 edition. Wallinford,
UK.**



**Tortoiseshell beetle
(*Aspidomorpha* sp.).**

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Sorghum bicolor head

Cotton
Cowpea
Cucumber
Eggplant
Green gram
Groundnut
Maize
Mango
Millet
Okra
Onion
Papaya
Passion fruit
Peas
Peppers
Pigeon pea
Pineapple
Potato
Pumpkin
Rice
Sesame

© Li Dajue, Courtesy of
Ecoport (www.ecoport.org)



**Sorghum field with purple
witchweed**

© USDA APHIS Archives,
www.insectimages.org

**Sorghum grain heads are dried
in the sun on the threshing floor
until the seeds drop easily.
Threshing is done with a patole
- a hand held flattened
instrument made from
torchwood.**

Sorghum

Soybean

Spider plant

Spinach

Sugarcane

Sweet

potato

Tea

Teff

Tomato

Wheat

Yam

Zucchini/Courgette

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**A sorghum rust infection at this level can cause
substantial reduction in yield.**

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**Ergot (*Claviceps africana*) on
sorghum crop**



© Odvody G. (Courtesy of EcoPort, www.ecoport.org)

Sorghum ergot (*Claviceps africana*). Syrupy honeydew covering inflorescence of male-sterile forage



© Odvody G. (Courtesy of EcoPort,
www.ecoport.org)

Covered kernel smut on sorghum



© J. Kranz,
www.ecoport.org

Loose kernel smut on sorghum



© Kranz J.,
www.ecoport.org

Leaf blight on sorghum



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Green stink bug on pearl millet



© Russ Ottens, University of Georgia, Bugwood.org

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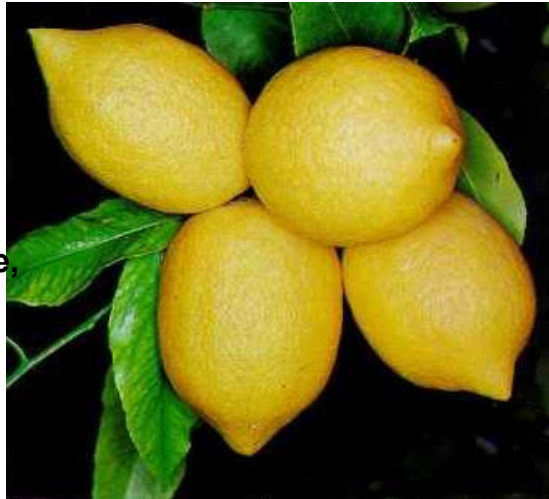
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- Coffee



Citrus fruits (*Citrus limon*)

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Citrus sp. - colour illustration

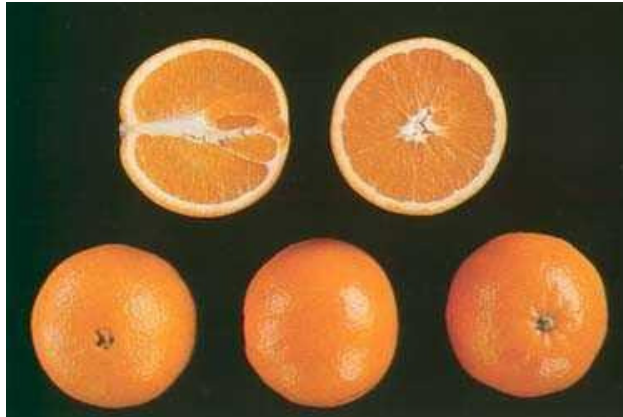
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- Potato**
- Pumpkin**
- Rice**
- Sesame**



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Oranges (*Citrus sinensis*)

Sorghum
Soybean
Spider plant
Spinach
Sugarcane
Sweet potato
Tea
Teff
Tomato
Wheat
Yam
Zucchini/Courgette



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Citrus tristeza virus

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**Cultural
practices**



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**Feeding by citrus rust mite causes the
fruit to turn silvery, reddish or black.**



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2005. Crop Protection
Compendium, 2005 Edition.
Wallingford, UK www.cabi.org

**African citrus psyllid -
Characteristic bumps on the
underside of sweet orange
leaves caused by the feeding of
the citrus psyllid (*Trioza
erythrae*) (South Africa).**



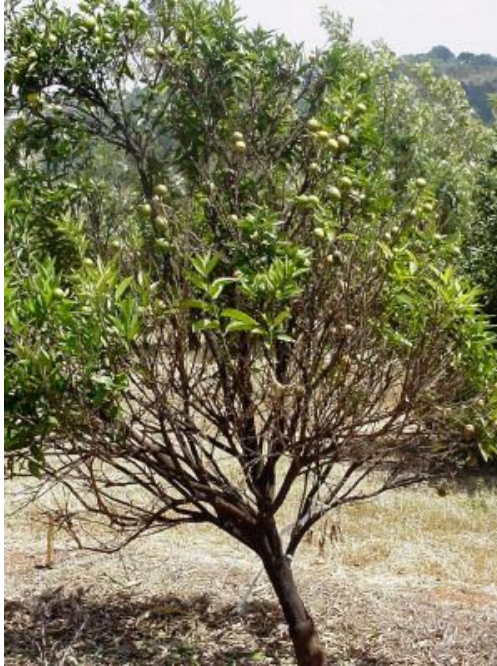
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Red scale on orange fruit



© A. A. Seif, icipe

Damage caused by armoured scales on an orange tree. Note yellowing of leaves, leaf drop, and dieback of branches,



© A. A. Seif icipe

Damage caused by armoured scales on an orange tree



© A. A.Seif, icipe

**Larvae of ladybird beetles
(*Cheilocorus sp*) feeding on red
scales on an orange fruit**



© A. M. Varela, icipe

**Ladybird beetle (*Cheilocorus sp*)
a predator of scales on citrus**



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Immature stages of the citrus woolly whitefly



© B. Loehr, icipe

Damage caused by the citrus woolly whitefly on citrus. Note leaves covered by sooty mould



©

**Immature stages of blackflies on
a citrus leaf**



© A. A. Seif, icipe

Heavy attack of the citrus aphid



© A. A. Seif, icipe

The parasitic wasp (*Cales noacki*) is a natural enemy imported into East Africa for control of the citrus woolly whitefly



© B. Löhr, icipe

African citrus psyllid on a citrus tree. Note bum-like galls on the upper leaf surfaces.



© A. A. Seif, icipe

Immature stages of the African citrus psyllid. Note healthy nymphs (yellow) and parasitised nymphs (black)



© A. A. Seif, icipe

**Adult of the African citrus psyllid
(*Trioza erytreaea*)**



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**Damage cause by the false
codling moth in a citrus fruit**



© A. M. Varela, icipe

Caterpillar of the false codling moth



© A. M. Varela, icipe

Damage by the false codling moth. The initial symptom on the fruit is a yellowish round spot with a tiny dark centre where the caterpillar entered the fruit. In a later stage brown patches appear on the skin,



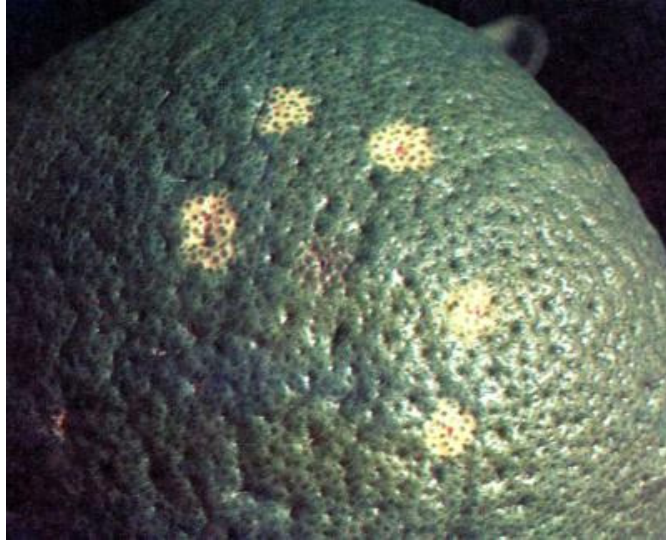
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**Damage by the citrus rust mite
on an orange fruit**



© A. A. Seif, icipe

**Egg laying marks by fruit flies
on an orange fruit**



© A. A. Seif

Phaeoramularia fruit and leaf spots



© A.A. Seif, icipe

Phaeoramularia fruit and leaf spots



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Phytophthora-gummosis



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Greening disease



© A.A. Seif

Greening disease



© A.A. Seif

Citrus bud mite damage



© A.A. Seif, icipe

Citrus leafminer damage on leaf



© A.A. Seif, icipe



Leafminer damage on citrus

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Mealybugs on citrus

© **A.M. Varela, icipe**

Weaver ant nest on a citrus tree



© A.A. Seif, icipe

Orange dog mature caterpillar



© A.M. Varela



Orange dog moth

© A.M. Varela, icipe

Orange dog moth



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Bananas (*Musa* sp.)

© Monique
Hunziker/BioVision

Banana (*Musa acuminata* and *Musa
balbisiana*)- colour illustration.

Eggplant
Green gram
Groundnut
Maize
Mango
Millet
Okra
Onion
Papaya
Passion fruit
Peas
Peppers
Pigeon pea
Pineapple
Potato
Pumpkin
Rice
Sesame
Sorghum
Soybean
Spider plant



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The cigar end rot disease
(*Trachysphaera fructigena*).

Spinach
Sugarcane
Sweet potato
Tea
Teff
Tomato
Wheat
Yam
Zucchini/Courgette



**Pests/
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Black leaf streak

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© INIBAP. International Network for the Improvement of Banana and Plantain (www.inibap.org)

Topped bananas due to root damage caused by *Radopholus similis*, the burrowing nematode.



**© John Bridge/CABI BioScience.
Reproduced from the Crop Protection
Compendium, 2005 Edition. CAB
International, Wallingford, UK, 2005.**

**Burrowing nematodes on
banana roots. Note brown
lesions (patches) caused by the
nematodes.**



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Banana with yellowing symptoms on lower leaves, caused by Fusarium wilt.



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Crop Protection Compendium, 2005
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UK, 2005.**

Fusarium wilt on banana



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**Pith discolouration of banana
pseudostem caused by Fusarium wilt.**



© A. A. Seif, icipe

Anthracnose fruit rot on Banana



© A. A. Seif, icipe

Thrips damage on banana fruits



Black leaf streak on banana leaf

© **A. M. Varela, ieipe.**

Fruit fly attack on green banana

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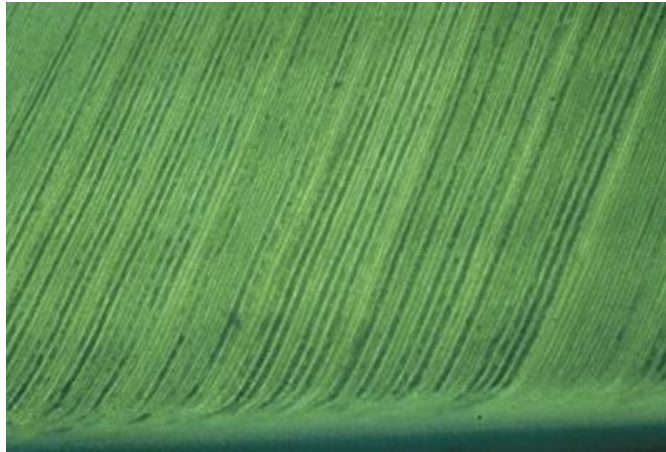
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Banana weevil



© A.M. Varela, icipe

Banana bunchy top virus



**© Denis Persley and Tony Cooke,
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Fisheries, Queensland, Australia
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Banana bunchy top virus



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Pigeon pea (*Cajanus cajan*). Ripening pods

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Eggplant
Green gram
Groundnut
Maize
Mango
Millet
Okra
Onion
Papaya
Passion fruit
Peas
Peppers
[Pigeon pea](#)
Pineapple
Potato
Pumpkin
Rice



© Cornell University
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www.ecoport.org)

Pigeon pea (*Cajanus cajan*).
Cultivated forms have larger
seeds than their wild relatives

Sesame
Sorghum
Soybean
Spider plant
Spinach
Sugarcane
Sweet potato
Tea
Teff
Tomato
Wheat
Yam
Zucchini/Courgette

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© Ellis RP (Courtesy of EcoPort, www.ecoport.org)

and have been subjected to selection for larger seed. Larger seed used as fresh vegetables and medium sized genotypes for split pea production and milling.

Pigeon pea used as green manure cover crop in Conservation Agriculture. On this smallholder's farm, pigeon pea is used solely as a green manure cover crop in a soil recovery process. The next crop entering is maize.

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Lima bean pod borer

© **Clemson University, USDA,**
www.ipmimages.org



***Phytophthora* blight on pigeon pea**

© **Y.L. Nene (EcoPort,**
www.ecoport.org)

***Cercospora* leaf spot on
soybean**



© Clemson University, USDA (EcoPort,
www.ecoport.org)

***Macrophomina* stem canker
(*Macrophomina phaseolina*)**



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(Reproduced from CABI 2006)

Powdery mildew of pea



© AgrEvo (Reproduced from CABI 2006)

Rust on beans



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Bruchids



© Ferris IF, Courtesy of EcoPort,
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Pod fly damage on pigeon pea

© Jeffrey Lotz, Florida

**Department of Agriculture and
Consumer Services.**



Apion species on bean pod.

**© Frank Peairs,
Colorado State
University**

**This is a male giant coreid bug /
Tip wilt, its about 2cm.**



© A.M. Varela

Blister beetle (*Mylabris oculata*)



© Botha AD (Courtesy of EcoPort, www.ecoport.org)



Leafhopper. Adults are small, about 2.5 mm long. Picture shows *Empoasca fabae* (related species).

© Steve L. Brown, University of Georgia,

Bugwood.org



Caterpillar of the legume pod borer (*Maruca vitrata*). Fully-grown caterpillars are about 15mm long.

© GTZ-IPM Horticulture Project. Kenya

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Images



Pumpkin (*Cucurbita maxima*)

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**Choanephora fruit rot
(*Choanephora cucurbitarum*) on
Cucurbita maxima.**

Green gram
Groundnut
Maize
Mango
Millet
Okra
Onion
Papaya
Passion fruit
Peas
Peppers
Pigeon pea
Pineapple
Potato
Pumpkin
Rice
Sesame
Sorghum
Soybean
Spider plant
Spinach



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Extension Slide Series,
www.insectimages.org

**Zucchini yellow mosaic
potyvirus on *Cucurbita pepo*.
ZYMV provokes in cucurbit
crops very severe symptoms of
stunting, yellowing, necrosis
(occasionally), mosaic, leaf**

Sugarcane

**Sweet
potato**

Tea

Teff

Tomato

Wheat

Yam

Zucchini/Courgette

**Pests/
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**deformations, fruit
discolorations and
deformations.**

© Pone S. (Courtesy of EcoPort,
www.ecoport.org)

Water melon damage by fruit fly



© A.M. Varela, icipe

Epilachna larvae and damage to water melon



© A.M. Varela, icipe

Epilachna adults and larvae feed on the leaf surface of water melon, scraping away cells to form open windows, causing the leaf to wither. Extensive feeding can completely skeletonize the leaf. They can sometimes also feed on the fruit causing surface damage through which secondary infection may occur.



© A.M. Varela, icipe

**Water melon leaves damaged by
Epilachna beetles**



© A.M. Varela, icipe

Mosaic virus on water melon



© A.M. Varela, icipe

**Foliage beetle feeding on water
melon**



© A.M. Varela, icipe

**Foliage beetle feeding on
pumpkin leaf**



© A.M. Varela, icipe

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- Cowpea
- Cucumber



Close-up of Millet (*Panicum miliaceum*) ready for harvest

© Jan Breithaupt
(www.ecoport.org)

Proso millet (*Panicum
miliaceum*) flower(s)

Eggplant
Green gram
Groundnut
Maize
Mango
Millet
Okra
Onion
Papaya
Passion fruit
Peas
Peppers
Pigeon pea
Pineapple
Potato
Pumpkin
Rice
Sesame
Sorghum
Soybean
Spider plant



© Steve Dewey, Utah State University,
Bugwood.org

Millet (*Panicum miliaceum*). The small creamy-yellow seeds are edible and used as a cereal.

Spinach
Sugarcane
Sweet potato
Tea
Teff
Tomato
Wheat
Yam
Zucchini/Courgette



© Botha R. (www.ecoport.org)

**Pests/
diseases/
weeds**

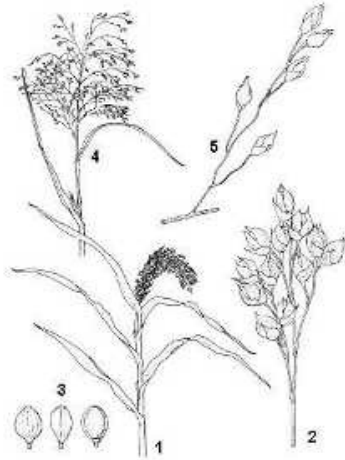
**Medicinal
plants**

**Fruit and
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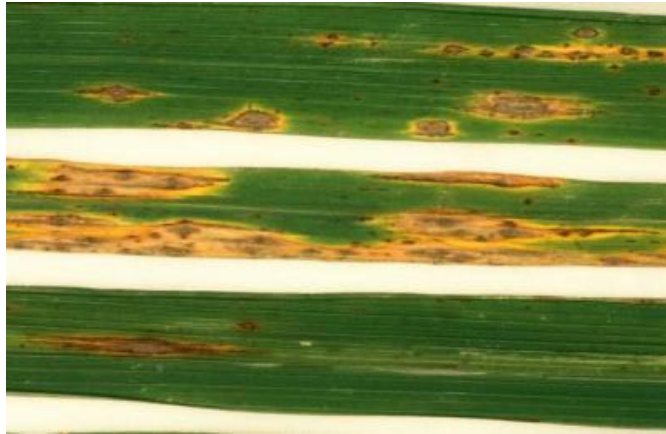
Millet (*Panicum miliaceum*): 1, habit flowering stem; 2, detail inflorescence branch; 3, grains; cv. subgroup Miliaceum:- 4, habit flowering stem; 5, detail inflorescence branch. Line drawing.

Cultural practices



© Reproduced from the series 'Plant Resources of South-East Asia', by kind permission of the PROSEA Foundation, Bogor, Indonesia.

Blast (*Pyricularia grisea*).
Lesions on rice plant leaves.



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Long smut (*Tolyposporium penicillariae*)



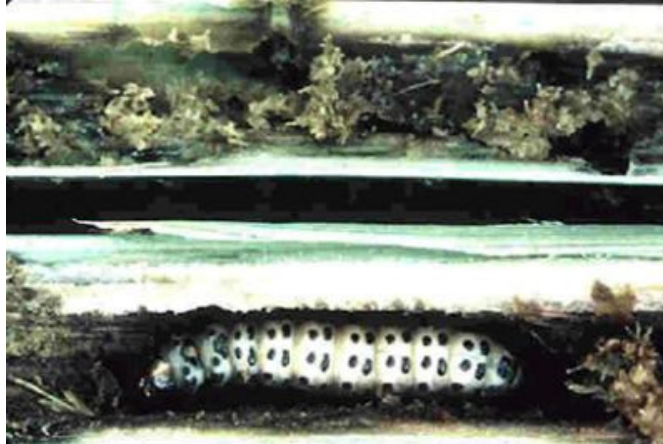
© Kranz J., Schmutterer H., Koch W.
Courtesy of EcoPort, www.ecoport.org

Crazy top downy mildew (*Sclerospora graminicola*)



© Kranz J., Courtesy of
EcoPort, www.ecoport.org

**Active full-grown millet
stem borer (*Coniesta
ignefusalis*) larva (feeding and
damage) in millet stem.**



© ICRISAT - International Crop Research
Institute for the Semi-Arid Tropics.
www.icrisat.org

Shoot fly (*Atherigona soccata*)
The adults are dark brown, and
similar to a housefly, but nearly
half the size.



© Georg Goergen, Courtesy of EcoPort,
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© PRIFAS. Courtesy of EcoPort,
www.ecoport.org

Variegated grasshopper
(*Zonocerus variegatus*). The size
of adult grasshoppers may vary
between 300 mm and 520 mm.

Lesser grain borer (*Rhyzopertha*



***dominica*). Adults are 2-3 mm in length and reddish-brown in colour (shown on wheat grains).**

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Ergot



© Reproduced from **PEARL MILLET DISEASES - A
Compilation of Information of the Known Pathogens
of Pearl Millet**
(<http://www.tifton.uga.edu/fat/pearlmilletdiseases.htm>)

Blast



© Reproduced from **PEARL MILLET DISEASES - A
Compilation of Information of the Known Pathogens
of Pearl Millet**
(<http://www.tifton.uga.edu/fat/pearlmilletdiseases.htm>)

Smut



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Compilation of Information of the Known Pathogens
of Pearl Millet**
(<http://www.tifton.uga.edu/fat/pearlmilletdiseases.htm>)

Crazy top downy mildew



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- Cocoa
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- Coffee
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Pawpaw (*Carica papaya*) - Tall plant with mature fruits.

© H. Wilson

Cowpea

(www.ecoport.org)

Cucumber

Eggplant

Green gram

Groundnut

Maize

Mango

Millet

Okra

Onion

[Papaya](#)

Passion fruit

Peas

Peppers

Pigeon pea

Pineapple

Potato

Pumpkin

Rice

Sesame

Sorghum



Pawpaw (*Carica papaya*). Detail of male flowers.

© J.R. Manhart (www.ecoport.org)

Pawpaw (*Carica papaya*). Mature fruit cut open.

Soybean
Spider plant
Spinach
Sugarcane
Sweet potato
Tea
Teff
Tomato
Wheat
Yam



Zucchini/Courgette
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(www.ecoport.org)

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**Papaya ringspot potyvirus - Severe
mosaic and distortion on young
leaves.**

17/10/2011

www.infonet-biovision.org 201003...

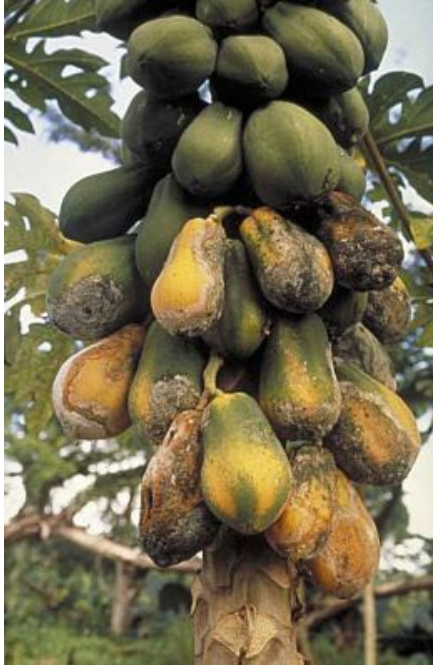
control

**Cultural
practices**



© Mike Pearson (Courtesy of
EcoPort, www.ecoport.org)

**White fungal crusts of white mycelium
associated with fruit rot of papaya
(*Phytophthora palmivora*).**



© **Grahame Jackson**
(Courtesy of EcoPort,
www.ecoport.org)

**Papaya mosaic potyvirus -
Affected leaf**



© Dr. Pankaj Oudhia (Courtesy of EcoPort, www.ecoport.org)

**Papaya ringspot potyvirus
(PRSV)**



© A.A. Seif, icipe

Bird damage on papaya



© A.A. Seif, icipe

Ripe fruit rot



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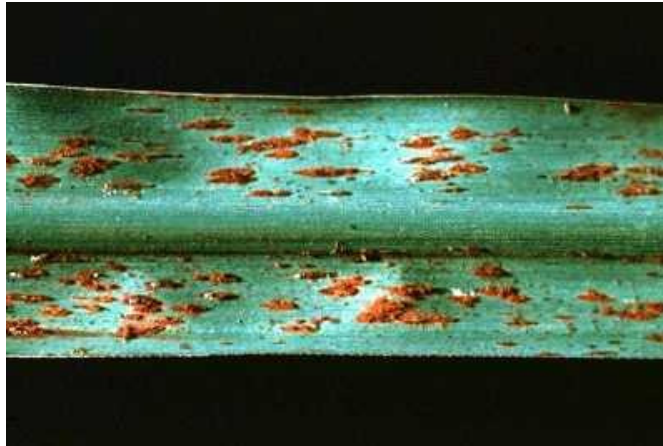


Sugarcane in bloom

© van Wik Ben-Eric
(www.ecoport.org)

**Sugarcane common rust
(*Puccinia melanocephala*)**

- Eggplant**
- Green gram**
- Groundnut**
- Maize**
- Mango**
- Millet**
- Okra**
- Onion**
- Papaya**
- Passion fruit**
- Peas**
- Peppers**
- Pigeon pea**
- Pineapple**
- Potato**
- Pumpkin**
- Rice**
- Sesame**
- Sorghum**
- Soybean**
- Spider plant**



© Mauritius Sugar Industry Research Institute

Severely strains of sugarcane mosaic virus infection on sugarcane compared to a healthy leaf.

Spinach

Sugarcane

Sweet

potato

Tea

Teff

Tomato

Wheat

Yam

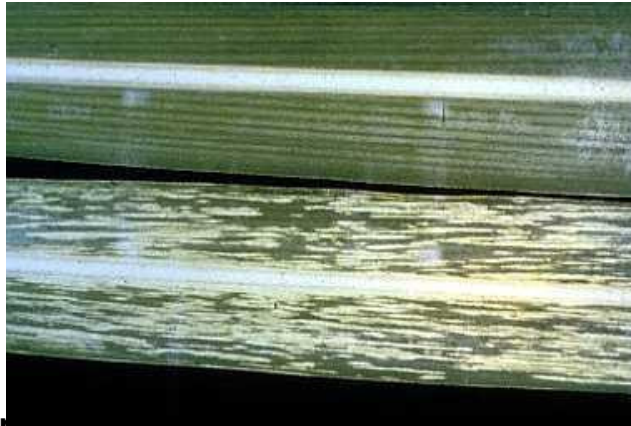
Zucchini/Courgette

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Sugarcane red rot (*Glomerella tucumanensis*) - Red spots on the midrib of the upper leaf surface develop pale yellow to white centres, merging to cover the length of the leaf. Similar spots also occur on the leaf blades.

Cultural practices



© LandCare Ltd., New Zealand
(Courtesy of EcoPort, www.ecoport.org)

***Clavibacter xyli* ssp. *xyli* -
Discolouration of the nodal and
internodal regions of sugarcane
stem due to ratoon stunting
disease (RSD).**



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**African
Nightshade**

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Cassava

Citrus

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Cocoa

Coconut

Coffee

Cotton

Cowpea

Cucumber

Eggplant

Green gram



Cotton (*Gossypium hirsutum*) approaching harvest stage

© Duthurburu H.V.
(<http://ecoport.org>)

***Gossypium* sp. - colour illustration**

- Groundnut**
- Maize**
- Mango**
- Millet**
- Okra**
- Onion**
- Papaya**
- Passion fruit**
- Peas**
- Peppers**
- Pigeon pea**
- Pineapple**
- Potato**
- Pumpkin**
- Rice**
- Sesame**
- Sorghum**
- Soybean**
- Spider plant**
- Spinach**
- Sugarcane**



© Wilhelm Valder

Cotton crop rotation strategies

**Sweet
potato
Tea
Teff
Tomato
Wheat
Yam**

Zucchini/Courgette

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Crop rotation – rotation crops

Rotation Type	1st year	2nd year	3rd year
Pulses + cereals	Cotton (winter crop: wheat or pulses)	Pulses (soya, moong beans, cow pea, black gram, pigeon pea), maize or sorghum	Cotton (winter crop: wheat or pulses)
Vegetable	Cotton (winter crop: wheat or pulses)	Chilli, onion or other intensive vegetable crop	Cotton (winter crop: wheat or pulses)
Sugar cane	Cotton	Sugar cane	Sugar cane
Cotton rotation (from Tanzania)	Cotton	Sesame, safflower, sorghum or maize	Pulses (moong, chick pea, cow pea, pigeon pea, groundnut)
Rotation with herbal plants (from Egypt)	Cotton (winter crop: wheat or pulses)	Herbs (anise, basil, fennel etc.)	Maize with clover intercrop

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Organic Agriculture FibL (www.fibl.org)

Larva of cotton bollworm



© USDA-ARS

Cotton bollworm feeding on cotton



© Alton N. Sparks
(University of
Georgia)
(<http://ecoport.org>)

Bollworm damage on cotton



© Daniel Anand Raj (<http://ecoport.org>)

Pink bollworm larva on cotton.



© USDA-ARS

African bollworm on cotton.



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Anthracnose on cotton.



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Aphids on cotton



© Ronald Smith (Courtesy of EcoPort,
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Cabbage looper on cotton



© David Jones (Courtesy of EcoPort, www.ecoport.org)

Couch grass infestation in cotton



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Cotton stainer - Nymphs (two to the left) and adult cotton stainer.



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- Cucumber**



Rice (*Oryza sativa*)

© David Nance, USDA Agricultural
Research Service, Bugwood.org

**Upland rice (*Oryza sativa*), Ivory
Coast.**

- Eggplant**
- Green gram**
- Groundnut**
- Maize**
- Mango**
- Millet**
- Okra**
- Onion**
- Papaya**
- Passion fruit**
- Peas**
- Peppers**
- Pigeon pea**
- Pineapple**
- Potato**
- Pumpkin**
- Rice**
- Sesame**
- Sorghum**
- Soybean**
- Spider plant**



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Farmers do weeding in an irrigated rice field in Burkina Faso.

Spinach

Sugarcane

**Sweet
potato**

Tea

Teff

Tomato

Wheat

Yam

Zucchini/Courgette

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**Symptoms of rice blast disease
on leaves**

© Jan Breithaupt (Courtesy of EcoPort,
www.ecoport.org)

**Dried rice tassels caused by rice
blast disease (*Magnaporthe
grisea*)**

Cultural practices



© Jan Breithaupt (Courtesy of EcoPort, www.ecoport.org)



Rice weevil (*Sitophilus oryzae*)

© Food Agency and Ministry of agriculture, forestry (Courtesy of EcoPort, www.ecoport.org)



Bacterial leaf blight on mature rice plants. Lesions begins as water-soaked stripes on the leaf blades and eventually would increase in length and width becoming yellow to grayish-white until the entire leaf dries up.

© T.W. Mew, International Rice Research Institute, Bugwood.org

Rice seedlings infected with



Bacterial leaf blight (*Xanthomonas oryzae* pv. *oryzae*). Infected leaves wilt and roll up, turning grayish-green to yellow, until the whole seedling dies. Plants which have survived the disease are stunted and yellowish.

© T.W. Mew, International Rice Research Institute, Bugwood.org

Root-knot nematode infestation
in rice field



© Roger Lopez-Chaves, Universidad de Costa Rica, Bugwood.org

Stalk-eyed shoot fly



© A.M. Varela, icipe

Rice miner damage to rice



© Boris Castro, Texas A&M University -
Dept. Entomology, Bugwood.org

**Green stink bug (nymphs and
adults). Adults are about 1.2cm long.
(Host: Pearl Millet)**



© Russ Ottens, University of Georgia, Bugwood.org

African gall midge - Onion shoot galls on rice



© Keith Harris. Reproduced from the Crop Protection Compendium, 2006 Edition. © CAB International, Wallingford, UK, 2006

African gall midge - Onion shoot galls on



rice

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Brown leaf spot on rice.



Symptoms on leaves

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Mature soybeans, sitting within their pod.

**© Scott Bauer, USDA
Agricultural Research Service,
Bugwood.org**

Eggplant
Green gram
Groundnut
Maize
Mango
Millet
Okra
Onion
Papaya
Passion fruit
Peas
Peppers
Pigeon pea
Pineapple
Potato
Pumpkin
Rice
Sesame
Sorghum
Soybean
Spider plant



Soybean plants (*Glycine max*)

© Scott Bauer, USDA Agricultural
Research Service, www.insectimages.org

**Soybean rust (*Phakopsora
pachyrhizi*) symptoms on lower
leaf surface**

Spinach
Sugarcane
Sweet potato
Tea
Teff
Tomato
Wheat
Yam
Zucchini/Courgette



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**Soybean downy mildew
symptoms of *Peronospora
manshurica* on soybean leaf**

**Cultural
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**Purple seed stain (*Cercospora
kikuchii*) on soybean**



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**Pod and stem blight on soybean
(*Diaporthe phaseolorum*)**



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Soybean mosaic potyvirus



© Mike Pearson (Courtesy of EcoPort, www.ecoport.org)

Stink bug (*Nezera viridula*) on soybean



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**Southern Blight (*Sclerotium
rolfsii*) on soybean**



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**Bean bruchid (*Acanthoscelides
obtectus* on soybean**



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Anthraxnose on soybean



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Spider mite damage on soybean



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Soybean mosaic virus symptoms on leaf - Extreme leaf blistering



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Soybean bacterial blight



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**Soybean bacterial pustules
caused by *Xanthomonas
axonopodis* pv. *glycines*.**



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Wildfire disease (*Pseudomonas syringae* pv. *glycinea*) symptoms.



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**White mould on bean pods
(*Sclerotinia sclerotiorum*).**



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Cucumber (*Cucumis sativus*)

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Downy mildew on cucumber

- Eggplant**
- Green gram**
- Groundnut**
- Maize**
- Mango**
- Millet**
- Okra**
- Onion**
- Papaya**
- Passion fruit**
- Peas**
- Peppers**
- Pigeon pea**
- Pineapple**
- Potato**
- Pumpkin**
- Rice**
- Sesame**
- Sorghum**
- Soybean**
- Spider plant**



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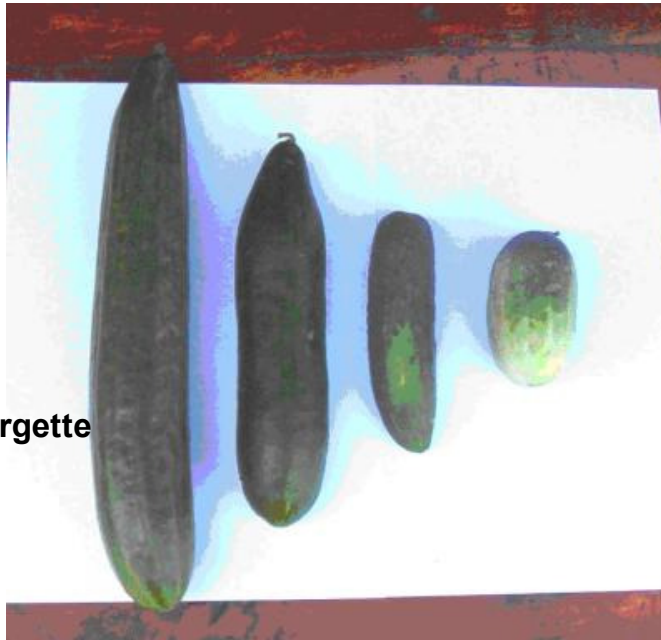
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- Wheat**
- Yam**
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© A. Bruntse

Angular leaf spot on cucumber

Cultural practices



© A. A. Seif

Virus on cucumber



© A. A. Seif

Mosaic virus on watermelon



© A. M. Varela, icipe

Fruit flies in watermelon fruit



© A. M. Varela, icipe

**Epilachna beetle and damage
caused on water melon**



© A. M. Varela, icipe

Larvae of Epilachna beetle and damage caused on water melon



© A. M. Varela, icipe



Leafminer damage on cucumber

© A A Seif icine



Foliage beetle feeding on water melon leaf

© A.M. Varela, icipe

Powdery mildew on cucumber



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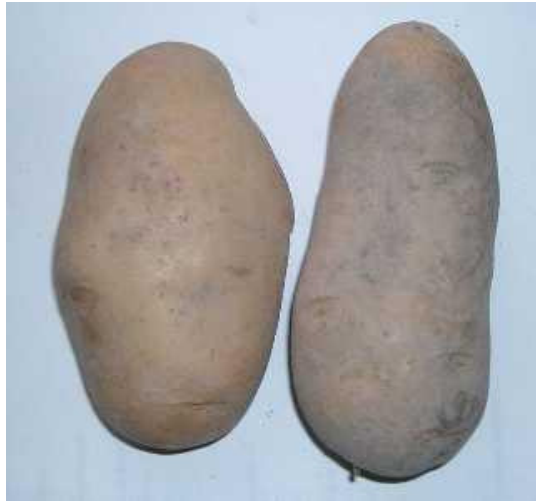


Potato *Solanum tuberosum* -
Tuberous roots and leaves.

© Arnoldo Mondadori Editore SpA
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Potato (*Solanum tuberosum*)

Cucumber
Eggplant
Green gram
Groundnut
Maize
Mango
Millet
Okra
Onion
Papaya
Passion fruit
Peas
Peppers
Pigeon pea
Pineapple
Potato
Pumpkin
Rice
Sesame
Sorghum
Soybean



© Kenpei

Early blight on potato. On potato tubers, early blight results in surface lesions that appear a little darker than adjacent healthy skin. Lesions are usually slightly sunken, circular or irregular, and vary in size up to 1.9 cm in diameter. There is usually a well defined and sometimes slightly raised margin

Spider plant

Spinach

Sugarcane

Sweet

potato

Tea

Teff

Tomato

Wheat

Yam

Zucchini/Courgette

**Pests/
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University of Minnesota Extension.

**between healthy and diseased
tissue. Internally, the tissue shows
a brown to black corky, dry rot,
usually not more than 6mm. Deep
cracks may form in older lesions.**

**Early blight on potato leaf. Note
concentric rings on spots.**

Cultural practices



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Late blight on potato tubers



© Fry, W. et al. (Courtesy of EcoPort, www.ecoport.org)

Bacterial wilt of potato



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Potato X potexvirus



© SASA (Courtesy of EcoPort,
www.ecoport.org)



Potato Y potyvirus

© Horvath J. (Courtesy of EcoPort,
www.ecoport.org)

Damping-off of potato



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Secondary infection to potatoes in storage due to damage by the potato tuber moth.

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Coffee plant (*Coffea arabica*)
with healthy berries.

© Flémal J. (Courtesy of EcoPort,
www.ecoport.org)

A well pruned, young coffee plant (*Coffea arabica*)

- Cocoa**
- Coconut**
- Coffee**
- Cotton**
- Cowpea**
- Cucumber**
- Eggplant**
- Green gram**
- Groundnut**
- Maize**
- Mango**
- Millet**
- Okra**
- Onion**
- Papaya**
- Passion fruit**
- Peas**
- Peppers**
- Pigeon pea**
- Pineapple**
- Potato**



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Coffea sp. - colour illustration

Pumpkin

Rice

Sesame

Sorghum

Soybean

Spider plant

Spinach

Sugarcane

Sweet potato

Tea

Teff

Tomato

Wheat

Yam

Zucchini/Courgette



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 UK

**Pests/
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Coffee rust

Fruit and vegetable processing
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Coffee leaf rust (*Hemileia vastatrix*) - Coffee leaf undersurface showing lesions of coffee leaf rust.

© Kenya Coffee Research Foundation.

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Coffee berry disease

© A.A. Seif, icipe

Root-knot nematode damage on coffee



© Jonathan D. Eisenback, Virginia
Polytechnic Institute and State University,
Bugwood.org

**Root-knot nematode
(*Meloidogyne exigua*) damage
on coffee root system**



© Roger Lopez-Chaves, Universidad de Costa Rica, Bugwood.org

Coffee berry borer - Adult female on a green coffee bean. Females are 1.4 to 1.6 mm long.



© Peggy Greb, USDA Agricultural Research Service, Bugwood.org

**Coffee berry borer
(*Hypothenemus hampei*).
Picture much enlarged. Females
are 1.4 to 1.6 mm long**



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**Female Mediterranean fruit fly
on a coffee fruit.**



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**Bacterial blight of coffee.
Secondary branch of coffee
killed by *Pseudomonas syringae*
pv. *garcae*.**



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**Symptoms of stem canker on
coffee (*Fusarium stilboides*).**



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**Adult females of Kenya
mealybug collected from coffee
in Kenya. 1.4-2.7 mm long and
0.8-2.0 mm wide.**

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Soft green scale (*Coccus viridis*) are immobile and can usually be found settled at underside of leaf, close to central vein or near tips of green shoots. They are flat and oval (about 3 x 2 mm).

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Scale Insects Photographs Archive, USDA
ARS, Bugwood.org

Coffee leafminer damage on
coffee leaf



© A.M. Varela, icipe



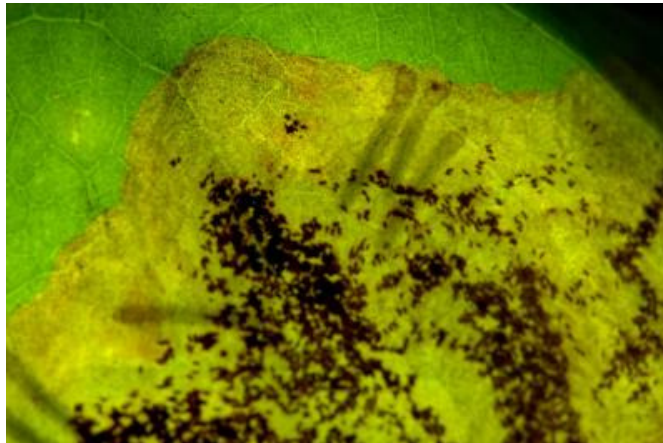
Coffee leafminer cocoon

© F.Haas, icipe



Coffee leafminer damage advanced

© A.M. Varela, icipe



Coffee leafminer. Caterpillars in side blotch mine

© F.Haas, icipe

Coffee leafminer moth



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Cotton

Cowpea

Cucumber

Eggplant

Tea (Camellia sinensis)



Tea plantation in Tanzania

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Tea bush

Green gram

Groundnut

Maize

Mango

Millet

Okra

Onion

Papaya

Passion fruit

Peas

Peppers

Pigeon pea

Pineapple

Potato

Pumpkin

Rice

Sesame

Sorghum

Soybean

Spider plant

Spinach



© A.A.Seif, icipe

Tea plant (*Camellia sinensis*)

Sugarcane

**Sweet
potato**

Tea

Teff

Tomato

Wheat

Yam

Zucchini/Courgette



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Blister blight (*Exobasidium vexans*)

Blister blight on tea leaves



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Black nightshade



Solanum nigrum

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(Ananas comusus)

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Black rot of pineapple (*Ceratocystis paradoxa*)

- Coffee**
- Cotton**
- Cowpea**
- Cucumber**
- Eggplant**
- Green gram**
- Groundnut**
- Maize**
- Mango**
- Millet**
- Okra**
- Onion**
- Papaya**
- Passion fruit**
- Peas**
- Peppers**
- Pigeon pea**
- [Pineapple](#)**
- Potato**
- Pumpkin**
- Rice**



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Cocoa fruit (*Theobroma cacao*)

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Cowpea

Cucumber

Eggplant

Green gram

Groundnut

Maize

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Millet

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Onion

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Pineapple

Potato

Pumpkin



Heavy mealybug attack on cocoa

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Cocoa black rot (*Phytophthora palmivora*)

- Rice**
- Sesame**
- Sorghum**
- Soybean**
- Spider plant**
- Spinach**
- Sugarcane**
- Sweet potato**
- Tea**
- Teff**
- Tomato**
- Wheat**
- Yam**
- Zucchini/Courgette**



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Diversification strategies for Cocoa 1

**Pests/
diseases/
weeds**

1. Year	2. Year	3. Year	5. - 10. Year	from 11. Year
Maize/dry rice	Sweet potato (Ipomoea batata)			
Papaya	Papaya	Papaya		
Bananas	Bananas	Bananas	Bananas	
Cocoa	Cocoa	Cocoa	Cocoa	Cocoa
Forest trees	Forest trees	Forest trees	Forest trees	Forest trees

**Medicinal
plants
Fruit and**

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Diversification strategies for Cocoa 2

**vegetable
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1. Year	2. Year	3. Year	5. - 10. Year	from 11. Year
Maize-beans- Okra	Cocojam, Taro (Xanthosoma sagittifolium or Colocasia esculenta sp.)			
Bananas	Bananas	Bananas	Bananas	
Cocoa	Cocoa	Cocoa	Cocoa	Cocoa
Forest trees	Forest trees	Forest trees	Forest trees	Forest trees

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Diversification strategies for Cocoa 3

1. Year	2. Year	3. Year	5. Year	6. to 10. Year	from 11. Year
Manioc	Okra (Hibiscus esculentus)				
Pineapple	Pineapple	Pineapple	Pineapple		
Bananas	Bananas	Bananas	Bananas	Bananas	
Cocoa	Cocoa	Cocoa	Cocoa	Cocoa	Cocoa
Forest trees	Forest trees	Forest trees	Forest trees	Forest trees	Forest trees

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Diversification strategies for Cocoa 4

1. Year	2. Year	3. Year	5. Year	6. to 10. Year	from 11. Year
Maize					
Papaya	Papaya	Papaya			
Bananas	Bananas	Bananas	Bananas	Bananas	
Rubber	Rubber	Rubber	Rubber	Rubber	Rubber
Cocoa	Cocoa	Cocoa	Cocoa	Cocoa	Cocoa
Forest-/	Forest-/	Forest-/	Forest-/	Forest-/	Forest-/
Fruit trees	Fruit trees	Fruit trees	Fruit trees	Fruit trees	Fruit trees

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Budding of cocoa plants



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Cocoa-mosquito (*Helopeltis schoutedeni*)



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Cotton

Cowpea

Cucumber

Eggplant



Yam tuber (*Dioscorea alata*)

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Yam marketing

**Yam (*Dioscorea alata*) marketing at Korogho,
Côte d'Ivoire, June 1999.**

Green gram

Groundnut

Maize

Mango

Millet

Okra

Onion

Papaya

Passion fruit

Peas

Peppers

Pigeon pea

Pineapple

Potato

Pumpkin

Rice

Sesame

Sorghum

Soybean

Spider plant

Spinach



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Yam leaves and stem

Yam (*Dioscorea alata*) leaves and stem

Sugarcane

**Sweet
potato**

Tea

Teff

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Carrot (Daucus carota)

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Coffee
Cotton
Cowpea
Cucumber
Eggplant
Green gram
Groundnut
Maize
Mango
Millet
Okra
Onion
Papaya
Passion fruit
Peas
Peppers
Pigeon pea
Pineapple
Potato
Pumpkin
Rice



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Cottony soft rot (*Sclerotinia sclerotiorum*). Greyish, white mold forms at the base of stem. Black round structures appear as disease progresses. Can extend underground to the root.

Leaf blight (*Alternaria dauci*). Small, irregular, black to purplish coloured spots. Spots may coalesce to cover the entire leaf.

- Sesame**
- Sorghum**
- Soybean**
- Spider plant**
- Spinach**
- Sugarcane**
- Sweet potato**
- Tea**
- Teff**
- Tomato**
- Wheat**



Yam
Zucchini/Courgette
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**Pests/
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Damping-off (*Pythium* spp.)

17/10/2011

www.infonet-biovision.org 201003...

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Cotton

Cowpea

Cucumber



Young leaves are widely used as spinach in Africa. These leaves can be dried and stored for later use, usually as a relish eaten with maize porridge. This food is rich in magnesium and iron, as well as nicotinic acid.

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Spider plant (*Cleome gynandra*)

- Eggplant**
- Green gram**
- Groundnut**
- Maize**
- Mango**
- Millet**
- Okra**
- Onion**
- Papaya**
- Passion fruit**
- Peas**
- Peppers**
- Pigeon pea**
- Pineapple**
- Potato**
- Pumpkin**
- Rice**
- Sesame**
- Sorghum**
- Soybean**



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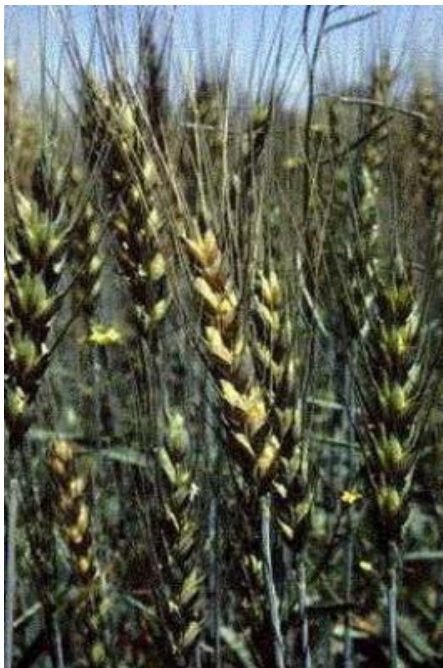
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Amaranth (*Amaranthus hybridus*)

Cotton
Cowpea
Cucumber
Eggplant
Green gram
Groundnut
Maize
Mango
Millet
Okra
Onion
Papaya
Passion fruit
Peas
Peppers
Pigeon pea
Pineapple
Potato
Pumpkin
Rice
Sesame

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Amaranth (*Amaranthus caudatus*)

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Weeds CD-ROM. A
guide to the weeds
of Western Australia
by B.M.J. Hussey,
G.J. Keighery, R.D.
Cousens, J. Dodd

Sorghum and S.G. Lloyd. Web
Soybean version by R.
Spider plant Randall (Courtesy of
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Weevil pupa in amaranth stem.

Weevil larva feeding in amaranth stem.

Natural pest control

Cultural practices



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Adult weevil in amaranth stem.

Amaranth plant with stem canker due to weevil attack.



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Amaranth stem with cankers due to internal feeding by weevil larvae.

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- Cucumber**
- Eggplant**
- Green gram**
- Groundnut**
- Maize**
- Mango**
- Millet**
- Okra**
- Onion**
- Papaya**
- Passion fruit**
- Peas**
- Peppers**
- Pigeon pea**
- Pineapple**
- Potato**



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Powdery mildew on pea

Pumpkin

Rice

Sesame

Sorghum

Soybean

Spider plant

Spinach

Sugarcane

Sweet

potato

Tea

Teff

Tomato

Wheat

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Ascochyta spots on snowpeas

Fruit and vegetable processing
Natural pest control
Cultural practices



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Ascochyta pod spots on snowpeas

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Fusarium wilt on peas



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African bollworm caterpillar feeding on peas - Fully grown caterpillars are 3-4cm long.



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**Caterpillar of the pea blue
butterfly and damage to peas**



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Blue pea butterfly. Male wingspan is 2.8-3.4 cm, upperside purplish-blue suffused with grey scales and with a distinct black marginal line; marginal fringe greyish-white. Female wingspan is 2.5-4.2 cm; upperside dark brown with purple scales at the base and discal area.



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Brown hairy caterpillar on snowpea. Real size: about 40 mm long.

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Caterpillar damage on snowpea

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Damage by caterpillar on garden pea leaves



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Damage by the beet armyworm on garden peas. Real size about 25 to 30 mm long.



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Damage by leafminer maggots



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Leafminer fly and damage caused by adult leafminer on peas.



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Thrips damage on snowpea pods



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The pea aphid (*Acyrtosiphon pisum*) is a large, rather long-bodied aphid, with long slender appendages (legs and cornicles), which forms colonies on young growth and developing pods of many.



Wingless forms of females are usually 2.5-4.4mm long, winged females range from 2.3-4.3 mm.

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Pea aphids on a snow pea pod.

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Leafminer damage on snow pea



Pods.

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Powdery mildew on peas.



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Sesamum indicum capsules

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Spinach (*S. oleracea*) seedlings grown as field crop.

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Zucchini plant

Coconut

Coffee

Cotton

Cowpea

Cucumber

Eggplant

Green gram

Groundnut

Maize

Mango

Millet

Okra

Onion

Papaya

Passion fruit

Peas

Peppers

Pigeon pea

Pineapple

Potato

Pumpkin



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Cucurbita pepo flower

Rice
Sesame
Sorghum
Soybean
Spider plant
Spinach
Sugarcane
**Sweet
potato**
Tea
Teff
Tomato
Wheat
Yam



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Mosaic virus on water melon



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Fruit fly maggots in water melon fruit



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Water melon damage by fruit fly



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Epilachna larvae and damage to water melon. Adults and larvae feed on the leaf surface, scraping away cells to form open windows, causing the leaf



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to wither. Extensive feeding can completely skeletonize the leaf.

Epilachna adult feeding on water melon leaf. Adults and larvae feed on the leaf surface, scraping away cells to form open windows, causing the leaf to wither. Extensive feeding can completely skeletonize the leaf. They can sometimes also feed on the fruit causing surface damage through which secondary infection may occur.

Epilachna beetle damage to water melon. Adults and larvae



feed on the leaf surface, scraping away cells to form open windows, causing the leaf to wither. Extensive feeding can completely skeletonize the leaf. They can sometimes also feed on the fruit causing surface damage through which secondary infection may occur.

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Foliage beetle feeding on water melon

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