2025 AOSA Rule Proposal #9

Detached Coleoptile Tip Rule Proposal-Cereals

PURPOSE OF RULE PROPOSAL: The purpose of this proposal is to add a sketch and clarify how a detached coleoptile tip should be evaluated for members of the Poaceae Grass Family I-Cereals, AOSA Rules for Testing Seeds, Vol. 4.

PRESENT RULE:

ABNORMAL SEEDLING DESCRIPTIONS

Shoot:

.
.
. (see also notes 1 and 2)

Seedling:

.
.
. seedlings with badly thickened and shortened roots and shoots due to injury from chemical treatment (see note 3).

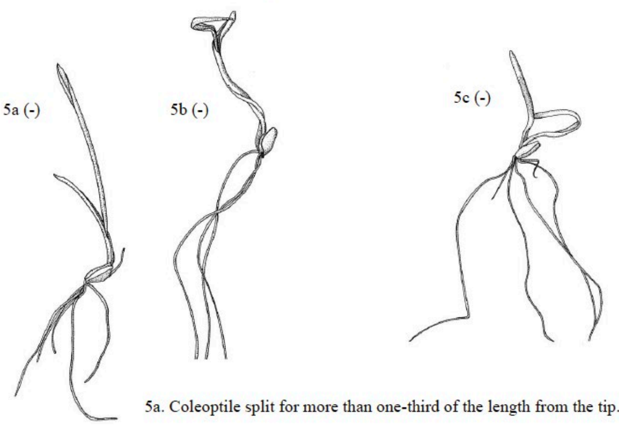
NOTES

1. Seedlings grown in the dark or in low intensity light will exhibit increased elongation of the coleoptile and in some cases the mesocotyl. In towels, there may be considerable twisting of the shoot.

2. Splitting of the coleoptile tip occurs naturally as a result of expansion of the leaves inside and occurs after emergence and after the coleoptile ceases to elongate upon exposure to light.

3. Seedlings with badly thickened and shortened roots and shoots due to injury from chemical treatment are to be classified as abnormal. If such seedlings are difficult to evaluate on paper substrata, the interpretation should be based on the seedling performance in sand, or soil, or organic growing media.

Fig. 5 Leaf defects.



5a. Coleoptile split for more than one-third of the length from the tip.

5b. Coleoptile damaged with leaf emerging through side split.

5c. Coleoptile split near base, with leaf bursting out.

PROPOSED RULE:

ABNORMAL SEEDLING DESCRIPTIONS

Shoot:

.
.
. (see also notes 1, 2, and 3)

Seedling:

.
.
. seedlings with badly thickened and shortened roots and shoots due to injury from chemical treatment (see note 4).

NOTES

1. Seedlings grown in the dark or in low intensity light will exhibit increased elongation of the coleoptile and in some cases the mesocotyl. In towels, there may be considerable twisting of the shoot.

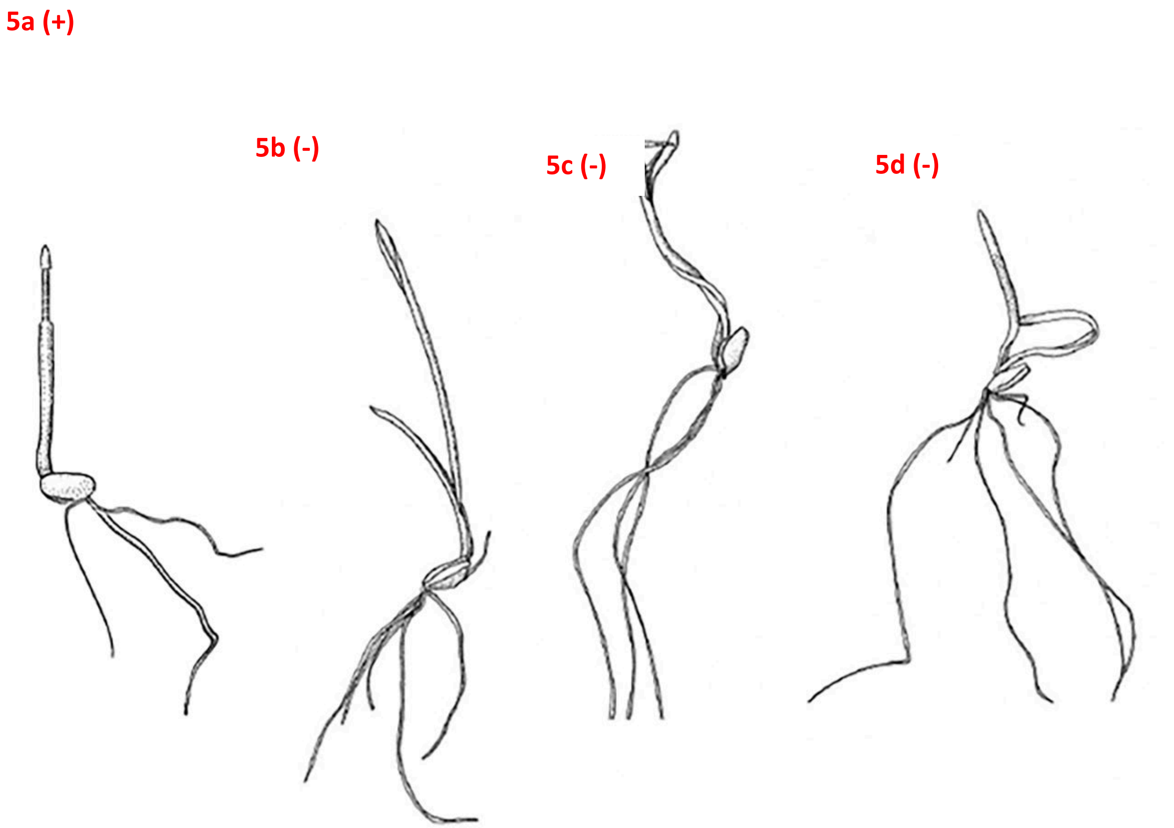
2. Splitting of the coleoptile tip occurs naturally as a result of expansion of the leaves inside and occurs after emergence and after the coleoptile ceases to elongate upon exposure to light.

3. In some cases, the senescing tip of the coleoptile (1-5 mm) will detach instead of splitting, persisting as a “cap” on the first leaf. In such cases, the coleoptile should be evaluated as normal. The coleoptile “cap” is not observed under field conditions and is to be regarded as a test condition. When assessing such seedlings, the “cap” must be removed before the first leaf is evaluated.

4. Seedlings with badly thickened and shortened roots and shoots due to injury from chemical treatment are to be classified as abnormal. If such seedlings are difficult to evaluate on paper

substrata, the interpretation sho ... ormance in sand, or soil, or organic growing media.

Fig. 5 Coleoptile and leaf defects.



5a. Coleoptile tip detached but leaf is not damaged (see note 3).

5b. Coleoptile split for more than one-third of the length from the tip.

5c. Coleoptile damaged with leaf emerging thorugh side split.

5d. Coleoptile split near base, with leaf bursting out.

HARMONIZATION AND IMPACT STATEMENT:

The Federal Seed Act, Canada M&P, and ISTA Rules do not include notes on evaluating cereal seedlings with detached coleoptile tips.

SUPPORTING EVIDENCE:

To the best of our knowledge, detached coleoptile tips have not been reported under field conditions, strongly indicating that this is a test condition. Since coleoptiles provide protection to the emerging leaf and, more importantly, determine the direction of shoot growth towards the light or soil surface, the question is whether detached coleoptile tips can negatively impact leaf development. The scientific literature provides well-documented evidence that senescence of coleoptiles and loss of the above two functions precedes splitting or detachment, and therefore has no impact on subsequent normal or abnormal leaf development.

The onset of coleoptile senescence in rye seedlings (*Secale cereale*), characterized by protein, RNA and DNA breakdown, decreased dry mass and sugar content, and cessation of elongation, takes place after emergence of the primary leaf, and is enhanced by exposure to light (Sossinka and Feierabend, 1978; Fröhlich and Kutschera, 1995). This senescence process, starting at the tip, causes coleoptiles to lose two of their main functions, protection and directional growth, while maintaining their ability to remobilize nutrients to the growing leaf. Therefore, at this stage, neither splitting nor detachment of the tip would have any effect on subsequent development of the first leaf. Related results were also reported when coleoptile development of corn (*Zea mays*), oats (*Avena sativa*), wheat (*Triticum aestivum*), barley (*Hordeum vulgare*), as well as rye, were investigated (Kutschera and Fröhlich, 1992). Inada et al. (2000), studying rice (*Oryza sativa*) coleoptiles, reported on the differences in tissue development and composition between the inner and outer epidermal cells, which might explain the observed detachment rather than splitting of many coleoptile tips during rice germination testing. Likewise, O'Brien and Thimann (1965) had reported on histological differences in coleoptile tips of oat and wheat. More recently, Gao et al. (2008) determined that extension growth of wheat coleoptiles was closely related to the activity and expression of expansins, the main regulators of wall extension, with the implication that breakdown of those expansins might produce the rigid effect resulting in tip detachment. In conclusion, tip detachment can be explained based on accumulated research studies investigating coleoptile development and elongation, with a general agreement that at the senescence stage coleoptile tips lose their functions that would otherwise cause abnormal development of non-senescing coleoptiles. Accordingly, detached tips in the absence of any leaf defects should be evaluated as normal.

1. Fröhlich, M., and U. Kutschera. 1995. Changes in soluble sugars and proteins during development of rye Coleoptiles. J. Plant Physiol. 146(1-2): 121-125. https://doi.org/10.1016/S0176-1617(11)81977-2.
2. Gao, Q., M. Zhao, F. Li, Q. Guo, S. Xing, and W. Wang. 2008. Expansins and coleoptile elongation in wheat. Protoplasma. 233: 73-81. https://doi.org/10.1007/s00709-008-0303-1.
3. Inada, N., A. Sakai, H. Kuroiwa, and T. Kuroiwa. 2000. Senescence in the nongreening region of the rice (*Oryza sativa*) coleoptile. Protoplasma. 214: 180–193. https://doi.org/10.1007/BF01279062.
4. Kutschera, U., and M. Fröhlich. 1992. Osmotic relations during elongation growth in coleoptiles of five cereal species. J. Plant Physiol. 139(5): 519-522. https://doi.org/10.1016/S0176-1617(11)80362-7.
5. O'Brien, T.P. and K.V. Thimann. 1965. Histological studies on the coleoptile I. Tissue and cell types in the coleoptile tip. Am. J. Bot. 52: 910-918. https://doi.org/10.1002/j.1537-2197.1965.tb07265.x.
6. Sossinka, J., and J. Feierabend. 1978. Influence of cytokinin and light on nucleic acid and protein metabolism of senescing coleoptiles. Biochem. Physiologie Pflan. 173(6): 505-513. https://doi.org/10.1016/S0015-3796(17)30529-2.

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