

SEMIS Seed Quality Assurance: Classifying Seedlings (maize, soybean, bean, sorghum, rice)

Michael Stahr CSA,CGT

Iowa State University Seed Laboratory

Seed Enterprises Management Institute

University of Nairobi

Seed Germination:

emergence & development from the seed embryo of those essential structures which, for the kind of seed in question, are indicative of the ability to produce a normal plant under favorable conditions

(AOSA Rules for Testing Seeds)

Seed Enterprises Management Institute

University of Nairobi

Planting Options

Corn

<u>Substrate</u>	<u>Temp.</u>	<u>1st Ct.</u>	<u>Final</u>
B,T,S,TC, TCS	20-30, 25°C	4 days	7 days (AOSA)
BP, S	20-30, 25, 20	4 day	7 days (ISTA)

Soybeans

B,T,S TC, TCS	20-30, 25 °C	4 days	8 days (AOSA)
BP,S	20-30, 25 °C	5 days	7 days (ISTA)

SEMLS UoN
Seed Enterprises Management Institute
University of Nairobi

Germination Terms

Normal: necessary structures are present and are not badly damaged. “Seedling doesn’t have to be vigorous”.

Abnormal: structures missing or are severely damaged.

Dead: no signs of life (or very little).

Dormant: “not present” in corn. Seeds don’t germinate when presented with conditions necessary for germination

Hard: present in legumes (dicots), such as soybean and field beans.

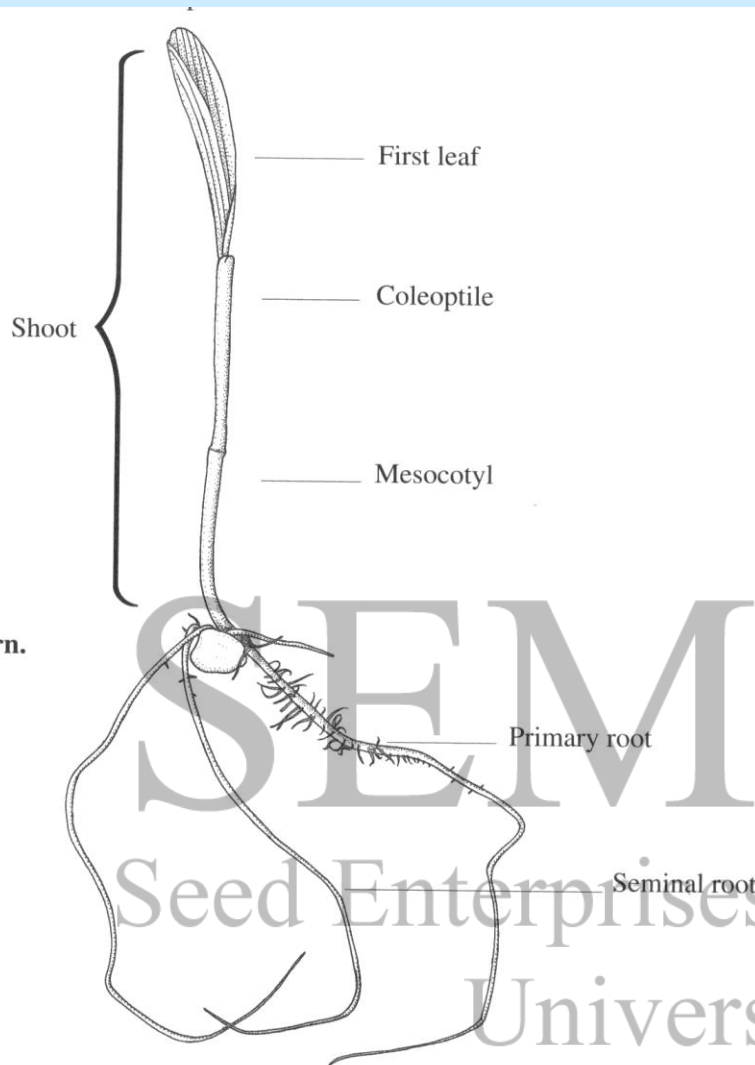


Fig. 21.1 Corn.



Normal Seedling:

Vigorous roots -

Primary and seminal

Leaf greater than halfway up
coleoptile.

Leaf not badly shredded or split

Corn Abnormal Seedling Description

Root:

- none
- weak, stubby or missing primary root with weak seminal roots

Seedling:

- decayed at point of attachment to the scutellum
- one or more essential structures impaired as a result of decay from primary infection.
- Albino

Corn Abnormal Seedling Description

Shoot:

- missing
- no leaf
- leaf extending less than halfway up into the coleoptile
- leaf badly shredded or longitudinally split
- Leaf protruding below the tip of the coleoptile

Rule change



New with Rule Change

The following damage to coleoptile with sufficient damage to first leaf causes seedlings to be abnormal:

- split more than 1/3 length from tip
- strongly bent over
- tip damaged or missing
- split at any location below the tip.

SEMI'S UoN
Seed Enterprises Management Institute
University of Nairobi

New with Rule Change

Seedlings are abnormal with following damage to coleoptile if the first leaf has not emerged at time of evaluation:

- tip damaged or missing
- split for more than 1/3 of length from tip

SEMI S U O N
Seed Enterprises Management Institute
University of Nairobi

Substrata Considerations

Rolled Towels:

- Seedlings tend to have longer mesocotyls than seedlings grown on CCP or in sand (especially seeds planted lower on the towels).
- The corresponding short coleoptile can make determining whether a leaf is more than halfway up the coleoptile difficult.

Seed Enterprises Management Institute
University of Nairobi

Substrata Considerations

Crepe Cellulose Paper:

- Water travels downward, but not sideways. Unlike towels or sand (without CCP), a dry spot probably will remain dry.
- Seeds that are not pressed firmly into CCP may have short shoots in corn or short hypocotyls in soybeans – with longer roots.
- Spidery roots can be a problem on CCP, but are not on towels or sand.
- Watch for seeds that roll off CCP onto edges of tray.
- Trays with CCP are quick to water, plant, and evaluate.
- CCP is quite a bit more expensive than towels.



Test Conditions

Discoloration of leaves is from high humidity in a germination cart.

Seedlings were planted on crepe cellulose paper on a tray.

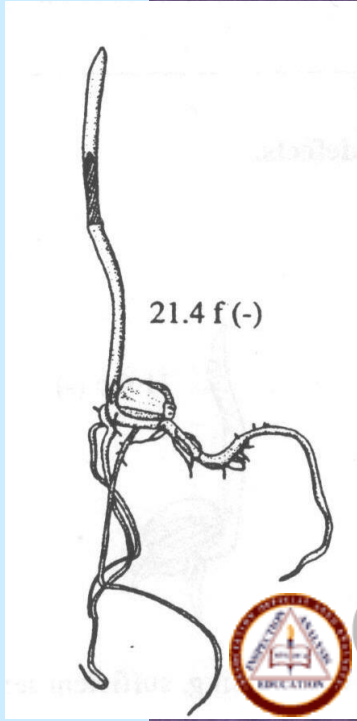
Some varieties are more tolerant to high humidity than others.

Seedlings are **normal**.

Half-Filled Coleoptiles

The primary leaf must be more than half-way up the coleoptile to be normal.

Measurement is from the node to the tip of the coleoptile.



Node

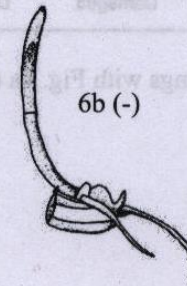


Damaged shoot



All seedlings on this page should be classified as abnormal on a warm germination test.

Fig. 6 Root defects.



6b (-)



6c (-)

6a. Primary root missing, sufficient seminal roots.

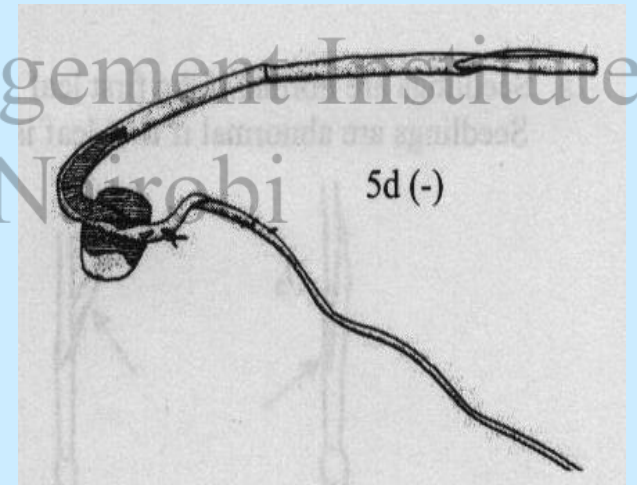
6b. Primary root missing, insufficient seminal roots.

6c. Insufficient roots.

Decayed shoots (from primary infection).

Typical?

Non-Typical?



5d (-)



- 21. 3 a. Leaf damaged, coleoptile tip damaged (see also Fig. 21.7)
- 21. 3 b. Leaf badly split.
- 21. 3 c. Leaf shredded.
- 21. 3 d. Leaf damaged.

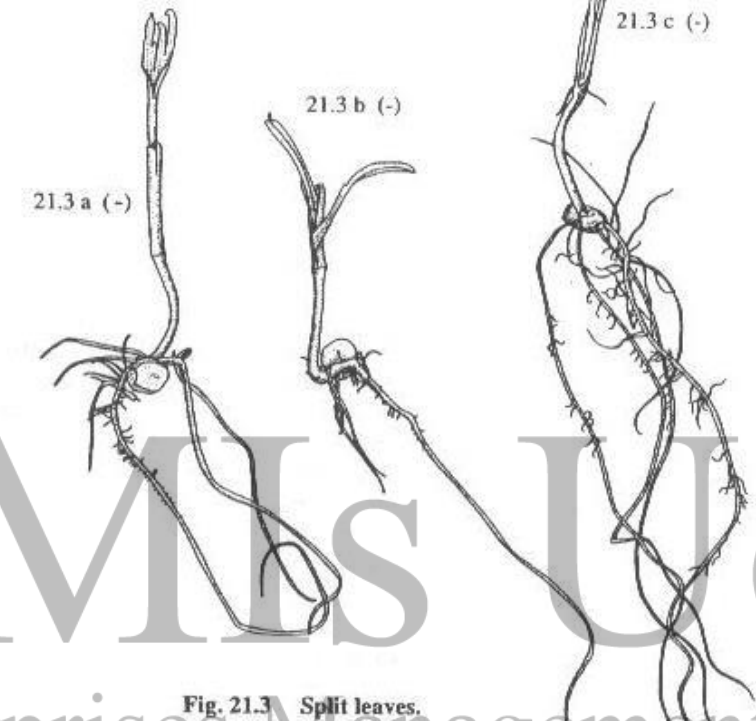


Fig. 21.3 Split leaves.

Badly shredded leaves

Leaves split or shredded
at least one-half.

Amount of split not designated in word description.





Normal

(leaf curled due to test conditions)

21.4 a (+)

21.4 b (+)

Abnormal

21.4 c (-)

Abnormal

21.4 d (-)

Normal

SEMI-UNION
Seed Enterprises Management Institute
University of Nairobi

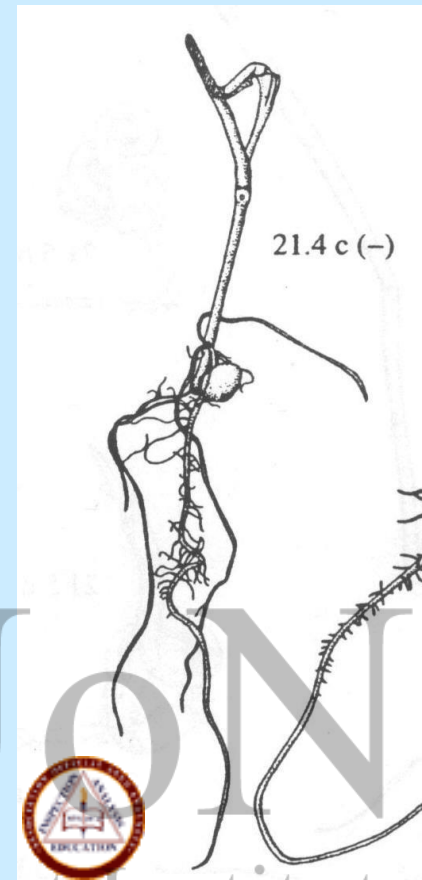
Coleoptile damage

Previously, AOSA was not concerned with the coleoptile damage on any of these seedlings.

ISTA would have called them all abnormal.

Now seedlings 1 & 2 are normal if leaves not badly shredded.

Seedling 3 is always abnormal.





All seedlings abnormal.

First leaf has not emerged:

Coleoptile tip damaged or missing.

SEMIS UoN
Seed Enterprises Management Institute
University of Nairobi

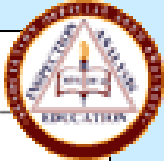
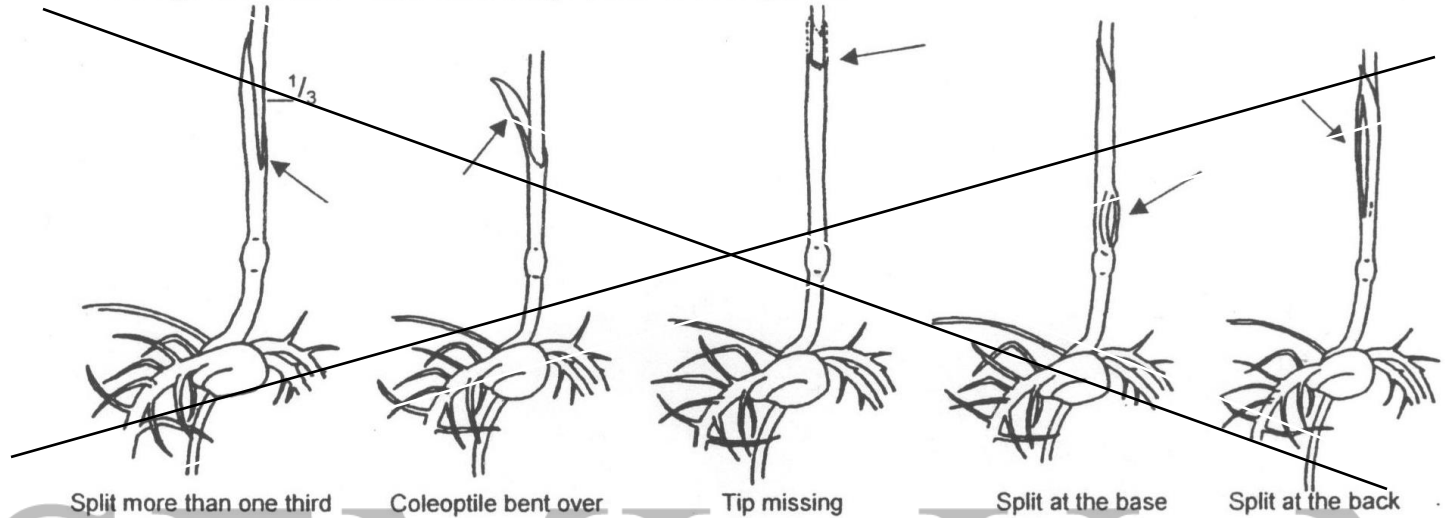


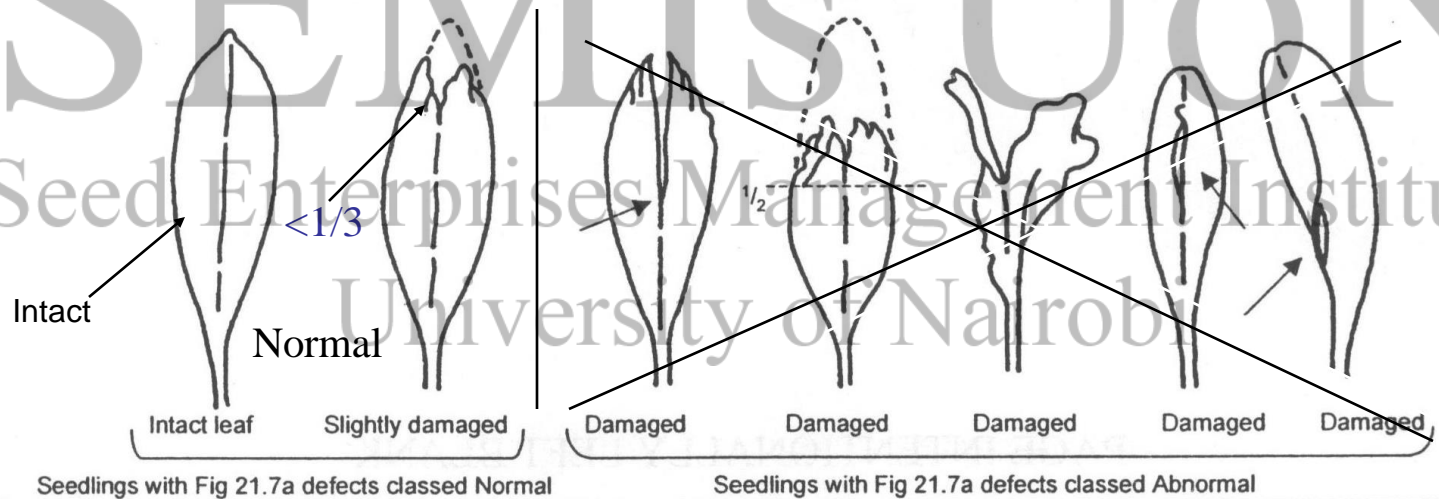
Figure 21.7 Coleoptile defects

21.7a Seedlings are normal if the first leaf is intact or only slightly damaged, as defined in Figure 21.7b. Seedlings are abnormal if first leaf is damaged, as defined in Figure 21.7b

Intact
or
Slight
Damage



21.7b : Definition of intact, slightly damaged and damaged first leaf, for evaluation of seedlings with coleoptile defects.



First two seedlings normal regardless of coleoptile damage

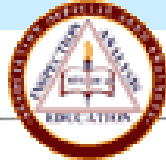
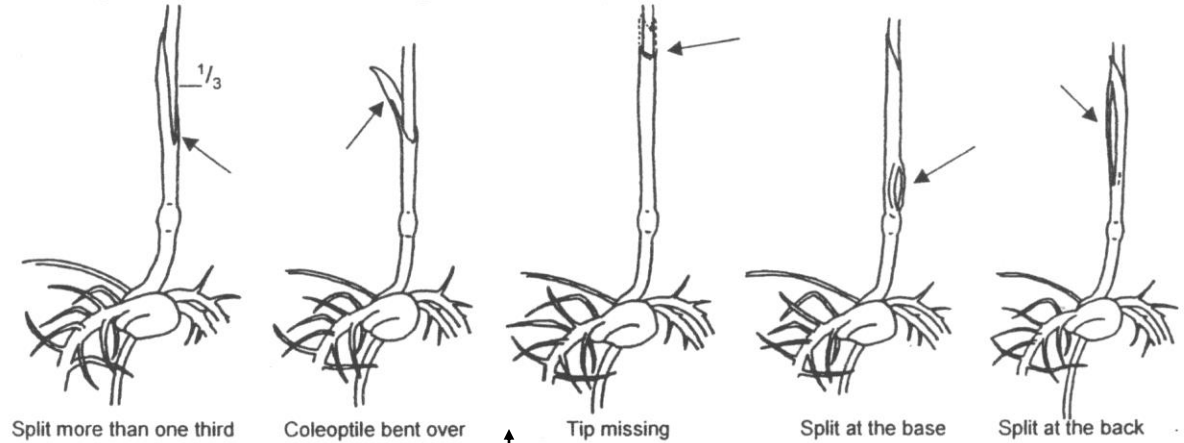
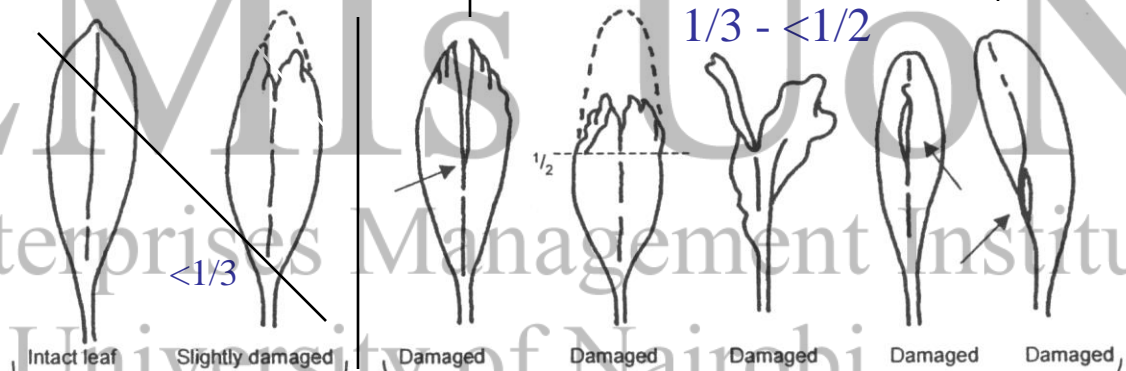


Figure 21.7 Coleoptile defects

21.7a Seedlings are normal if the first leaf is intact or only slightly damaged, as defined in Figure 21.7b. Seedlings are abnormal if first leaf is damaged, as defined in Figure 21.7b



21.7b: Definition of intact, slightly damaged and damaged first leaf, for evaluation of seedlings with coleoptile defects.



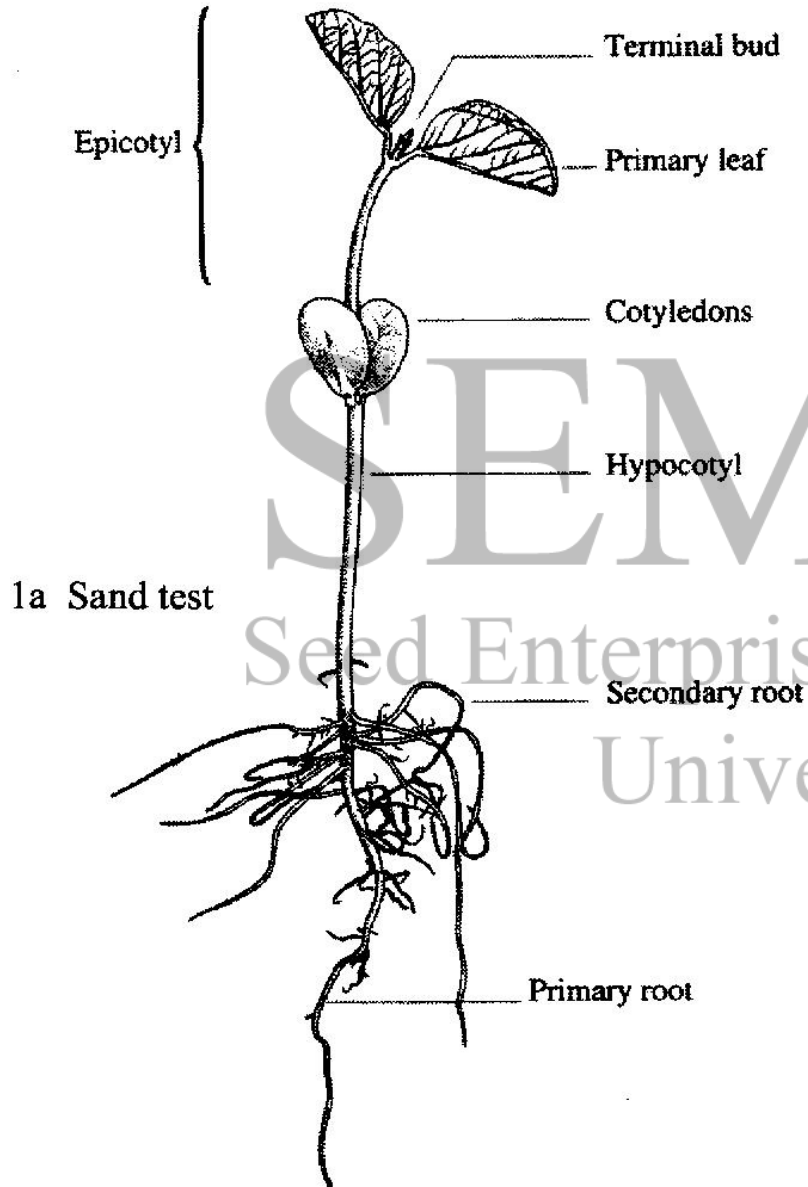
Seedlings with Fig 21.7a defects classed Normal

Seedlings with Fig 21.7a defects classed Abnormal

These damaged seedlings are **normal** if 21.7a coleoptile damage is not present.

If split $1/2$ or more: Abnormal regardless of coleoptile

Normal Seedling



Roots: vigorous primary or two or more secondary roots.

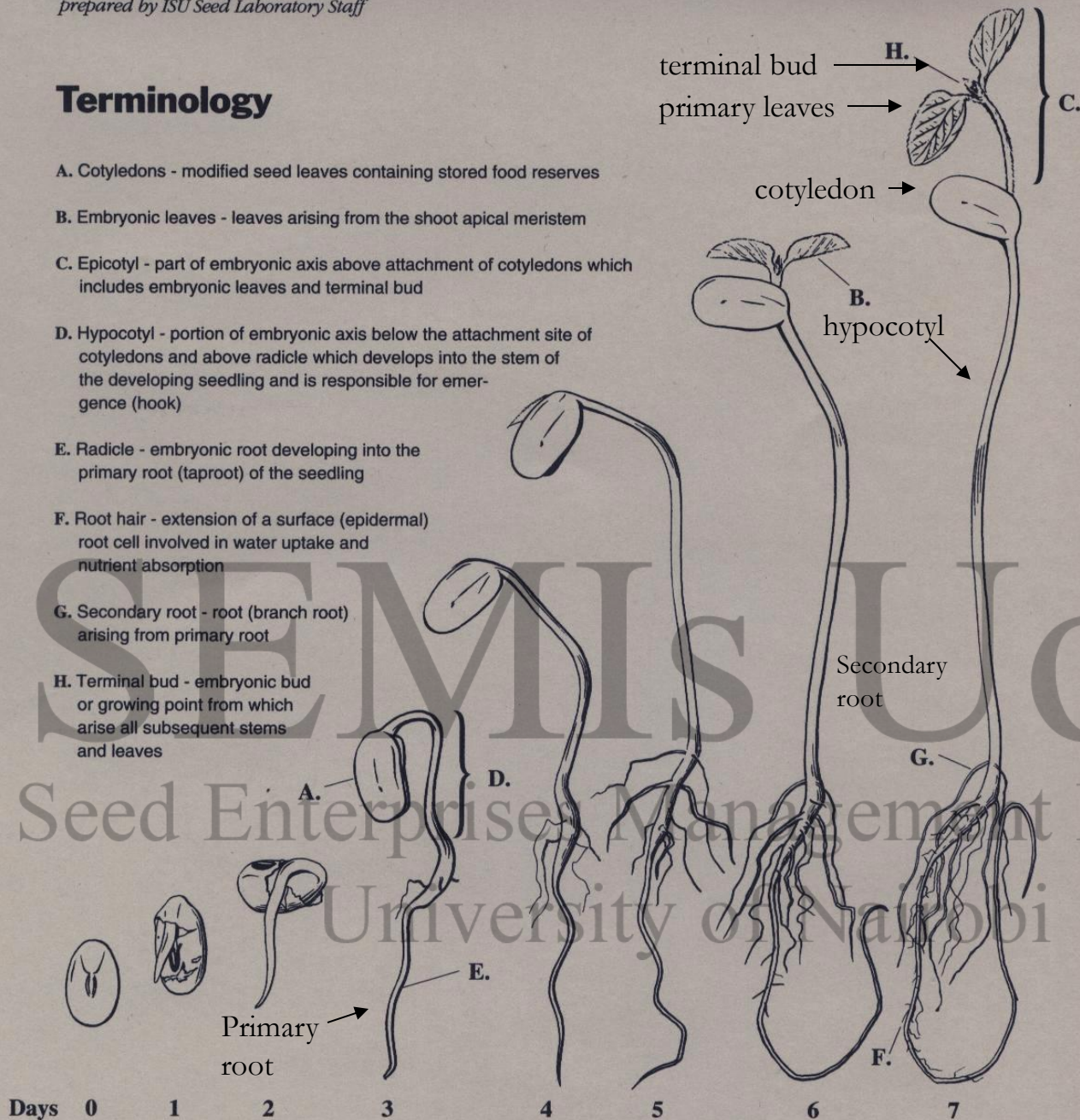
Hypocotyl: not markedly shortened or thickened

Cotyledons: one or two halves (50%)

Epicotyl: at least one primary leaf; terminal bud present.

Terminology

- A. Cotyledons - modified seed leaves containing stored food reserves
- B. Embryonic leaves - leaves arising from the shoot apical meristem
- C. Epicotyl - part of embryonic axis above attachment of cotyledons which includes embryonic leaves and terminal bud
- D. Hypocotyl - portion of embryonic axis below the attachment site of cotyledons and above radicle which develops into the stem of the developing seedling and is responsible for emergence (hook)
- E. Radicle - embryonic root developing into the primary root (taproot) of the seedling
- F. Root hair - extension of a surface (epidermal) root cell involved in water uptake and nutrient absorption
- G. Secondary root - root (branch root) arising from primary root
- H. Terminal bud - embryonic bud or growing point from which arise all subsequent stems and leaves



Soybean Abnormal Seedling Description

Root:

- none
- weak, stubby or missing primary root with weak secondary or adventitious roots.

Hypocotyl:

- deep open cracks extending into the conducting tissue.
- malformed, such as markedly shortened, curled or thickened.

Soybean Abnormal Seedling Description

Cotyledons:

- less than half of the original cotyledon tissue remaining attached.
- less than half of the original cotyledon tissue free of necrosis or decay.

Seedling:

- one of more essential structures impaired as a result of decay from primary infection.
- albino

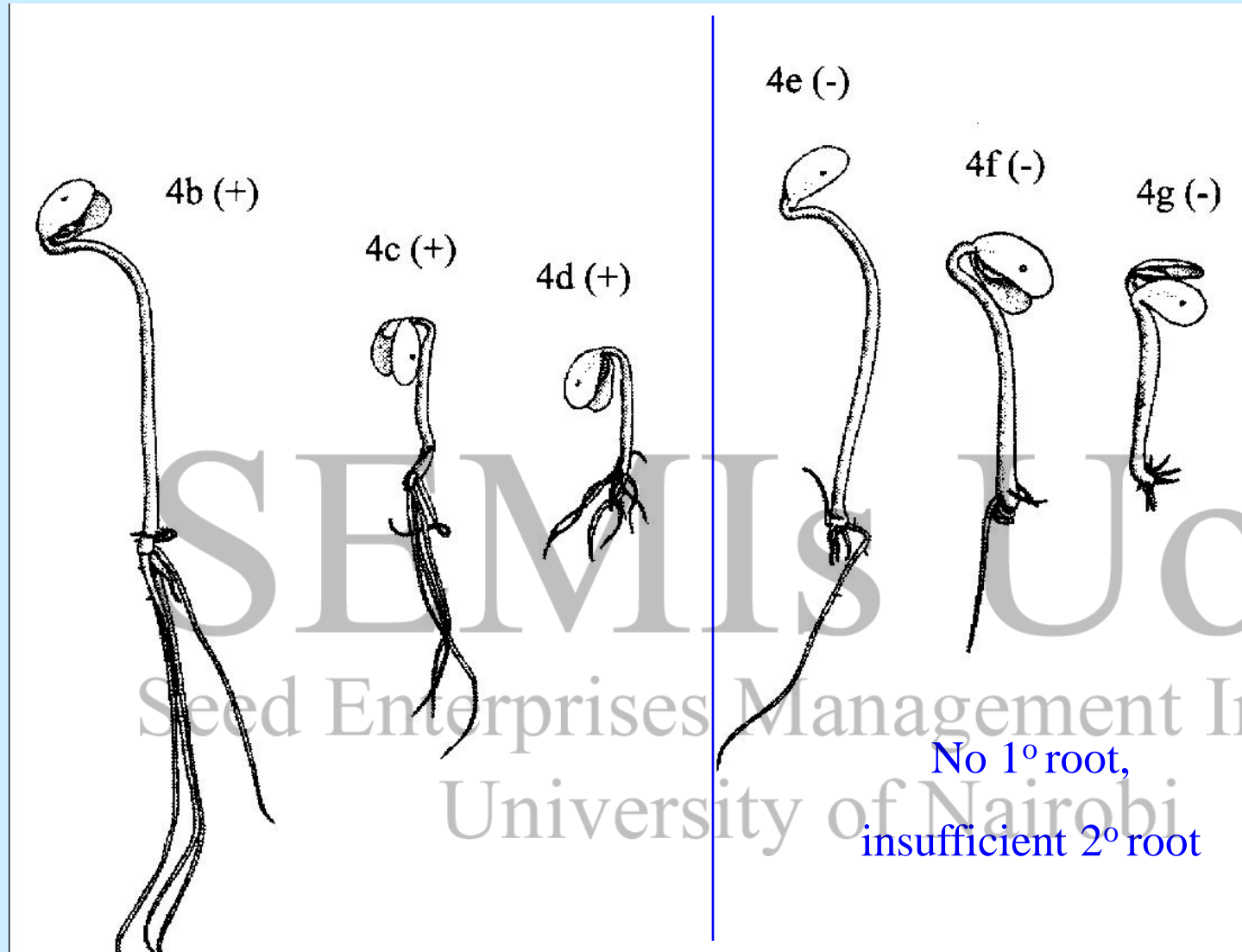
Soybean Abnormal Seedling Description

Epicotyl:

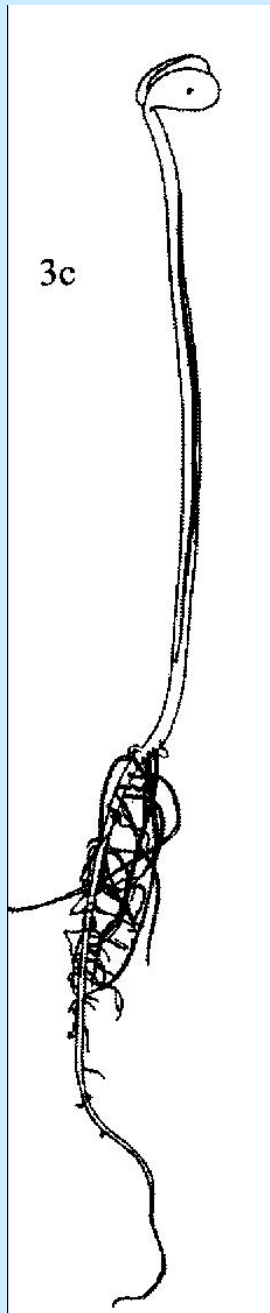
- missing
- less than one primary leaf.
- deep, open cracks.
- terminal bud damaged, missing or decayed.

SEMMIS UoN
Seed Enterprises Management Institute
University of Nairobi

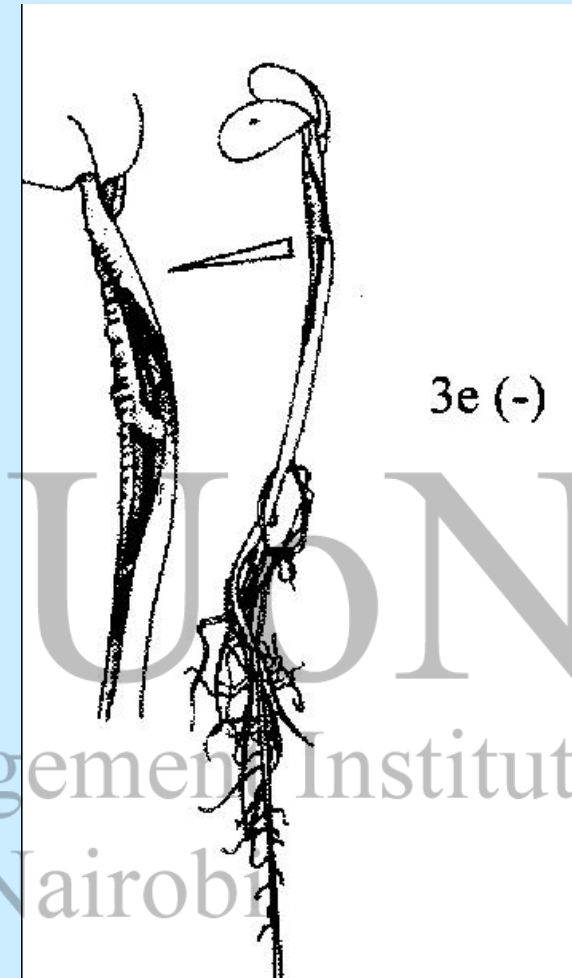
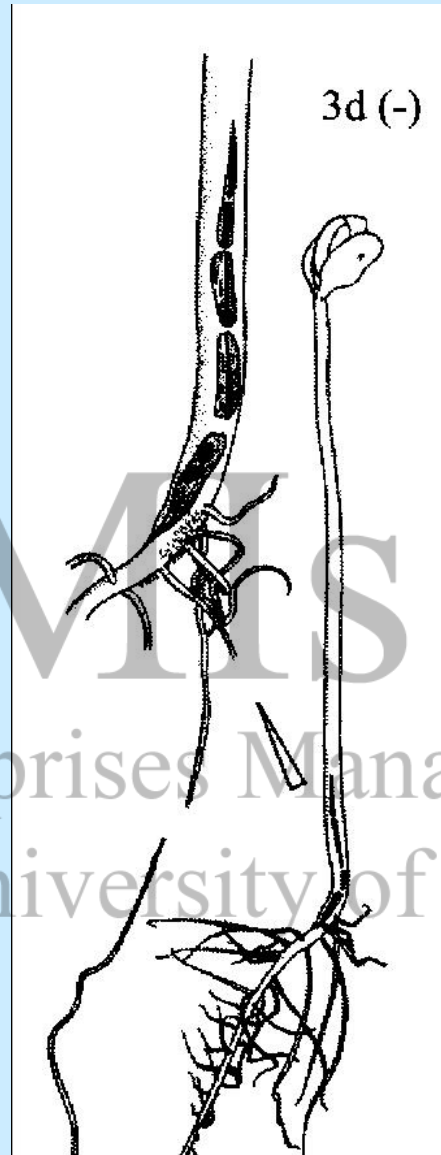
Seedlings



Hypocotyl Lesions

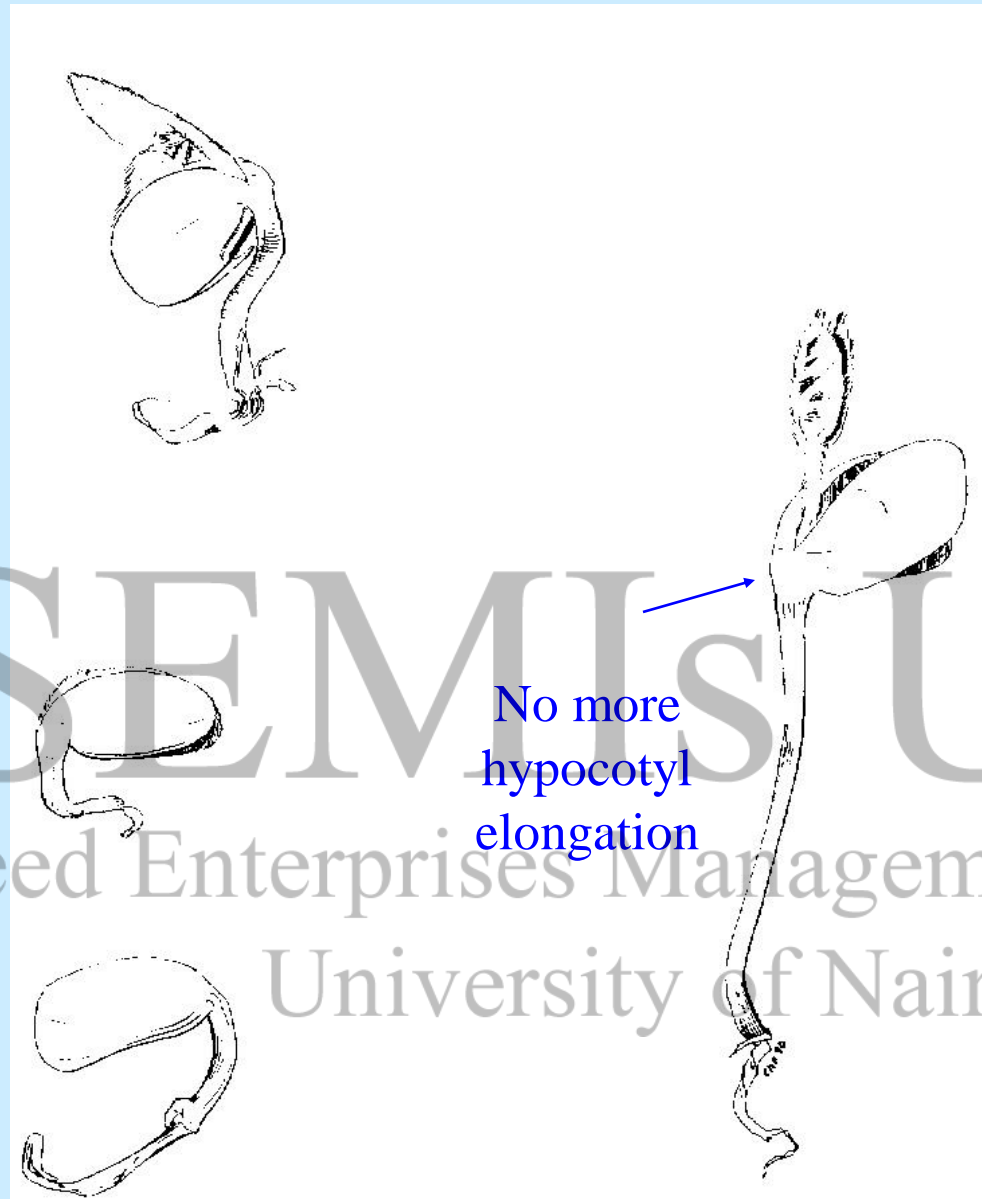


Superficial
lesion



SEMAIS UON
Seed Enterprises Management Institute
University of Nairobi

Short, Damaged Hypocotyls

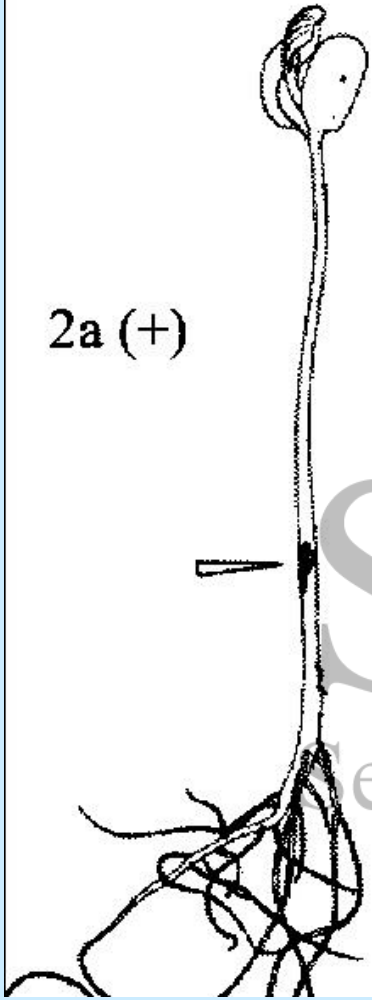


SEMISUON
Seed Enterprises Management Institute
University of Nairobi

Primary vs. Secondary Infection

Fig. 2 Decay.

2a (+)



2b (+)

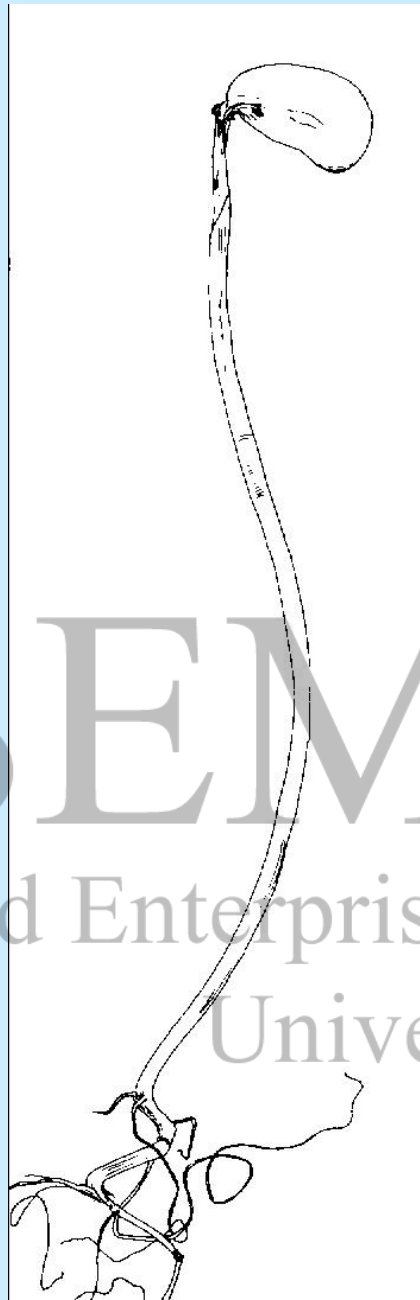


2c (-)



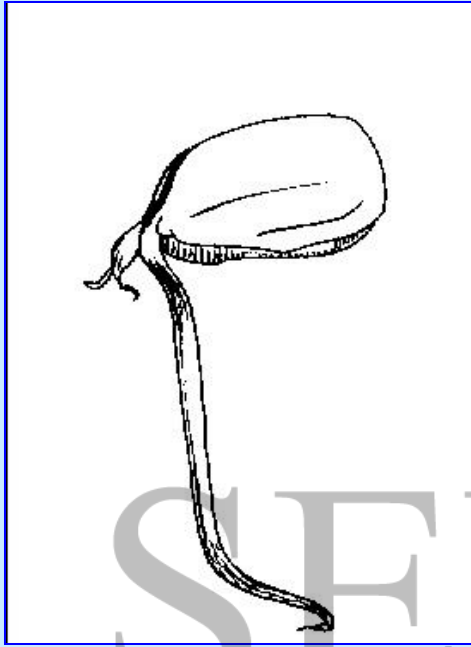
Epicotyl

Must have at least one intact primary leaf and an intact terminal bud (growing point).



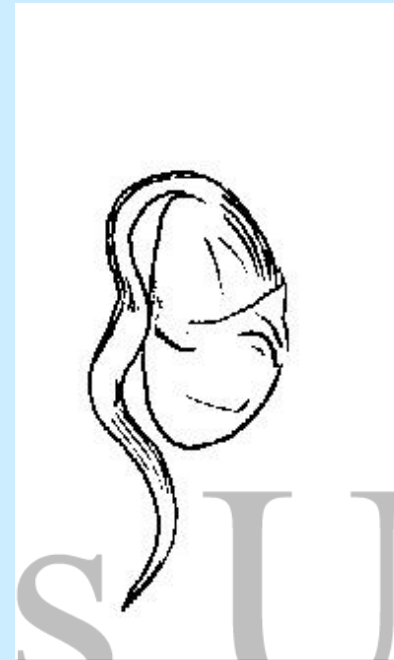
SEMIs UoN
Seed Enterprises Management Institute
University of Nairobi

Seedlings



ISU

Damaged point of attachment (abn)

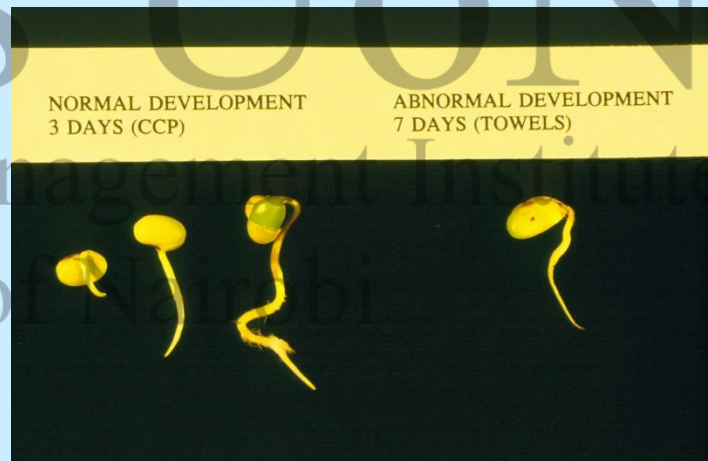
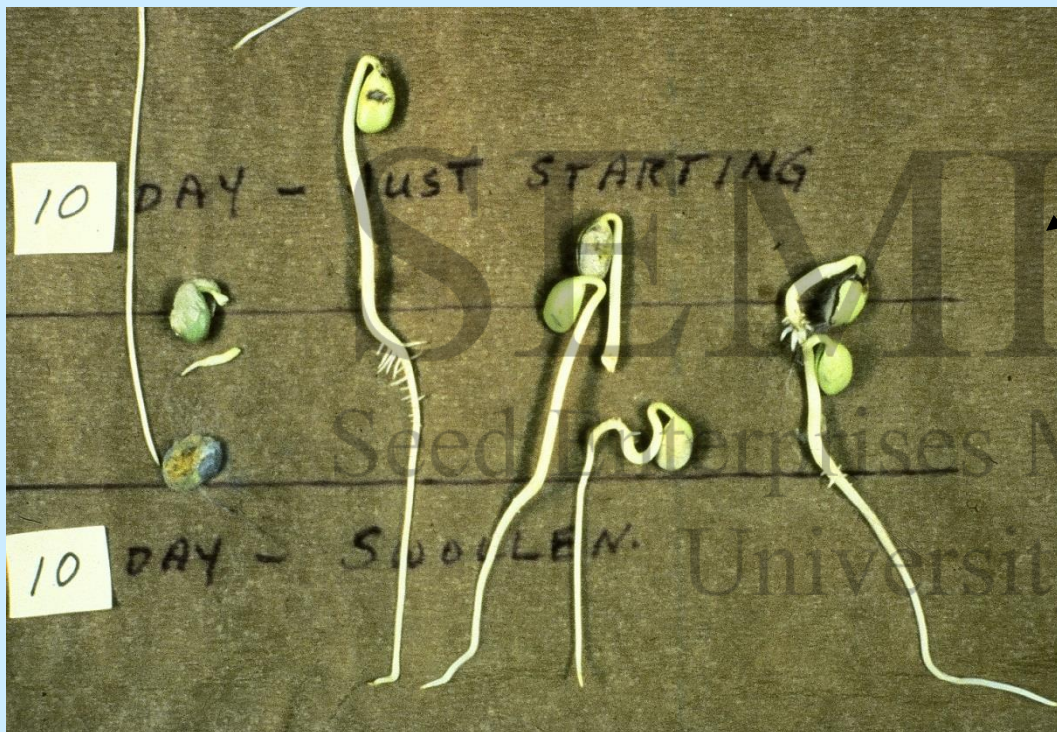
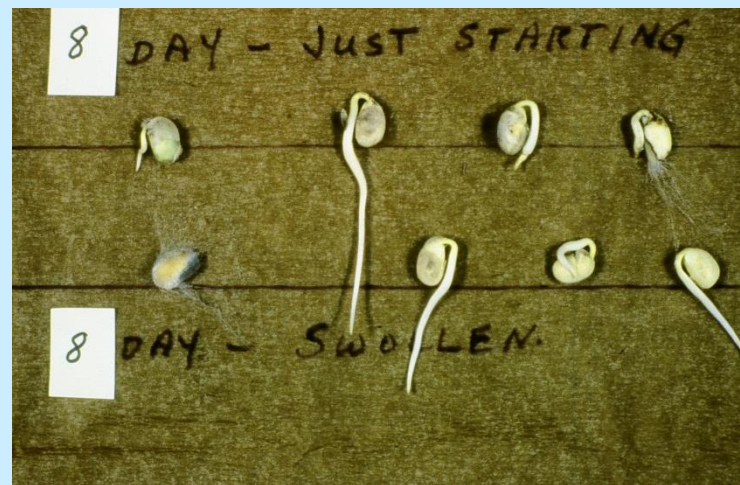
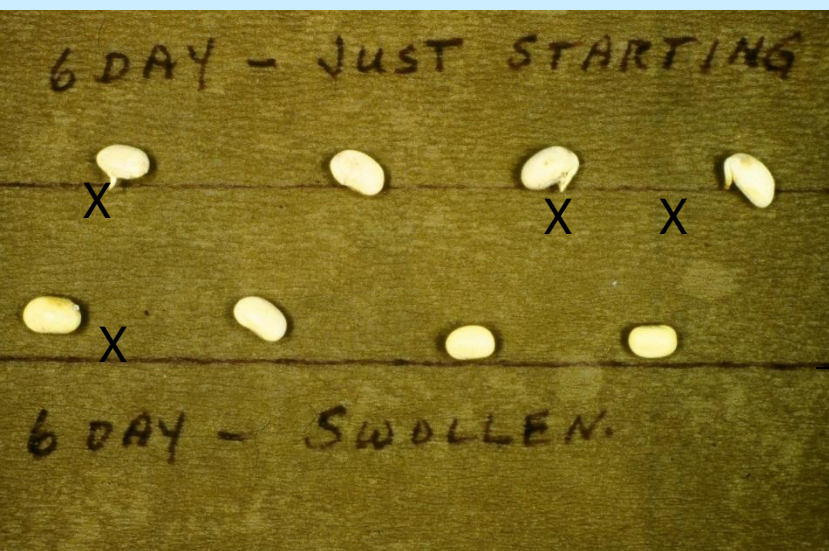


ISU

Late-starting seedling (abn)

Extend 2-5 days

How quickly to end a test?



Phomopsis –
dead seed



?



Normal



Damaged point
of attachment



Decayed
cotyledons –
A. flavus



Insufficient
roots +
epicotyl
showing



Negative
geotropism



Normal



SEEDS UoN
Seed Enterprises Management Institute
University of Nairobi