

Rule Change Proposal No. 4

PURPOSE OF PROPOSAL

The purpose of this rules change proposal is to reconcile AOSA and ISTA rules regarding split coleoptiles in cereal species. The premise that the current AOSA rule that regards a seedling with a split coleoptile capable of producing a normal plant under favorable conditions appears to be flawed.

PRESENT RULE

AOSA Seedling Evaluation Handbook, Page 78

General Description: Shoot system

The shoot consists of the coleoptile and enclosed leaves which grow from the meristematic region at their base and the mesocotyl. The shoot elongates and pushes through the soil surface; the mesocotyl may elongate depending on the variety and light intensity, but is usually not discernable. Splitting of the coleoptile occurs naturally as a result of expansion of the leaves inside.

Notes:

2. Splitting of the coleoptile occurs naturally as a result of expansion of the leaves inside. The condition of the coleoptile is not to be considered as an evaluation factor on its own; however, damage to the coleoptile is an indication that the other shoot structures should be examined closely to determine if they have been damaged.

AOSA Seedling Evaluation Handbook, Page 79

Abnormal Seedling Descriptions

Shoot

- missing.
- no leaf.
- leaf extending less than halfway up into the coleoptile.
- leaf badly shredded or longitudinally split.
- thin, spindly, pale or watery.
- badly frost-damaged (characterized by graininess, spiral twisting and shredding, and loss of vigor).
- deep open cracks in the mesocotyl.
- (see also notes 1 and 2).

AOSA Seedling Evaluation Handbook, page 81, Poaceae, Grass Family I - Cereals, figure 5 Leaf defects classifies the following as normal seedlings.

5a (+). Coleoptile split, but shoot otherwise healthy

5b (+). Coleoptile damaged with leaf emerging through side split.

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

PROPOSED RULE

AOSA Seedling Evaluation Handbook, Page 78, Poaceae, Grass Family I – Cereals

General Description: Shoot system.

The shoot consists of the coleoptile and enclosed leaves which grow from the meristematic region at their base and the mesocotyl. The shoot elongates and pushes through the soil surface; the mesocotyl may elongate depending on the variety and light intensity, but is usually not discernable. Splitting of the coleoptile tip occurs naturally as a result of expansion of the leaves inside.

Notes

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.

AOSA Seedling Evaluation Handbook, Page 79, Poaceae, Grass Family I – Cereals

Abnormal Seedling Descriptions

Shoot

- missing.
- no leaf.
- leaf extending less than halfway up into the coleoptile.
- leaf badly shredded or longitudinally split.
- coleoptile split for more than one-third the length from the tip.
- thin, spindly, pale or watery.
- badly frost-damaged (characterized by graininess, spiral twisting and shredding, and loss of vigor).
- deep open cracks in the mesocotyl.
- (see also notes 1 and 2).

AOSA Seedling Evaluation Handbook, page 81, Poaceae, Grass Family I - Cereals, figure 5 Leaf defects classifies the following as abnormal seedlings.

5a (-). Coleoptile split for more than one-third of the length from the tip, but shoot otherwise healthy.

5b (-). Coleoptile damaged with leaf emerging through side split.

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

HARMONIZATION

This rule change would bring the split coleoptile classification in cereals species into agreement with ISTA Rules.

SUPPORTING EVIDENCE

Natural splitting of the coleoptile is not a common event during the standard germination period prescribed by AOSA. However it can be agreed upon that the coleoptile tip can split after it has emerged from the soil and/or ceases to elongate upon exposure to light due to the expansion of the leaf.

Observations of extremely high levels of split coleoptiles have been made in some wheat seed lots. Many of these seed lots had good germination according to AOSA rules, but exhibited poor performance (emergence) in the field. In a replicated field trial planted at six locations, emergence of three seed lots of Alpowa spring wheat was determined. Although all three seed lots had similar germinations, the lot with a high frequency of split coleoptiles had much poorer emergence than the seed lots without split coleoptiles. In the laboratory, it has been shown that seedlings with split coleoptiles rarely emerge from soil due to the inability of unprotected and unsupported leaves to advance against even mild soil resistance. Further research shows that classifying split coleoptiles as abnormal would reveal potential problems with regard to a lot's potential to produce a uniform stand. This is valuable information that is currently being withheld from the consumer under the AOSA rule as now stated. Considering a split coleoptile as normal seedling can mask serious deficiencies in a seed lot. This has the potential to cause significant economic harm by reducing potential yield of a field that is seeded with a lot of grain that has even a modest rate of split coleoptiles. With the purpose of the AOSA germination test being a measurement of a seedlings ability to produce a normal seedling under favorable conditions, changing the rule to consider split coleoptiles as an abnormal defect would support this purpose.

Dr. Robert L. Warner, Dr. Steve C. Spaeth, and Ellen S. Johnston. 2002. **Performance Quality of Washington's Certified Wheat Seed.** Washington State University. [This paper is available online](http://pubs.wsu.edu) [go to: <http://pubs.wsu.edu>; under Search, type: EB1929; then, click on: EB1929 Performance Quality of Washington's Certified Wheat Seed; then, click on PDF to open PDF of paper. You may either read paper on computer screen or print it out.].

Supporting Documentation to Change AOSA Split Coleoptile Rule

Dr. Robert L Warner

The AOSA rule for classifying seedlings with split coleoptiles in cereal species should be brought into agreement with the ISTA rule and the AOSA rule for corn.

While we agree that the coleoptile can split after it emerges from the soil and/or ceases to elongate upon exposure to light, “natural splitting” is not a common event during the standard germination period prescribed by AOSA. However, we have observed extremely high levels of split coleoptiles in some certified wheat seed lots. Many of these seed lots had good germination but exhibited poor performance (emergence) in the field. In a replicated field trial planted at six locations, emergence of three seed lots of Alpowa spring wheat was determined (Table 1). Although all three seed lots had similar germinations, the lot with a high frequency of split coleoptiles had much poorer emergence than the seed lots without split coleoptiles. In the laboratory, we have shown that seedlings with split coleoptiles rarely emerge from soil due to the inability of unprotected leaves to advance against even mild soil resistance.

Our research indicates that seed lots with high split coleoptile (AOSA normal, ISTA abnormal) frequencies have been exposed to water after physiological maturity and prior to harvest. Generally, these seed lots have little visible indication of sprout or obvious mechanical damage, and have good to excellent germination. Although hydration/dehydration of mature seeds may cause physiological damage, split coleoptile formation appears to result from subtle mechanical injury to the coleoptile of embryos after one or more hydration/dehydration cycles. We have shown that split coleoptiles can be readily induced by mechanical abrasion in seed lots predisposed by exposure to water (Table 2). Although the seed lot used in this study was predisposed to mechanical injury by exposure to water after physiological maturity, it had good germination (99%) with only 0.3% split coleoptiles. However, after mild mechanical abrasion the frequency of split coleoptiles increased, indicating that splitting of the coleoptile is not always natural and can be induced by mechanical means, especially in seeds having been exposed to water after physiological maturity.

Changing the AOSA rule for split coleoptiles to conform with the ISTA rule will not greatly affect the overall seed viability of certified wheat seed produced in Washington. We evaluated 390 certified wheat seed lots produced in Washington in 1998, 1999, and 2000. For these years, the average frequency of split coleoptiles (AOSA normal, ISTA abnormal) was slightly less than 0.7%, indicating that split coleoptiles are not a serious problem in the vast majority of our certified wheat seed lots. However, classifying split coleoptile as abnormal would have revealed potential problems with a low percentage of the certified wheat seed lots produced in Washington, especially lots with exceptionally high frequencies, such as lot Irr-L in Table 1. Many growers had serious emergence problems with this seed lot, which was of great concern for a new cultivar in its first year of commercial production.

Although we recognize that the AOSA germination test is a measure of viability and not vigor, we believe the AOSA rule which considers splitting of the coleoptile to be normal can mask serious deficiencies in some seed lots, and that “natural splitting” is a rather rare event in sound wheat and barley seeds. We respectfully request the AOSA rule regarding split coleoptiles in wheat and barley be changed and brought into accordance with the ISTA rule.

Table 1. Effect of split coleoptiles on the emergence of Alpowa spring wheat. Three seed lots with similar germination were selected for an emergence trial in the spring of 1997. Each seed lot was planted in three replications at six locations in eastern Washington. Seed lots Irr-H and Irr-L were produced under irrigation in the Columbia Basin; seed lot Dry was produced under dryland conditions at Pullman, WA.

Seed Lot	Seed Size Mg/seed	Germination	Split Coleoptiles*	Emergence
		-----	-----%	
Irr-H	42	97	1	68
Irr-L	44	96	21	45
Dry	34	97	1	61

* AOSA normal, ISTA abnormal

Table 2. Split coleoptile induction by mechanical abrasion of wheat seeds. A mechanical laboratory device was developed to subject seeds to varying degrees of movement and static load. Both applied load and the distance moved increased the frequency of split coleoptiles.

Movement	Static Load (kg)				
	0.0	1.3	4.8	7.1	11.3
Turns	-----% split coleoptiles*-----				
0	0.3	---	---	---	---
8		0.7	1.0	1.7	5.0
16		0.3	2.0	2.7	---
24		0.3	3.3	7.0	9.3

* AOSA normal, ISTA abnormal

SUBMITTED BY:

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