

Needs major updates-it is amazing that this section has no sketches at all!

Volume 4. Seedling Evaluation

APIACEAE, CARROT FAMILY

Anethum graveolens, dill
Anthriscus cerefolium, chervil
Apium graveolens, celery and celeriac
Carum carvi, caraway
Coriandrum sativum, coriander
Cuminum cyminum, cumin

Add *Angelica archangelica* and *Eryngium foetidum*.
Note: should we add species that are not listed in Table 6A?

Daucus carota subsp. *carota*, Queen Anne's lace
Daucus carota subsp. *sativus*, carrot
Foeniculum vulgare, fennel
Pastinaca sativa, parsnip
Petroselinum crispum, parsley
Pimpinella anisum, anise

Trachymene coerulea [Araliaceae], blue lace flower

What is the point of including a species from a different family? It makes the volume look unprofessional! Since the affiliation of this species was changed, it should be moved from this section.

GENERAL DESCRIPTION

Seeding type: Epigeal dicot.

Food reserves: Endosperm that is fleshy and firm; long, narrow cotyledons that become leaf-like and photosynthetic.

Shoot system: The hypocotyl elongates and carries the cotyledons above the soil surface. The epicotyl usually does not show any development within the test period.

Root system: A long, slender primary root.

Sketch of normal seedling (carrot) to be added to go with the GENERAL DESCRIPTION part. The sketch will be based on figure 1 (see below).

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.

Epicotyl:

- missing (may be assumed to be present if cotyledons are intact).

Hypocotyl:

- decayed at ~~point of attachment~~. the hypocotyl-cotyledon juncture.
- deep open cracks extending into the conducting tissue. (see section I)
- malformed, such as markedly shortened, curled or thickened. Add spindly to this description.
- watery.

Root:

- weak, stubby or missing primary root (secondary roots will not compensate for a defective primary root). (see note 3) Add spindly to this description. Add following to the Root abnormal descriptions:
-Deep lesions extending into the conducting tissue
-Watery.

Seedling:

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

AOSA Rules for Testing Seeds

NOTES

1. Seed units in the Apiaceae may be schizocarps (two-seeded) or mericarps (one-seeded). Frequent counts should be made on schizocarps, since growing seedlings will separate. Any schizocarp that produces at least one normal seedling is classified as normal; only one seedling per schizocarp is to be counted.

REFERENCES

Wellington, P.S. 1970. Evaluation of seedlings of the Umbelliferae. Proc. Int. Seed Test. Ass. Vol. 35(2):591-597.

See suggested revision to the Notes section on next page,
and suggested addition to the References.

Note: References of all sections need to be updated with any recent literature
directly related to evaluation.

NOTES

1. Seed units in the Apiaceae may be schizocarps (two-seeded) or mericarps (one-seeded). Any schizocarp that produces at least one normal seedling is classified as normal; only one seedling per schizocarp is to be counted. To ensure that seed lots with schizocarps or a mixture of mericarps and schizocarps are properly evaluated, one or more of the following methods should be used:
 - Frequent counts should be made, since growing seedlings will separate
 - Ensure that the seed units are physically separated in the replicate
 - Mark the schizocarps on the media directly after planting
 - When planting seed between substrate, open substrate very slowly to avoid separating seedling(s) from the schizocarps. Remove both halves of the schizocarp and the seedling(s) after counting.
2. On occasion, test conditions within rolled towels may cause firm and healthy hypocotyls to break laterally. In some cases, adventitious roots will form around the area of the hypocotyl break. These seedlings are to be considered normal if no other defects are present. If a high percentage of these seedlings are noted, it is recommended that seeds be retested on a different medium to alleviate the problem and allow for proper evaluation of the seedlings.
3. Some seed lots of *Apium graveolens* and *Foeniculum vulgare* grown on certain media can have markedly shortened primary roots. These seedlings are to be considered normal if the primary root growth is adequate to support the seedling and is well balanced with a symmetrical growth pattern in relation to other essential structures.

REFERENCES

- Wellington, P.S. 1970. Evaluation of seedlings of the Umbelliferae. Proc. Int. Seed Test. Assoc. Vol. 35(2):591-597.
- USDA. 1952. Manual for testing agricultural and vegetable seeds. Agricultural Handbook No. 30. USDA, Washington, D.C.

GENERAL DESCRIPTION

Seedling type: Epigeal dicot.

Food reserves: Endosperm that is fleshy and firm; long, narrow cotyledons that become leaf-like and photosynthetic.

Shoot system: The hypocotyl elongates and carries the cotyledons above the soil surface. The epicotyl usually does not show any development within the test period.

Root system: A long, slender primary root.

Format of revised
GENERAL DESCRIPTION part.
The sketch will be a replica of the
picture to the right.

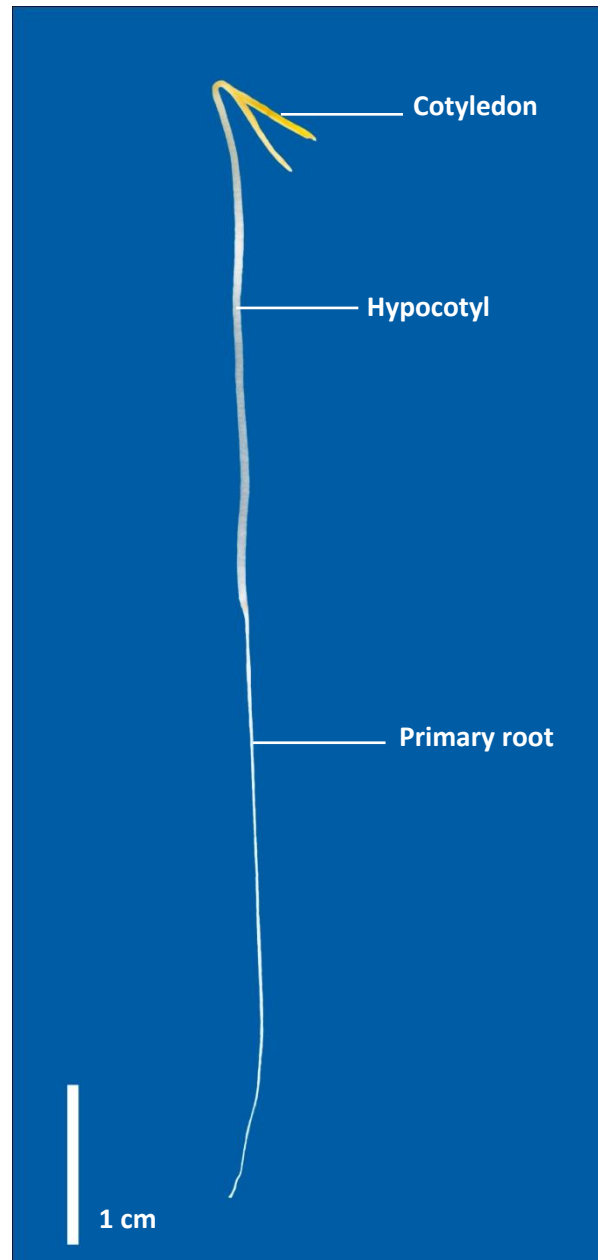


Figure 1. Normal carrot seedling.

Supplemental Pictures

The most obvious deficiency in this section is the lack of sketches. The pictures below (pages numbered 6-11) were previously intended for inclusion in the revised Volume 4. They provided examples of every condition listed under Abnormal Descriptions. Some or all these pictures can be used to develop corresponding sketches. Those pictures, and many more, will now be part of the online database.

Another set of pictures (pages 12-19) was contributed by labs as examples of different abnormalities. This set will not be included in the online database, but select any you think should be depicted as a sketch.



Figure 2. Epigeal germination pattern characteristic of Apiaceae species: parsley seedling soil emergence.

This figure will be moved to Part one of this volume, illustrating difference between hypogeal and epigeal development patterns.

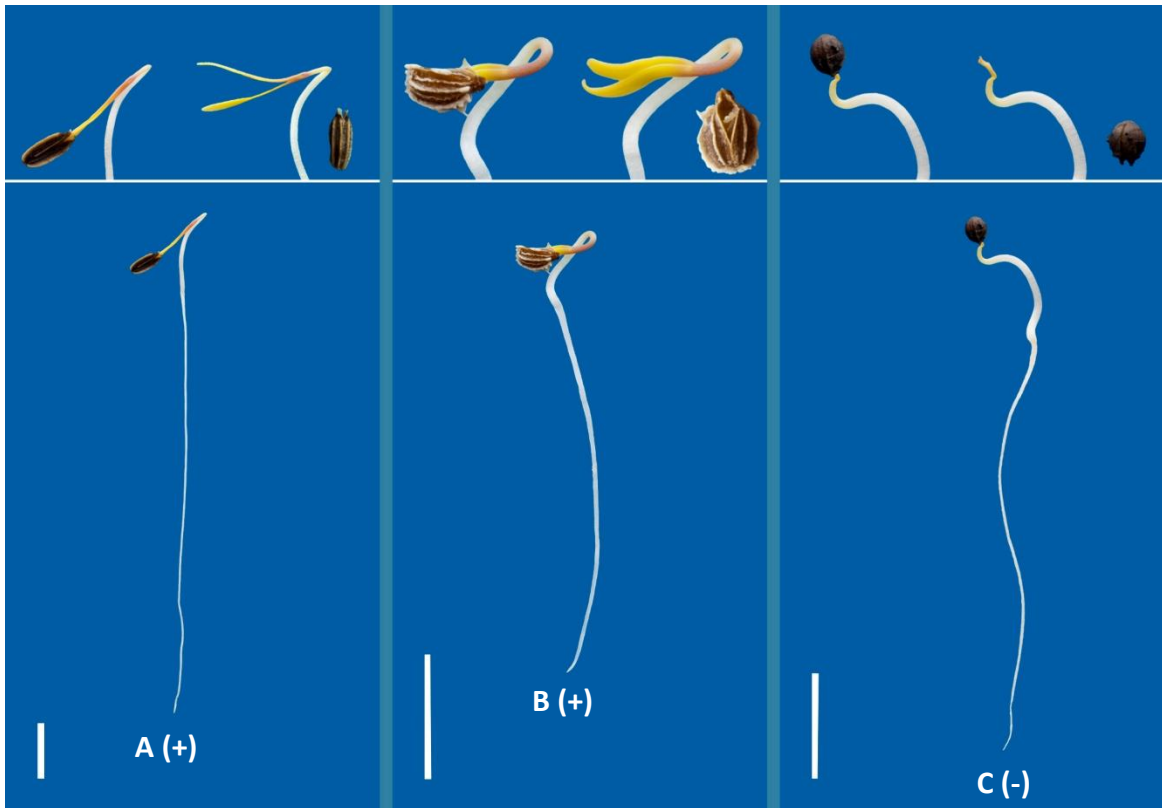


Figure 3-Cotyledon defects. **A:** normal fennel seedling with seed coat attached and more than half of the cotyledons showing, no need to remove seed coat for evaluation; **B:** normal carrot seedling with seed coat attached and less than half of the cotyledons showing, seed coat must be removed and, in this case, revealing normal cotyledons; **C:** abnormal coriander seedling with less than half the cotyledons showing, before and after seed coat is removed, revealing missing cotyledons.

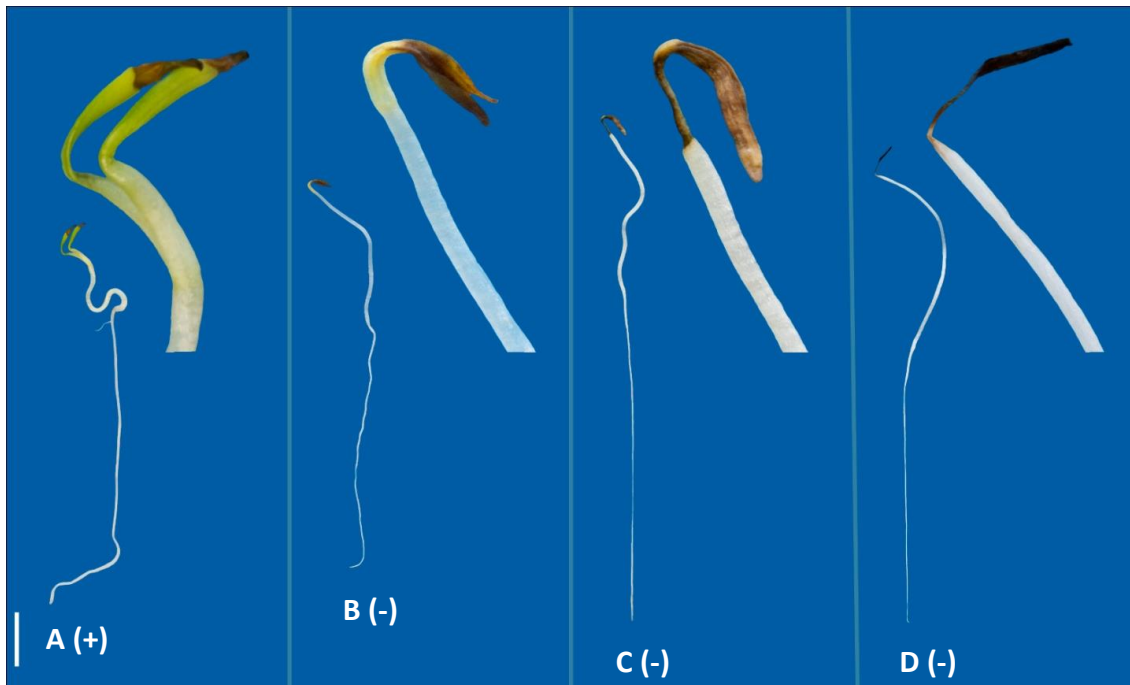


Figure 4-Cotyledon defects. Carrot seedlings. **A:** normal seedling with more than half of the cotyledon tissue free of necrosis; **B:** abnormal seedling with less than half of the cotyledon tissue free of necrosis; **C** and **D:** abnormal seedlings with necrotic tissue extending from the cotyledon to the hypocotyl.

Comment: Fig. 4 D looks like a test condition (the cotyledons are damped off) rather than a true abnormal. I don't think the sprout would have been able to reach such a size if the cotyledons had not been functioning at the beginning of germination.

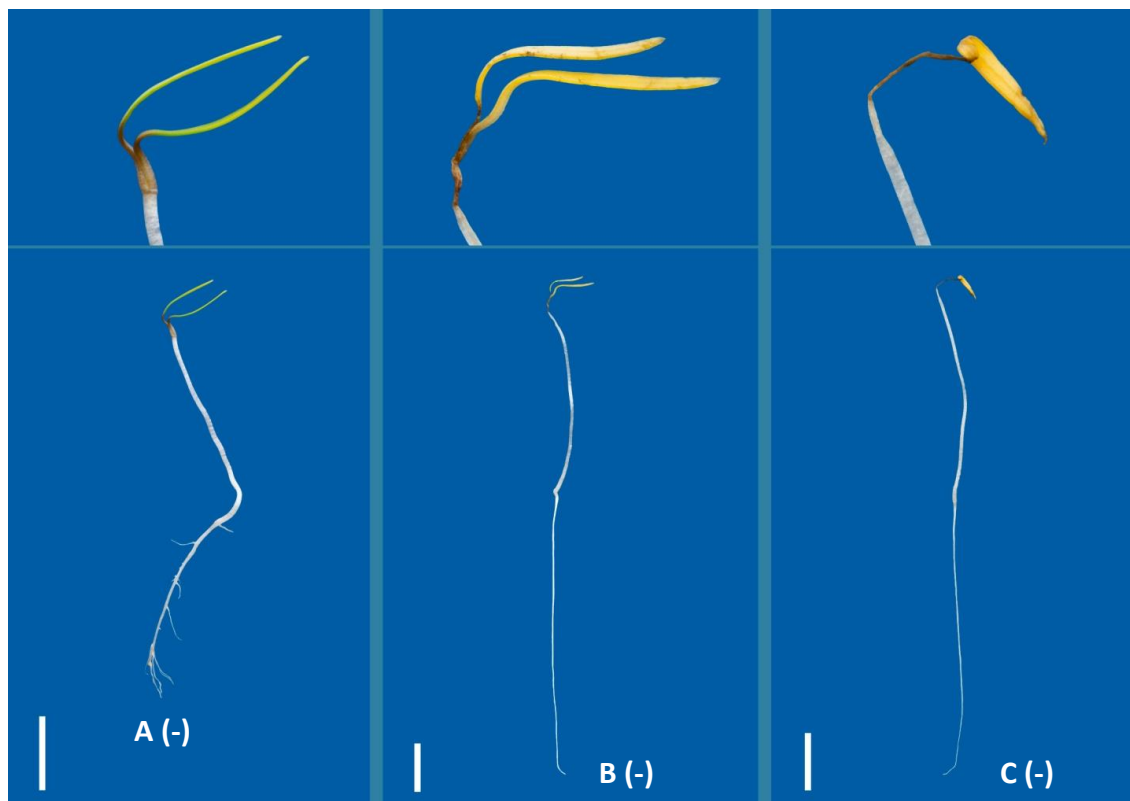


Figure 5-Hypocotyl defects. Abnormal carrot seedlings with varying degrees of decay at the hypocotyl-cotyledon juncture (each picture in top row is a closeup of the picture below).

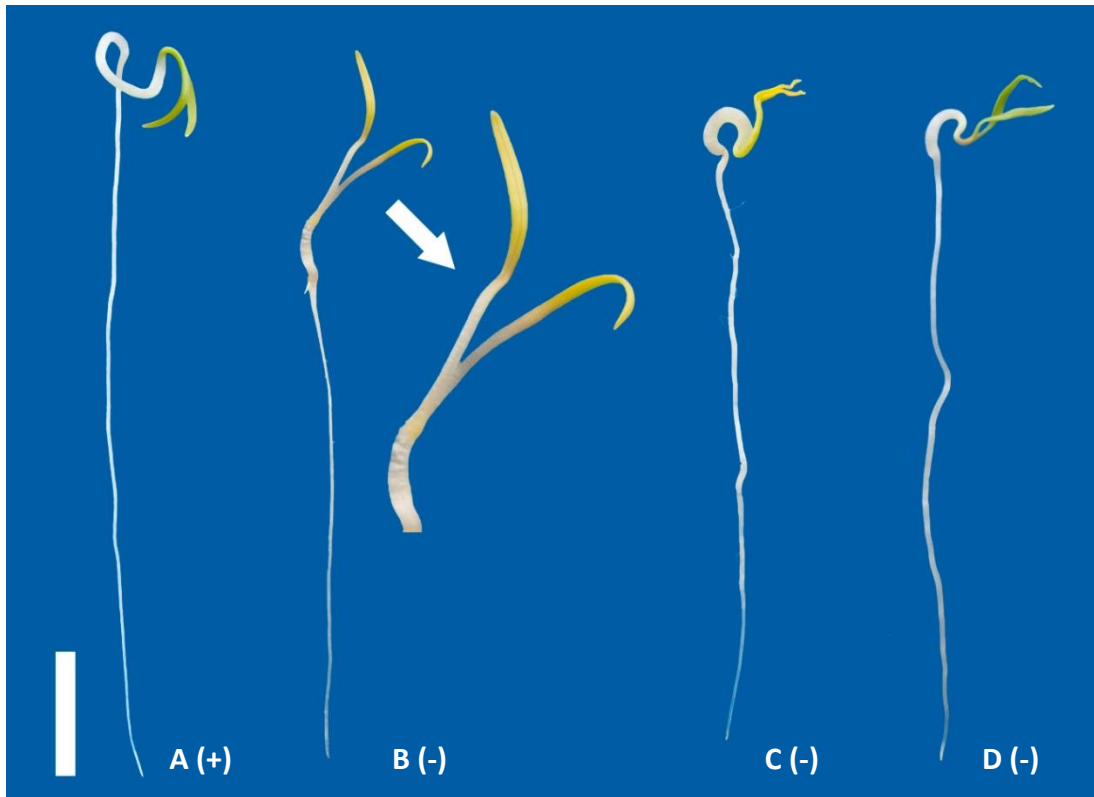


Figure 6-Hypocotyl defects. Carrot seedlings. **A:** normal seedling with curled hypocotyl due to test conditions; **B:** abnormal seedling with short, malformed hypocotyl; **C** and **D:** abnormal seedlings with short, thickened hypocotyls.

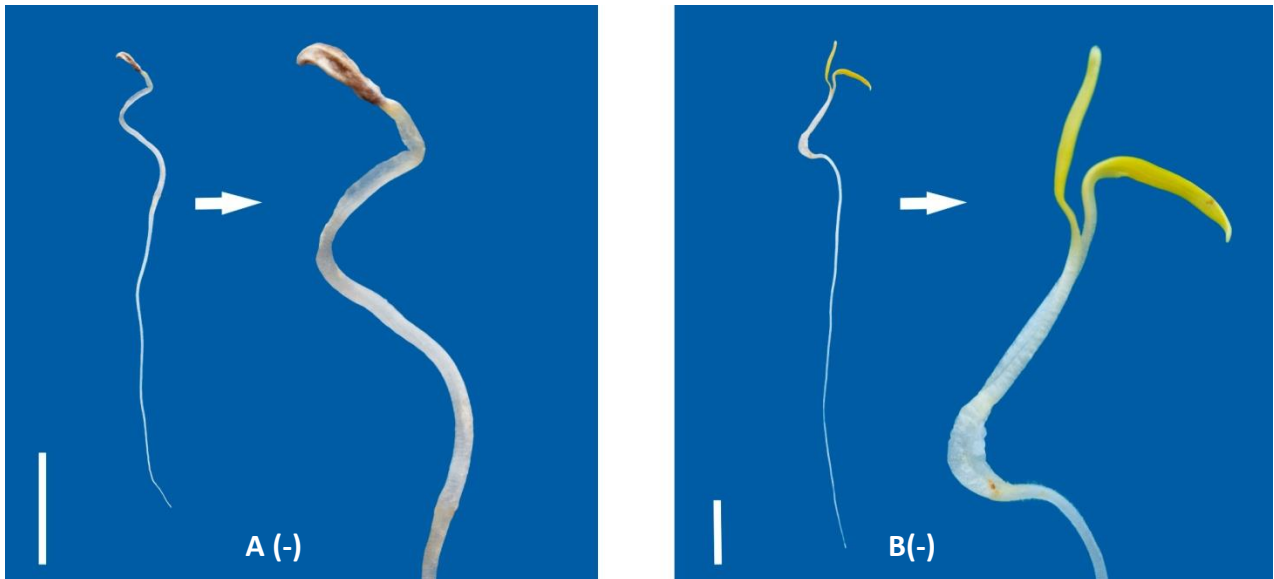


Figure 7-Hypocotyl defects. **A:** abnormal parsley seedling with watery hypocotyl and decayed cotyledons; **B:** abnormal carrot seedling with watery, thickened hypocotyl.

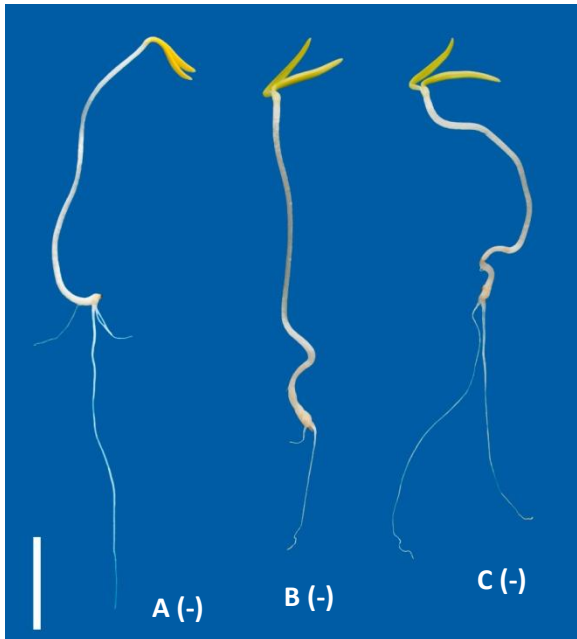


Figure 8-Root defects. Carrot seedlings. **A:** abnormal seedling with missing primary root, secondary roots do not compensate for a defective primary root; **B and C:** abnormal seedlings with stubby primary roots.

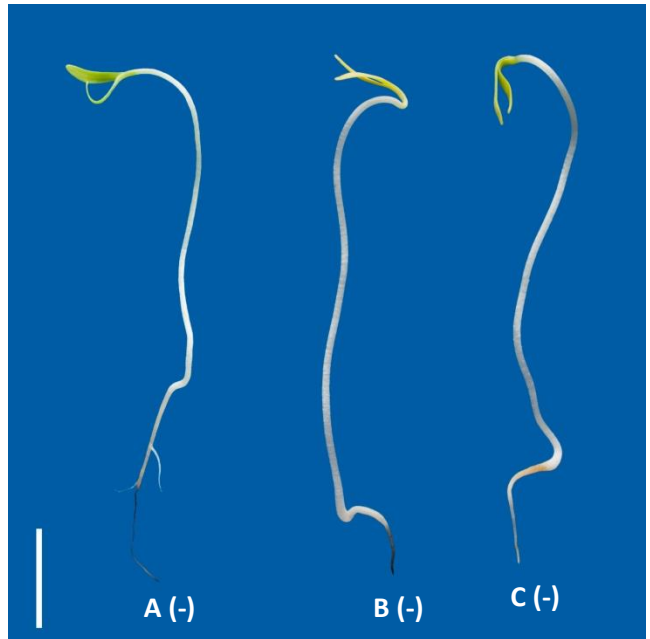


Figure 9-Root defects. Coriander seedlings. **A and B:** abnormal seedlings with weak, decayed primary roots; **C:** abnormal seedling with weak primary root.
Comment: can you include closeups of A, B and C?

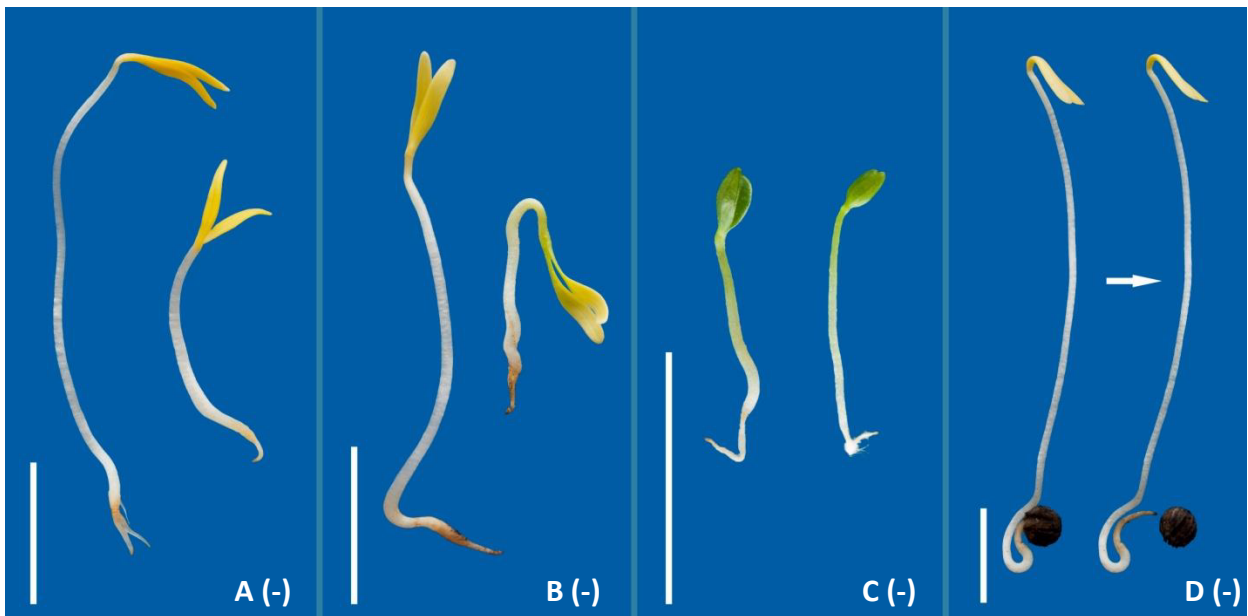


Figure 10-Root defects. **A:** abnormal carrot seedlings with missing (left) and weak, short (right) primary roots; **B:** abnormal coriander seedlings with decayed, short primary roots; **C:** abnormal celery seedlings with short, weak primary roots; **D:** abnormal coriander seedling with weak primary root revealed after the seed coat is removed.

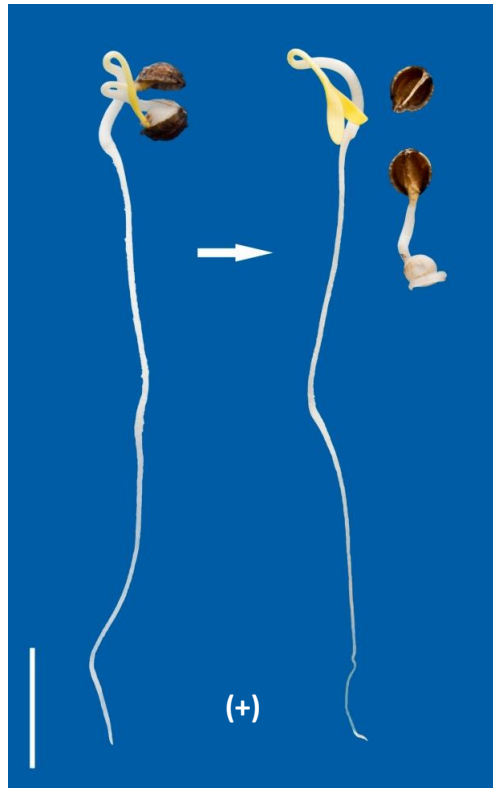


Figure 11: Two-seeded coriander schizocarp with one normal seedling and one abnormal seedling, classified as normal. Only one seedling per schizocarp is to be counted (see note 1).

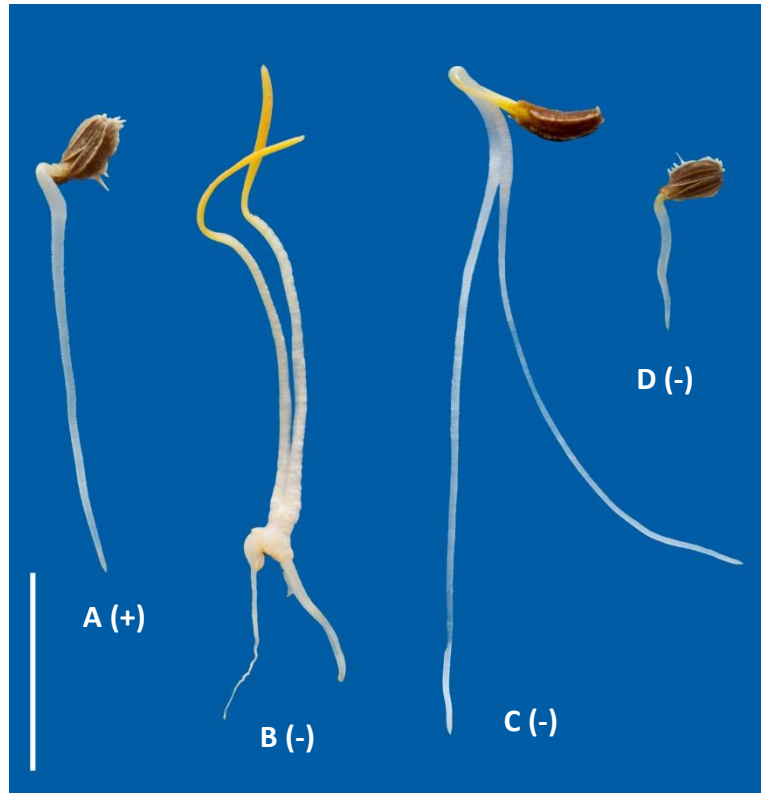


Figure 12-Seedling defects. Carrot seedlings. **A:** normal late germinating seedling; **B:** abnormal seedling with cotyledon point of attachment split past epicotyl into hypocotyl and a broken, swollen, stunted primary root; **C:** abnormal seedling with split primary root; **D:** abnormal watery seedling with damping off at point of attachment.

Comment: the sprout in A looks watery.

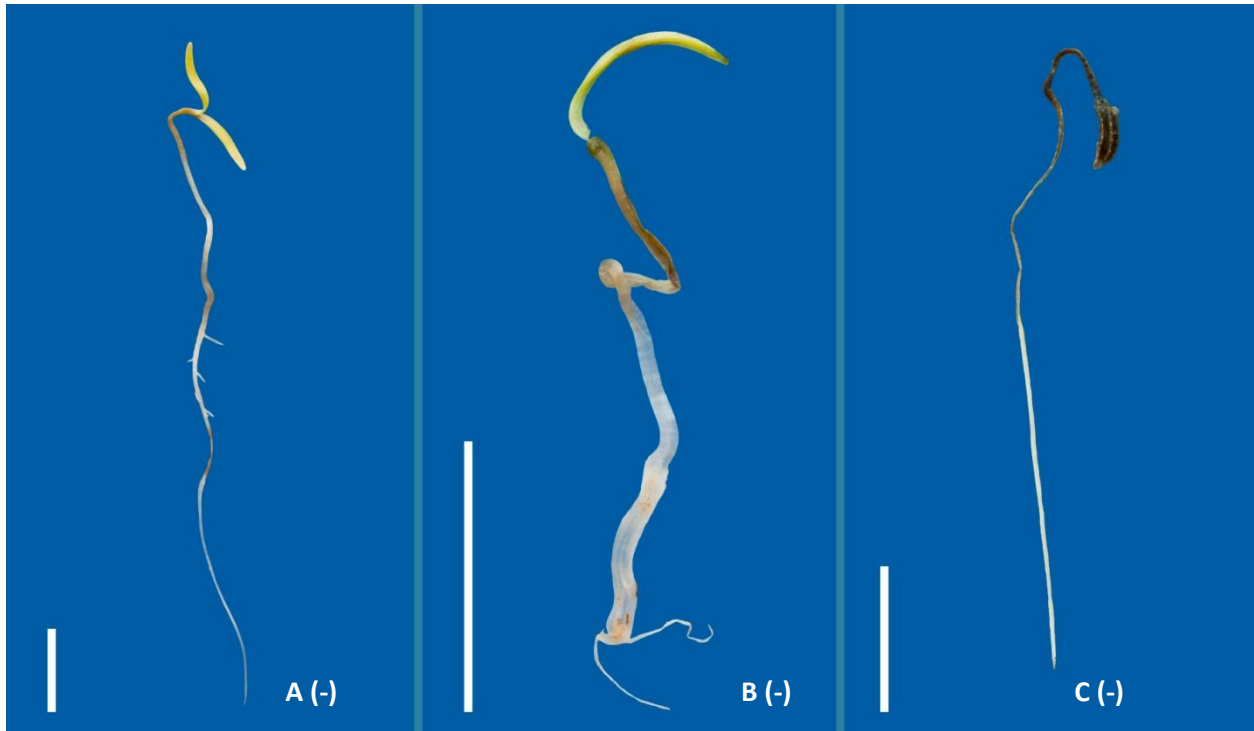


Figure 13-Seedling defects. **A:** abnormal coriander seedling with widespread necrotic areas; **B:** abnormal carrot seedling with watery, thickened hypocotyl decayed at the hypocotyl-cotyledons juncture, and missing primary root; **C:** abnormal carrot seedling with primary infection.

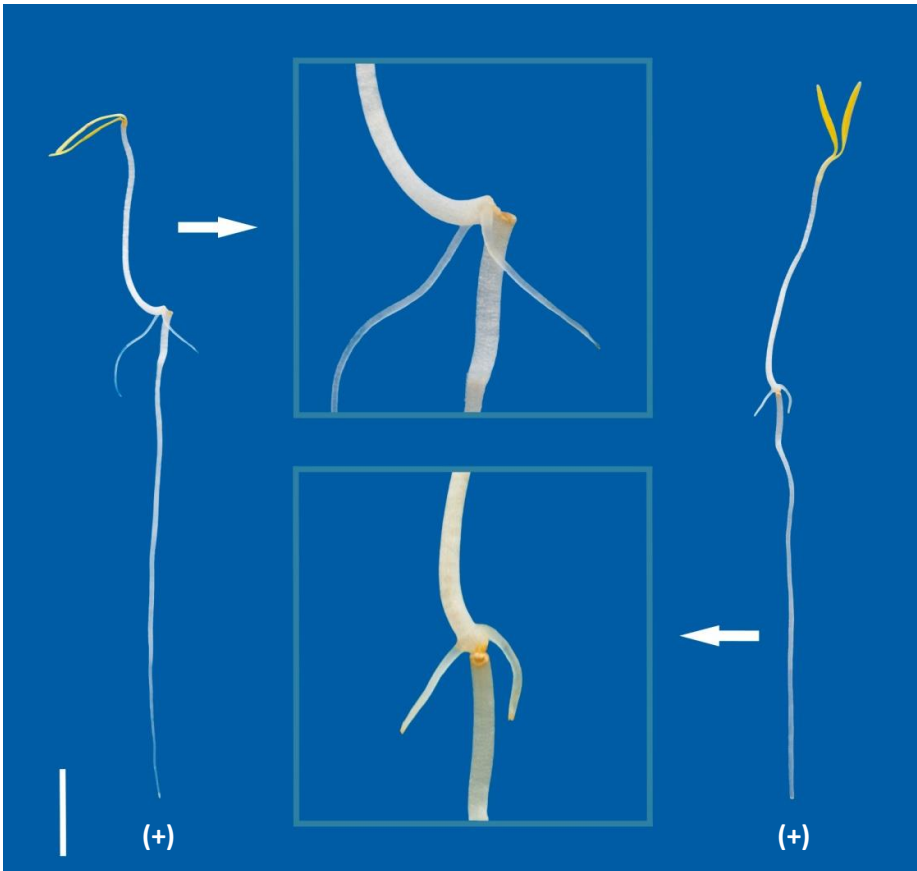


Figure 14. Normal carrot seedlings with lateral breaks due to test conditions (see note 2).

ABNORMAL SEEDLINGS:

□ **COTYLEDON ABNORMALITIES:**

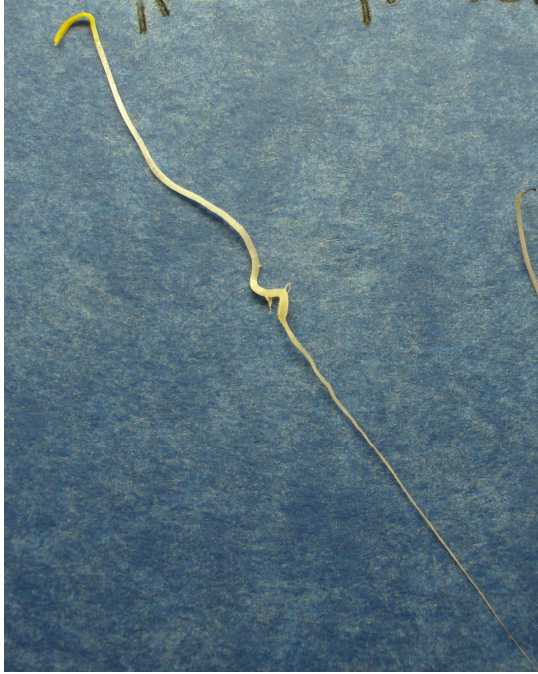


Carrot, *Daucus carota*; left seedling, more than half the original cotyledon tissue free from decay (normal); right seedling, less than half the original cotyledon tissue free from decay (abnormal).

□ **HYPOCOTYL ABNORMALITIES:**



Carrot, *Daucus carota*, decayed at point of attachment



Carrot, *Daucus carota*, deep open cracks extending into the conducting tissue



Carrot, *Daucus carota*, weak and watery

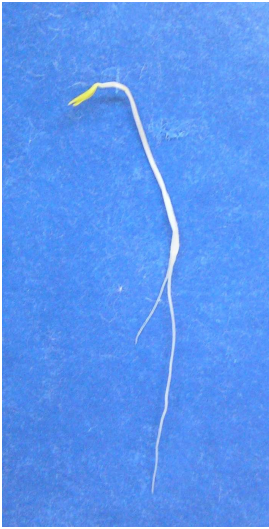


Carrot, *Daucus carota*, seedling malformed

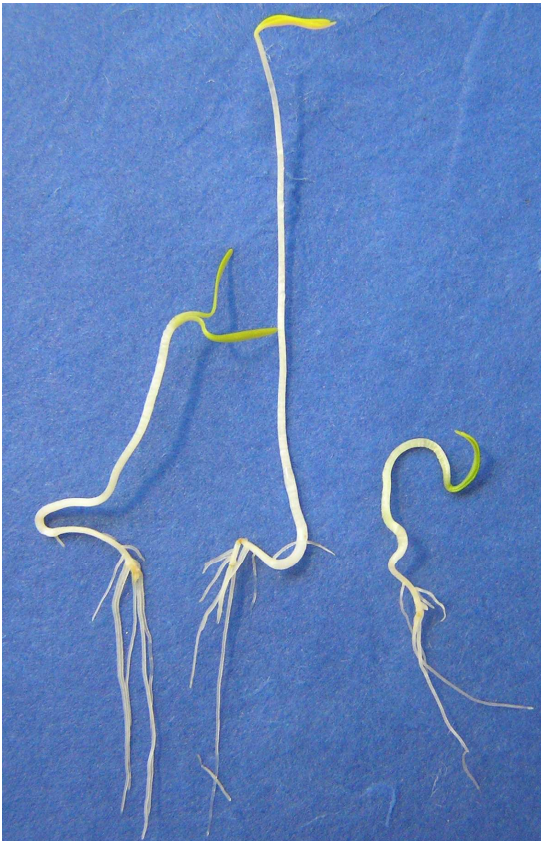


Carrot, *Daucus carota*, watery (flattened) hypocotyl

□ **ROOT ABNORMALITIES:**



Carrot, *Daucus carota*, damaged primary root (split root)



Carrot, *Daucus carota*, missing primary root



Coriander, *Coriandrum sativum*, insufficient root (seedling on left is normal)



Carrot, *Daucus carota*, insufficient root

□ **SEEDLING ABNORMALITIES:**



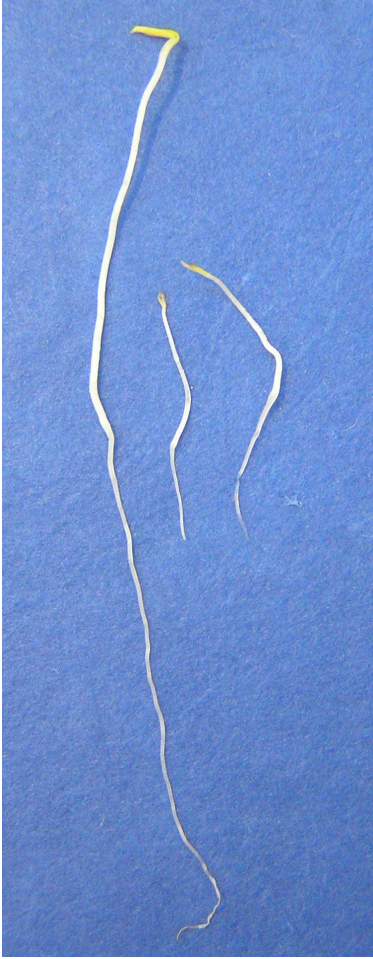
Carrot, decay from primary infection.



Carrot, *Daucus carota*, seedling on left decayed/damping off, seedling on right with damping off and with insufficient root.



Carrot, *Daucus carota*, decay from primary infection



Carrot, *Daucus carota*, Weak seedlings (seedling on left is normal)