

**DIAGNOSIS OF
SOME WILT-LIKE
DISORDERS OF
CHICKPEA**
(Cicer arietinum L.)

ICRISAT

International Crops Research Institute
for the Semi-Arid Tropics, Hyderabad, India

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**DIAGNOSIS OF
SOME WILT-LIKE DISORDERS
OF CHICKPEA (Cicer arietinum L.)**

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DIAGNOSIS OF SOME WILT-LIKE DISORDERS OF CHICKPEA (*Cicer arietinum* L.)

Considerable confusion exists in diagnosing various chickpea disorders, particularly wilt and root rots. ICRISAT in 1974 initiated a project to investigate the so-called "wilt complex." After many critical observations of symptoms, hundreds of isolations of fungi in pure cultures, pathogenicity tests, and visits to research stations and farmers' fields in India and other chickpea-growing countries, we concluded that what has generally been referred to as "wilt complex" is actually a number of distinct diagnosable diseases.

In order to assist workers in identifying the main disorders of chickpea, we describe in this booklet the characteristic features of each. Some of the problems, such as the root rot caused by *Fusarium solani* or *Ozonium texanum* var. *parasiticum*, have not been included because we are not yet fully confident in diagnosing these under field conditions. Certain injuries, either mechanical or due to insects (including termites), can cause premature drying of plants. Wilting or drying from these causes should be considered before attempting to diagnose the disorder further. A key to diagnosis of the disorders has been presented in Appendix I. A listing of the diseases observed at different locations in India and a few other countries is presented in Appendix II.

WILT (*Fusarium oxysporum* f. sp. *ciceri*)

Typical wilt can be identified on the basis of the following symptoms:

Seedling stage

1. The disease can be observed about 3 weeks after sowing.
2. Whole seedlings (3 to 5 weeks after sowing) collapse and lie flat on the ground. These seedlings retain an almost normal green color.
3. Such collapsed seedlings, when uprooted, usually show uneven shrinking of the stem above and below the collar region (soil level). The shrunken portion may be about 1 inch long or longer (Fig 1).
4. Affected seedlings do not show rotting on outer surface. However, when split open vertically from collar region downwards, black discoloration of internal tissues is clearly visible (Fig 2).
5. In seedlings of highly susceptible cultivars which die within 10 days after emergence, black discoloration may not be clearly visible. However, internal browning from root tip upwards would be evident.

Adult stage (6 weeks or more after sowing)

1. The affected plants show typical wilting -- i.e., drooping of the petioles and rachis along with leaflets. Drooping is visible



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initially in the upper part of a plant, but within a day or two it is seen on the entire plant (Fig 3).

2. The lower leaves are chlorotic, but most of the other leaves wilt while retaining dull green color. Gradually, however, all the leaves turn yellow and then light brown or straw-colored.

3. Dried leaflets of infected plants are not shed at maturity (Fig 4).

4. Affected plants, when uprooted and examined before complete drying, show no external rotting, drying, or discoloration of roots.

5. When the stem is split by holding half the branches of the affected plant in each hand and pulling downwards, internal discoloration can be seen. Around the collar region, above and below, the central inner portion (pith and part of the wood) shows dark brown to black discoloration of the xylem which is usually continuous (Fig 5). In the initial stage of wilting, the discoloration may not be continuous. Discoloration also extends several centimeters above the collar region into the main stem and branches. If a transverse cut is given with a sharp razor blade through the collar region, black discoloration of pith and xylem can be seen (Fig 6).

6. Sometimes only a few branches are affected, resulting in partial wilt (Fig 7).



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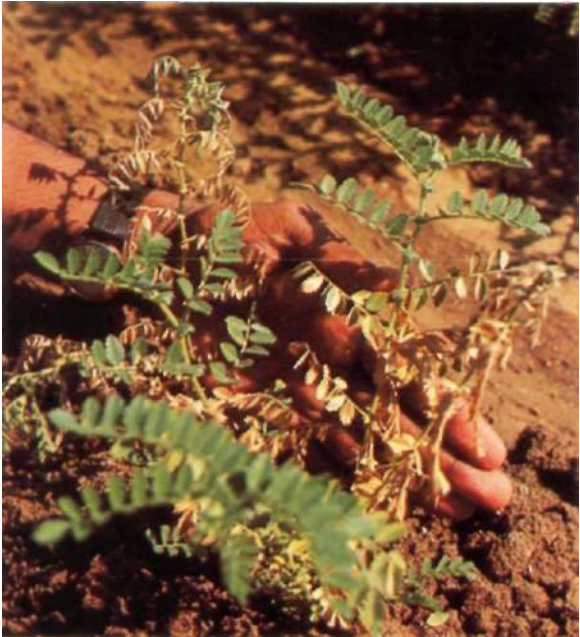
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Certain cultivars, like T-3, show drying of lower leaves before the top droops.

COLLAR ROT (*Sclerotium rolfsii*)

1. Most often, collar rot is seen in the seedling stage (up to 6 weeks after sowing), particularly if the soil is wet.
2. Affected seedlings turn yellow (Fig 8). Younger seedlings may collapse, but older seedlings may dry without collapsing.
3. No clear-cut drooping of leaves is seen.
4. Seedlings show evidence, when pulled out, of rotting at the collar region and downwards. The rotten portion is covered with whitish mycelial strands. White mycelial coating can be seen on the tap root of a completely dried seedling, even after several days (Fig 9).
5. If affected seedlings are uprooted from wet soil in earlier stages of infection, rapeseed-like sclerotia (1 mm in dia) can be observed attached to mycelial strands around the collar (Fig 10).
6. The nonaffected portion of the root is normal white inside.
7. Affected seedlings usually occur in small patches scattered in the field.

ROOT ROT (*Rhizoctonia solani*)

1. Like collar rot, this disease is seen most often in the seedling stage (up to 6

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weeks after sowing) in soils with relatively higher moisture contents. However, in irrigated chickpea, the disease may occur at later stages.

2. Affected seedlings gradually turn yellow and petioles and leaflets droop. Generally the seedlings do not collapse.

3. A distinct dark brown lesion appears above the collar region on the main stem and can extend to lower branches in older plants (Fig 11).

4. The stem and root below the lesion show rotting, frequently with pinkish mycelial growth. Sclerotia are not seen.

DRY ROOT ROT (*Rhizoctonia bataticola*)

1. Drying of the whole plant is the only conspicuous symptom of this disease. Affected plants are seen scattered in the field (Fig 12).

2. The petioles and leaflets droop only at the very top of the plant (Fig 13).

3. Sometimes when the rest of the plant is dry, the topmost leaves are chlorotic.

4. The leaves and stems of affected plants are usually straw-colored, but in some cases the lower leaves and stems will show brown color.

5. The lower portion of the tap root usually remains in the soil when plants are pulled. The tap root is dark, shows signs of rotting, and is devoid of most of the lateral and finer



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roots. The root is dry, provided the soil is not wet due to rains or irrigation. Sometimes near the tap root tip a grayish mycelial coating can be seen (Fig 14).

6. The dead root is quite brittle and shows shredding of the bark. The root tip can be easily broken.

7. Very minute sclerotial bodies can be seen with the aid of a 10X hand lens on the exposed wood of the root, as well as on the inner side of the bark.

8. When the dry stem of the collar region is split open vertically, either sparse thread-like mycelium or minute sclerotia can be seen (with hand lens) in the pith (Fig 15).

9. Diseased plants generally appear when day temperatures are 30°C or above.

FOOT ROT (*Operculella padwickii*)

1. The disease appears under wet soil conditions.

2. The above-ground symptoms of this disease are similar to typical wilt (*Fusarium oxysporum* f. sp. *ciceri*), with drooping petioles and rachis.

3. Rotting is evident from the collar region downwards; however there is no visible mycelial growth (Fig 16).

4. Internal discoloration appears above the rotten portion, but this discoloration is brown and does not involve the pith (Fig 17), as does the black discoloration in wilt.



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STEM ROT (*Sclerotinia sclerotiorum*)

1. The disease appears mostly on adult plants when these form a thick canopy and when the soil remains wet for an extended period.
2. The above-ground symptoms are drooping of petioles and leaflets without turning yellow. Ultimately, the leaves dry and turn straw-colored prematurely (Fig 18).
3. A web of white mycelial strands appear in the collar region and above (up to 5 cm), and may cover the base of the branches (Fig 19). Extended grayish lesions with or without mycelial coating can also be seen in the upper parts of stems (Fig 20, 21).
4. Whitish irregular sclerotial knots can be seen occasionally mingled with mycelial strands on branches.
5. The below-ground plant parts show surface discoloration, but no internal discoloration.

STUNT (An aphid-transmissible virus not yet identified)

1. Affected plants can be easily spotted in the field by their yellow, orange, or brown discoloration with stunted growth (Fig 22).
2. Stunting is due to shortened internodes (Fig 23).
3. The leaflets are smaller in size and show yellow, orange, or brown discoloration.



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In some cases, stems show brown discoloration. Generally the tips and margins of leaflets show chlorosis before turning brown.

4. In general, the discoloration of leaves is more pronounced in *desi* types (reddish) than in *kabuli* types (yellow only).

5. The stems and leaves of diseased plants are stiffer and thicker than normal.

6. A shallow vertical knife-cut at the collar region invariably reveals phloem browning and this is the *most characteristic* symptom of stunt (Fig 24). A horizontal cut through the collar region reveals a brown ring of discolored phloem (Fig 25).

7. The interior wood of the root is normal white, without xylem discoloration.

8. If plants survive up to podding stage, very few pods can be seen.

9. Many plants dry prematurely.

10. Sometimes stunt is accompanied by wilting. In such cases, xylem discoloration typical of *Fusarium oxysporum* f. sp. *ciceri* is also seen. The wilt, therefore, is due to the combined infection.

11. Stunting is most conspicuous in case of early infections. In later infections, stunting may not be obvious, but plant discoloration and phloem browning are seen.

12. Damage to the phloem by chewing insects, which attack the plant at the collar region, can result in leaf discoloration and stunting.



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This type of damage can be readily distinguished from stunt by the absence of phloem browning.

MOSAIC (Alfalfa Mosaic Virus)

1. The first visible symptom of mosaic in the field is twisting of the terminal bud followed by necrosis (Fig 26) and the initiation of secondary branches.

2. The new branches are stiff, erect, and have smaller leaflets which show a mild mottle (Fig 26, 27). Mottle is clearly seen in *kabuli* types with larger leaflets.

3. Very few pods are produced.

4. Phloem browning does not appear in the collar region.

5. Premature drying is common.

6. Terminal bud necrosis caused by iron deficiency can be distinguished from bud necrosis caused by mosaic by the absence of proliferation of branches.

7. On artificial inoculation of cultivars, such as NEC-10 in seedling stage, wilting is observed. It is possible, therefore, that seedlings which wilt without internal or external discoloration may be affected by the mosaic.

ROOT-KNOT (*Meloidogyne* spp.)

1. Plants are stunted and are found in small or large patches in the field (Fig 28).



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2. The lower leaves are chlorotic, later turning brown.
3. The plants slowly dry and become dark brown to almost black after complete drying.
4. Small or large knots, quite distinct from the *Rhizobium* nodule, appear on the roots (Fig 29).
5. The root system almost always turns black.

CHLOROSIS (Iron deficiency)

1. Scattered bright yellow plants can be spotted from a distance (Fig 30).
2. Severely affected plants are stunted.
3. As the symptoms progress, terminal leaflets dry and turn gray (terminal bud necrosis) (Fig 31).
4. The gray leaflets readily fall off if pressed lightly with fingers.
5. Mainly the younger leaves show most chlorosis; the older leaves may retain their green color for quite some time (Fig 31).
6. Affected plants do not normally die. In most cases they show at least partial recovery with time. When this happens the younger leaflets turn uniformly green, but the leaflets near mid-height of the plant show mottling. This mottling can be confused with mosaic; however, in mosaic the younger leaflets will continue to show symptoms.



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7. In extreme cases, plants may turn slightly brown and appear to be affected by stunt. However, the characteristic phloem browning of stunt is absent.

SALINITY INJURY

1. Affected plants generally show reddish-brown color (Fig 32). *Kabuli* types, however, remain yellow.

2. Salty deposits will usually be seen on soil surface around affected plants.

3. If salinity is high, the plants will dry prematurely; at lower salinity levels, plants remain stunted and produce a few pods.

4. The older leaflets have yellow margins, which turn brown (Fig 33). Ultimately these dry, but remain attached to plants.

5. The younger leaflets, in contrast to older ones, remain green, except where the salinity level is so high that the entire plant turns brown. If stunt is suspected, because of the browning, examine for phloem browning in the collar region; if phloem browning is seen, stunt is present.

6. Plant growth in a saline field will vary from one area to another, reflecting differences in salinity levels.

FROST INJURY

Normally there should be no reason for confusing frost injury with root rots and wilt. However, for a casual observer, the





above-ground symptoms on affected plants along with the irregular field incidence of frost injury can be misleading. The diagnostic symptoms are:

1. From a distance, patches of plants with dried tops can be seen (Fig 34).
2. If the frost has been severe whole plants are killed, particularly if plants are widely spaced. More often, however, tops only are affected.
3. Affected parts show drooping (branches, rachis, petioles, leaflets) (Fig 35).
4. Leaflets appear water-soaked in the morning.
5. After a few days, leaflets show irregular pattern of drying (essentially scorching); i.e., spots have no definite shape or size (Fig 36).
6. If pods are present at the time of frost, they become discolored. Immature seeds fail to develop and turn black (Fig 37).
7. Partially affected plants recover after temperatures rise.





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APPENDIX I

Key for the diagnosis of wilt-like disorders of chickpea

CHICKPEA PLANTS SHOWING PREMATURE WILTING/ DRYING

I. **Wilting** (drooping of petiole and rachis)

A. No external root rot

1. Internal (xylem)

discoloration *Fusarium oxysporum*
f. sp. *ciceri* (WILT)

2. No internal discoloration; irregular pattern of leaflet scorching ..

.. Frost injury (to be confirmed through weather data)

B. External root rot (tap root not brittle)

1. Rotting at collar region downwards; small (1 mm) brown round rapeseed-like sclerotia visible at base along with white mycelium ..

.. *Sclerotium rolfsii*
(COLLAR ROT)

2. Dark brown lesion extending on stem above collar region;

lesion can extend to lower branches; *no* sclerotia seen *Rhizoctonia solani*
(ROOT ROT)

3. Dark brown lesion at base; mycelium not visible; internal brown discoloration restricted to periphery of the wood *Operculella padwickii*
(FOOT ROT)

C. External base/stem lesion; white mycelium on lesion with / without white mycelial knots developing into dark sclerotia *Sclerotinia sclerotiorum*
(STEM ROT)

II. Drying without general wilting

A. Stunting/discoloration

1.No external rotting of roots

a. Proliferation of branches

i. Browning of leaves in *desi* and yellowing in *kabuli* cultivars; phloem necrosis in the collar region Unidentified virus
(STUNT)

ii. Terminal bud
necrosis; mild mottle
clearly seen on
broader leaflets of
kabuli cultivars; no
phloem necrosis Alfalfa Mosaic Virus
(MOSAIC)

b. No proliferation of branches

i. Browning of older
leaflets in *desi* and
yellowing in *kabuli*
cultivars; younger
leaflets remain
green; no phloem
browning Salinity injury

ii. Young foliage
bright yellow;
terminal bud
necrosis; mottle
at mid-height on
a recovering
plant Iron deficiency
(CHLOROSIS)

2. External rotting of
roots; galls on roots
quite distinct from
Rhizobium nodules.. .. *Meloidogyne* spp.
(ROOT-KNOT)

B. No stunting/dis-
coloration; only tops
may show drooping;
rotting of most roots;
tap root brittle; minute

sclerotia and / or sparse
gray mycelium in pith
cavity in the collar
region, which can be
seen with a 10X hand
lens. Also the sclerotia
can be seen under the
root bark which peels
off easily ..

.. *Rhizoctonia*

bataticola

(DRY ROOT ROT)

APPENDIX II

Summary of the chickpea "wilt complex" surveys

Locations ¹	Diseases / problems identified ²
INDIA	
Northern	
JAMMU & KASHMIR¹	
Taparwaripura and Dobi Ghat	Stunt
PUNJAB	
Faridkot	Stunt
Gurdaspur	<i>O. padwickii</i> (foot rot), <i>F. oxysporum</i> f. sp. <i>ciceri</i> (wilt)
Ludhiana	<i>Meloidogyne</i> sp. (root-knot), <i>F. oxysporum</i> f. sp. <i>ciceri</i> (wilt), Stunt, Termites ⁴
HARYANA	
Hissar	Stunt, Termites ⁴ , Salinity injury, Frost injury, <i>F.</i> <i>oxysporum</i> f. sp. <i>ciceri</i> (wilt), <i>F. sotani</i> (root rot) ⁴ , <i>S. sclerotiorum</i> (stem rot), Mosaic
DELHI	Stunt, <i>F. solani</i> (root rot) ⁴ , <i>F.oxysporum</i> f.sp. <i>ciceri</i> (wilt)

Locations ¹	Diseases / problems identified ²
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UTTAR PRADESH

Kanpur	<i>F. oxysporum</i> f. sp. <i>ciceri</i> (wilt), Stunt, <i>O. padwickii</i> (foot rot)
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Pantnagar	<i>Sclerotinia sclerotiorum</i> (stem rot), <i>R. bataticola</i> (dry root rot), Stunt, Frost injury
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Central

MADHYA PRADESH

Gwalior	Stunt, <i>F. oxysporum</i> f. sp. <i>ciceri</i> (wilt), <i>R. bataticola</i> (dry root rot)
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Indore	<i>S. rolfsii</i> (collar rot), Frost injury
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Jabalpur	<i>F. oxysporum</i> f. sp. <i>ciceri</i> (wilt), <i>S. rolfsii</i> (collar rot), Stunt, <i>R. bataticola</i> (dry root rot), <i>O. padwickii</i> (foot rot)
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MAHARASHTRA

Akola	Stunt, <i>F. oxysporum</i> f. sp. <i>ciceri</i> (wilt), <i>R. bataticola</i> (dry root rot)
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Nagpur	<i>F. oxysporum</i> f. sp. <i>ciceri</i> (wilt), <i>R. bataticola</i> (dry root rot), Stunt, <i>S. rolfsii</i> (collar rot)
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Rahuri	Stunt, <i>R. bataticola</i> (dry root rot), <i>F. oxysporum</i> f. sp. <i>ciceri</i> (wilt)
--------	---

Southern

ANDHRA PRADESH

Hyderabad *F. oxysporum* f. sp. *ciceri*
(wilt), Stunt, *R. bataticola*
(dry root rot), *S. rolfsii* (collar
rot), *R. solani* (root rot),
Mosaic, Iron deficiency,
Neocosmospora vasinfecta
(root rot)⁴, Unidentified
sterile fungus (white seed/
seedling root rot)⁴,
Meloidogyne sp.(root-knot),
F. solani (root rot)⁴

KARNATAKA

Bangalore *Meloidogyne* sp. (root-knot)

Gulbarga *R. bataticola* (dry root rot),
Stunt, Iron deficiency,
R. solani (root rot),
F. oxysporum f. sp. *ciceri*
(wilt)

TAMIL NADU

Coimbatore *Macrophomina phaseolina*
(*R. bataticola*- dry root rot)

Eastern

WEST BENGAL

Berhampore *F. oxysporum* f. sp. *ciceri*
(wilt), *S. rolfsii* (collar rot)

Locations ¹	Diseases/problems identified ³
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OTHER COUNTRIES⁵

ETHIOPIA	Stunt
IRAN	Stunt and some other viruses
LEBANON	<i>R. bataticola</i> (dry root rot), Stunt
PAKISTAN ⁶	<i>F. oxysporum</i> f. sp. <i>ciceri</i> (wilt), Stunt
SUDAN	Stunt
SYRIA	<i>R. bataticola</i> (dry root rot), Stunt
TURKEY	Stunt, <i>R. bataticola</i> (dry root rot)

¹In most cases these represent experiment stations, but the diseases were observed in areas around.

²The order in which diseases are listed represent the order of prevalence.

³Experimental plantings in summer.

⁴Description of this disorder is not included in this publication.

⁵Only countries visited and the diseases actually seen have been mentioned. In many of these countries, *Ascochyta* blight is more serious than any of the diseases listed above.

⁶Personal communication from Dr. A. K. Auckland, former ICRISAT chickpea breeder.

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