

the mesocotyl and coleoptile. Splitting of the coleoptile occurs naturally as a result of growth and emergence of the leaves.

(iv) Root system: A long primary root, usually with secondary roots developing within the test period. Adventitious roots may start to develop from the mesocotyl or coleoptilar node within the test period. Areas of natural, reddish pigmentation may develop on the root.

(2) Abnormal seedling description.

(i) Shoot:

(A) Missing.

(B) Thickened and shortened.

(C) No leaf.

(D) Leaf extending less than halfway up into the coleoptile.

(E) Leaf extensively shredded or split.

(F) Spindly or watery.

(G) Deep open cracks in the mesocotyl.

(ii) Root:

(A) None.

(B) Damaged or weak primary root with less than two strong secondary roots.

(iii) Seedling:

(A) Decayed at point of attachment to the scutellum.

(B) One or more essential structures impaired as a result of decay from primary infection.

(C) Albino.

(e) Grasses and millets.

(1) General description.

(i) Germination habit: Hypogeal monocot.

(ii) Food reserves: Endosperm. The scutellum is a modified cotyledon which is in direct contact with the endosperm. During germination the scutellum remains inside the seed to absorb nutrients from the endosperm and transfer them to the growing seedling.

(iii) Shoot system: The shoot consists of the coleoptile, leaves enclosed in the coleoptile, and the mesocotyl. The coleoptile elongates and pushes through the soil surface. The mesocotyl may or may not elongate significantly, depending on the kind. Splitting of the coleoptile occurs naturally as a result of growth and emergence of the leaves.

(iv) Root system: A long primary root. Secondary or adventitious roots may develop within the test period. In certain kinds (e.g. bermudagrass) the primary root may not be readily visible because it is coiled inside the tightly fitting lemma and palea. At the time of evaluation, the glumes should be removed and the root observed. Such seedlings are classified as normal if the primary root has developed. For Kentucky bluegrass, a primary root  $\frac{1}{16}$  inch (1.6 mm) or more in length is classified as normal.

(2) Abnormal seedling description.

(i) Shoot:

(A) Missing.

(B) Short, thick, and grainy.

(C) No leaf.

(D) Leaf extending less than halfway up into the coleoptile.

(E) Leaf extensively shredded or split.

(F) Spindly or watery.

(G) Deep open cracks in the mesocotyl.

(ii) Root:

(A) Missing or defective primary root even if other roots are present.

(B) Spindly, stubby, or watery primary root.

(iii) Seedling:

(A) Decayed at point of attachment to the scutellum.

(B) One or more essential structures impaired as a result of decay from primary infection.

(C) Albino.

(D) Yellow (when grown in light).

(E) Endosperm obviously detached from the root-shoot axis (e.g. kernel lifted away by the growing shoot).

[59 FR 64501, Dec. 14, 1994, as amended at 65 FR 1708, Jan. 11, 2000]

**§ 201.56-6 Legume or pea family, Fabaceae (Leguminosae).**

Kinds of seed: Alfalfa, alyceclover, asparagusbean, beans (*Phaseolus* spp.), Florida beggarweed, black medic, broadbean, burclovers, buttonclover, chickpea, clovers (*Trifolium* spp.), cowpea, crotalarias, crownvetch, guar, hairy indigo, kudzu, lentil, lespedezas, lupines, northern sweetvetch, peas, peanut, roughpea, sainfoin, sesbania, sourclover, soybean, sweetclovers, trefoils, velvetbean, and vetches.

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(a) Field bean, garden bean, lima bean, mung bean, asparagusbean, and cowpea.

(1) General description.

(i) Germination habit: Epigeal dicot.

(ii) Food reserves: Cotyledons which are large and fleshy.

(iii) Shoot system: The hypocotyl elongates and carries the cotyledons above the soil surface. The epicotyl elongates, causing the terminal bud to emerge from between the cotyledons; the primary leaves expand rapidly.

(iv) Root system: A long primary root with secondary roots.

(2) Abnormal seedling description.

(i) Cotyledons:

(A) For garden bean (*Phaseolus vulgaris* in part), remove any attached seed coats at the end of the test period for evaluation of cotyledons:

(1) Less than half of the original cotyledon tissue remaining attached.

(2) Less than half of the original cotyledon tissue free of necrosis or decay.

(B) All other kinds:

(1) Both missing and the seedling generally weak.

(2) [Reserved]

(ii) Epicotyl:

(A) Missing.

(B) Deep open cracks.

(C) Malformed, such as markedly curled or thickened.

(D) Less than one primary leaf.

(E) Primary leaves too small in proportion to the rest of the seedling, usually associated with visible defects of, or damage to, the main stem of the epicotyl.

(F) Terminal bud missing or damaged. (If a few seedlings with total or partial decay to the epicotyl are found, they may be classified as normal, provided the hypocotyl and root are normal. The epicotyl on such seedlings usually does not decay when grown in a fairly dry environment and exposed to light. A retest, preferably in soil or sand, will aid in interpretation of such seedlings.)

(iii) Hypocotyl:

(A) Deep open cracks extending into the conducting tissue. (A healed break, sometimes referred to as a "knee," is considered normal.)

(B) Malformed, such as markedly shortened, curled, or thickened. (Hypocotyl stunting or curling may be

caused by seedling orientation or constriction on or in the substratum.) (Hypocotyl collar rot is the breakdown of hypocotyl tissue initially characterized by a watery appearance and collapse of the hypocotyl below the cotyledonary node. The area later becomes discolored, shrivelled, and necrotic. The condition is caused by insufficient calcium available to the seedling. If hypocotyl collar rot is observed on seedlings of garden bean, the sample involved shall be retested in accordance with § 201.58(b)(12).)

(iv) Root:

(A) None.

(B) Weak, stubby, or missing primary root with weak secondary or adventitious roots. (A root bound within a tough seed coat is considered normal.)

(v) Seedling:

(A) One or more essential structures impaired as the result of decay from primary infection. (Secondary infection is common in towel and blotter tests. Some pathogens, such as *Fusarium*, *Phomopsis*, and *Rhizoctonia*, can spread through the substratum and infect seedlings some distance away from the primary source. Seedlings with secondary infection are to be classified as normal. A retest in sand or soil may be advisable.)

(B) Albino.

(b) Adzuki bean, broadbean, chickpea, field pea, lentil, pea, roughpea, runner bean, velvetbean, and vetches.

(1) General description.

(i) Germination habit: Hypogeal dicot.

(ii) Food reserves: Cotyledons which are large and fleshy, and remain enclosed within the seed coat beneath the soil surface. They are usually not photosynthetic.

(iii) Shoot system: The epicotyl elongates and carries the terminal bud and primary leaves above the soil surface. The stem bears one or more scale leaves and, prior to emergence, is arched near the apex, causing the terminal bud to be pulled through the soil; after emergence, the stem straightens. For practical purposes, the hypocotyl is not discernible and is not an evaluation factor. Buds in the axils

of each cotyledon and scale leaf usually remain dormant unless the terminal bud is seriously damaged. In this case, one or more axillary buds may start to develop into a shoot. If the axillary shoot is well-developed, it may be considered normal.

(iv) Root system: A long primary root with secondary roots.

(2) Abnormal seedling description.

(i) Cotyledons:

(A) Less than half of the original tissue remaining attached.

(B) Less than half of the original tissue free of necrosis or decay.

(ii) Epicotyl:

(A) Missing.

(B) Less than one primary leaf.

(C) Malformed such as markedly shortened, curled, or thickened.

(D) Severely damaged (e.g. terminal bud missing or damaged) with only a weak shoot developing from the axil of a cotyledon or scale leaf.

(E) Two weak and spindly shoots.

(F) Deep open cracks extending into the conducting tissue.

(iii) Root:

(A) None.

(B) Weak, stubby, or missing primary root with weak secondary roots.

(iv) Seedlings:

(A) One or more essential structures impaired as a result of decay from primary infection. (Secondary infection is common in towel and blotter tests. Some pathogens can spread through the substratum and infect seedlings some distance away from the primary source. Seedlings with secondary infection are classified as normal. A retest in sand or soil may be advisable.)

(B) Albino.

(c) Soybean and lupine.

(1) General description.

(i) Germination habit: Epigeal dicot.

(ii) Food reserves: Cotyledons, which are large and fleshy; they expand and become photosynthetic.

(iii) Shoot system: The hypocotyl elongates and carries the cotyledons above the soil surface. The primary leaves usually increase in size and the epicotyl may elongate within the test period.

(iv) Root system: A long primary root with secondary roots.

(2) Abnormal seedling description.

(i) Cotyledons:

(A) Less than half of the original cotyledon tissue remaining attached.

(B) Less than half of the original cotyledon tissue free of necrosis or decay.

(ii) Epicotyl:

(A) Missing.

(B) Less than one primary leaf.

(C) Deep open cracks.

(D) Terminal bud damaged, missing, or decayed. (If a few seedlings with partial decay of the epicotyl are found, they may be classified as normal, provided the hypocotyl and root are normal. The epicotyl on such seedlings usually does not decay when grown in a fairly dry environment and is exposed to light. A retest, preferably in soil or sand, will aid in interpretation of such seedlings.)

(iii) Hypocotyl:

(A) Deep open cracks extending into the conducting tissue. (Adventitious roots may occur at the site of injury, particularly on the hypocotyl and near the base of the cotyledons. The seedling is classified as normal if the injury is healed over and other essential structures are normal.)

(B) Malformed, such as markedly shortened, curled, or thickened. (Hypocotyl development is slow until the roots start functioning. Caution should be exercised to ensure slow seedlings are not classified as abnormal. Hypocotyl stunting or curling also may be caused by seedling orientation or constriction on or in the substratum.)

(iv) Root:

(A) None.

(B) Weak, stubby, or missing primary root with weak secondary or adventitious roots. (Roots of seedlings on "Kimpak" with insufficient moisture may not become established and hypocotyl elongation may appear to be abnormal. There may be curling of the root and hypocotyl. When a number of seedlings are observed with this condition, the sample should be retested.)

(v) Seedlings:

(A) One or more essential structures impaired as a result of decay from primary infection. (Secondary infection is common in towel and blotter tests. Some pathogens, such as *Fusarium*, *Phomopsis*, and *Rhizoctonia*, can spread through the substratum and infect seedlings some distance away from the

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primary source. Seedlings with secondary infection are to be classified as normal. A retest in sand or soil may be advisable.)

(B) Albino.

(d) Peanut.

(1) General description.

(i) Germination habit: Epigeal dicot.

(ii) Food reserves: Cotyledons, which are large and fleshy.

(iii) Shoot system: The cotyledons are carried to the soil surface by the hypocotyl which is very thick, narrowing abruptly at the root. Elongation of the hypocotyl stops when the epicotyl is exposed to light at the soil surface. The primary leaves are compound and usually expand during the test period.

(iv) Root system: A long primary root with secondary roots. Adventitious roots develop from the base of the hypocotyl if the primary root is damaged.

(2) Abnormal seedling description.

(i) Cotyledons:

(A) Less than half of the original cotyledon tissue remaining attached.

(B) Less than half of the original cotyledon tissue free of necrosis or decay.

(ii) Epicotyl:

(A) Missing.

(B) Less than one primary leaf.

(C) Deep open cracks.

(D) Terminal bud damaged, missing, or decayed.

(iii) Hypocotyl:

(A) Deep open cracks extending into the conducting tissue.

(B) Malformed, such as markedly shortened or curled. (Hypocotyls remain somewhat thickened and may appear to be stunted. Light, depth of planting, and substratum moisture all contribute to the length of the hypocotyl. Hypocotyl stunting or curling may be caused by seedling orientation or constriction in the substratum. Seedlings planted in a soil test with the radicle too close to the surface may send roots above the soil and appear to exhibit negative geotropism and a distorted, U-shaped hypocotyl.)

(iv) Root:

(A) None.

(B) Weak, stubby, or missing primary root with weak secondary or adventitious roots.

(v) Seedling:

(A) One or more essential structures impaired as a result of primary infection.

(B) Albino.

(e) Alfalfa, alyceclover, Florida beggarweed, black medic, burclovers, buttonclover, milkvetch, clovers, crotalaris, crownvetch, guar, hairy indigo, kudzu, lespedezas, northern sweetvetch, sainfoin, sesbania, sourclover, sweetclovers, and trefoils.

(1) General description.

(i) Germination habit: Epigeal dicot.

(ii) Food reserve: Cotyledons, which are small and fleshy; they expand and become photosynthetic. The cotyledons of sub clover develop elongated petioles.

(iii) 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.

(iv) Root system: A long, tapering primary root, usually with root hairs. Secondary roots may or may not develop within the test period, depending on the kind.

(2) Abnormal seedling description.

(i) Cotyledons:

(A) Less than half of the original cotyledon tissue remaining attached. (Breaks at the point of attachment of the cotyledons to the hypocotyl are common in seeds which have been mechanically damaged. It is important that seedlings not be removed during preliminary counts unless development is sufficient to allow the conditions of the cotyledons to be determined. If the point of attachment of the cotyledons cannot be seen at the end of the test, the seed coat should be peeled back to determine whether a break has occurred.)

(B) Less than half of the original cotyledon tissue free of necrosis or decay.

(ii) Epicotyl:

(A) Missing. (May be assumed to be present if both cotyledons are intact.)

(B) [Reserved]

(iii) Hypocotyl:

(A) Deep open cracks extending into the conducting tissue.

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(B) Malformed, such as markedly shortened, curled, or thickened. (Seedlings of sainfoin which have been constricted by growing through the netting of the pod, but which are otherwise normal, are classified as normal.)

(C) Weak and watery.

(iv) Root:

(A) None.

(B) Primary root stubby. (The roots of sweetclovers may be stubby when grown on artificial substrata due to the presence of coumarin in the seed; since this condition usually does not occur in soil, such seedlings are classified as normal. Roots may appear stubby as a result of being bound by the seed coat; such seedlings are classified as normal. Crownvetch produces phytotoxic effects similar to sweetclovers.)

(C) Split extending into the hypocotyl.

(v) Seedling:

(A) One or more essential structures impaired as a result of decay from primary infection.

(B) Albino.

[59 FR 64503, Dec. 14, 1994, as amended at 65 FR 1708, Jan. 11, 2000]

**§ 201.56-7 Lily family, Liliaceae.**

Kinds of seed: Asparagus, chives, leek, onion, and Welsh onion.

(a) Asparagus.

(1) General description.

(i) Germination habit: Hypogeal monocot.

(ii) Food reserves: Endosperm which is hard, semi-transparent, and non-starchy; minor reserves in the cotyledon. The endosperm surrounds the entire embryo.

(iii) Cotyledon: A single cylindrical cotyledon; following germination, all but the basal end remains embedded in the endosperm to absorb nutrients.

(iv) Shoot system: The epicotyl elongates and carries the terminal bud above the soil surface. The epicotyl may bear several small scale leaves. A short hypocotyl is barely distinguishable, joining the root to the basal end of the cotyledon. More than one shoot may arise simultaneously, and the seedling may be considered normal if at least one shoot is well-developed and has a terminal growing point, provided other essential structures are normal.

(v) Root system: A long slender primary root.

(2) Abnormal seedling description.

(i) Cotyledon:

(A) Detached from seedling.

(B) Deep open cracks at basal end.

(ii) Epicotyl:

(A) Missing.

(B) Terminal bud missing or damaged.

(C) Deep open cracks.

(D) Malformed, such as markedly shortened, curled, or thickened.

(E) Spindly.

(F) Watery.

(iii) Hypocotyl:

(A) Deep open cracks.

(B) [Reserved]

(iv) Root:

(A) No primary root.

(B) Stubby primary root with weak secondary roots.

(v) Seedling:

(A) One or more essential structures impaired as a result of decay from primary infection.

(B) Albino.

(b) Chives, leek, onion, Welsh onion.

(1) General description.

(i) Germination habit: Epigeal monocot.

(ii) Food reserves: Endosperm which is hard, semi-transparent, and non-starchy; minor reserves in the cotyledon.

(iii) Cotyledon: A single cylindrical cotyledon. The cotyledon emerges with the seed coat and endosperm attached to the tip. A sharp bend known as the "knee" forms; continued elongation of the cotyledon on each side of this knee pushes it above the soil surface. The cotyledon tip is pulled from the soil and straightens except for a slight kink which remains at the site of the knee.

(iv) Shoot system: The first foliage leaf emerges through a slit near the base of the cotyledon, but this does not usually occur during the test period. The hypocotyl is a very short transitional zone between the primary root and the cotyledon, and is not distinguishable for purposes of seedling evaluation.