



Establishing Evaluation Criteria for Secondary Roots for *Zea mays*

ISTA Germination Committee

Melissa Phillips



Concern Brought to the Committee



A concern was brought to the committee by Marija Milivojevic, Republic of Serbia & Aidin Hamidi, Iran regarding the ambiguity of the current rule for secondary root evaluations.



Current Rule: Type D- Group A-1-2-3-2

root system	
the primary root	<p>is defective if it</p> <ul style="list-style-type: none"> • is stunted or stubby • is retarded or missing • is broken or split from the tip • shows negative geotropism • is constricted • is spindly • is glassy • is decayed as a result of primary infection
Seedlings with a defective primary root are classed as normal, if sufficient normal secondary roots have developed.	

This rule is consistent with AOSA's current rule

The Question Of The Day: What is “sufficient”?

Complex Question to Answer

Root System of *Zea*
is complex and
develops in phases

Variations:

- Field
- Sweet
- Inbred
- Hybrid

Secondary Roots
is a grey area, but
do we have a
problem?

If root/ shoot
comparison

- Media/ light relationship
- Impact on structure size
- Additional Study?

Establish Criteria

- What is currently used?
- Survey

Lacking Primary Root

- Declining Vigor
- Mechanical Damage

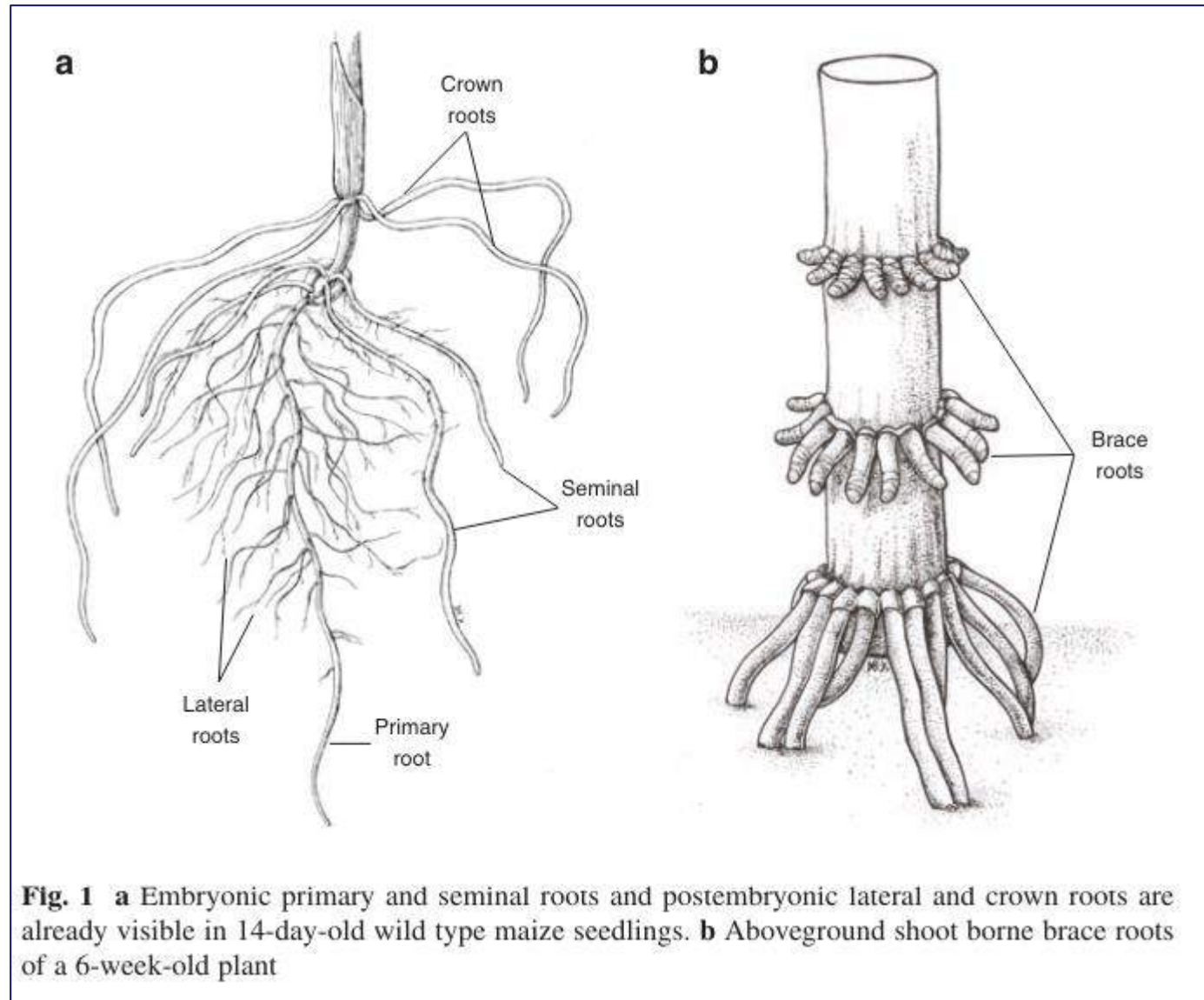
Definition of Germination

- Growth stage needed to be considered an “acceptable plant”
- What is criteria of acceptable?
- Is field grow out required?

Global Seed
Maize market
\$43.75B USD
in 2029*

*marketdataforecast.com

The maize plant has a complex root system that develops after the 7-day evaluation of a germination test



Hochholdinger, F. (2009). The Maize Root System: Morphology, Anatomy, and Genetics. In: Bennetzen, J.L., Hake, S.C. (eds) Handbook of Maize: Its Biology. Springer, New York, NY. https://doi.org/10.1007/978-0-387-79418-1_8

Is the current criteria causing a problem?

Does this lack of clarity in evaluation criteria a cause for increased variation?

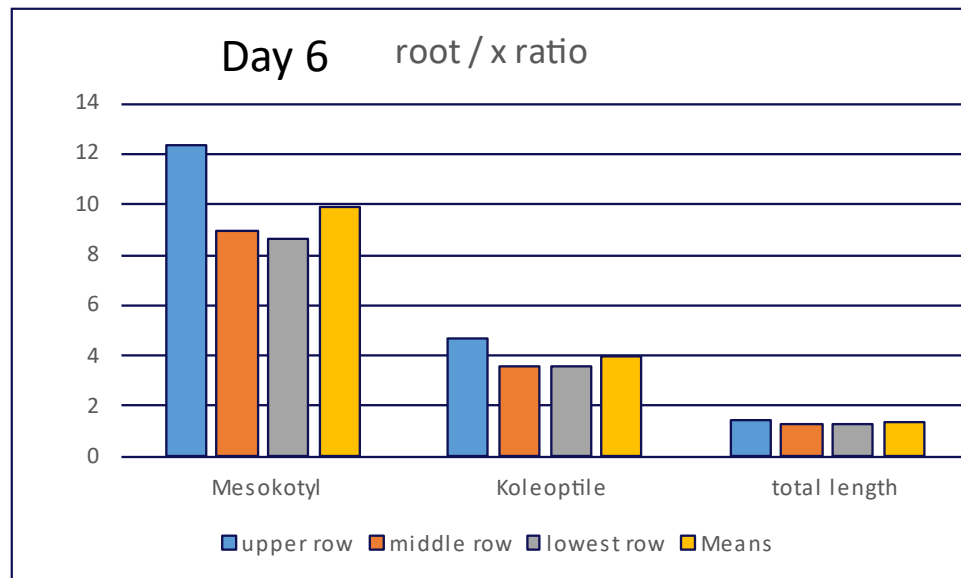
We contacted the proficiency committee.....

The conclusion from the Proficiency Chair, Didier Demilly

“My conclusion is that there was not higher variability for *mays* compared to other species. And the variability for *mays* is lower compared to other agricultural species with large seeds.”

When criteria is based on structure size

Andrea Jonitz (Germany) conducted an experiment to understand the size of the seedling structures based on placement in a towel



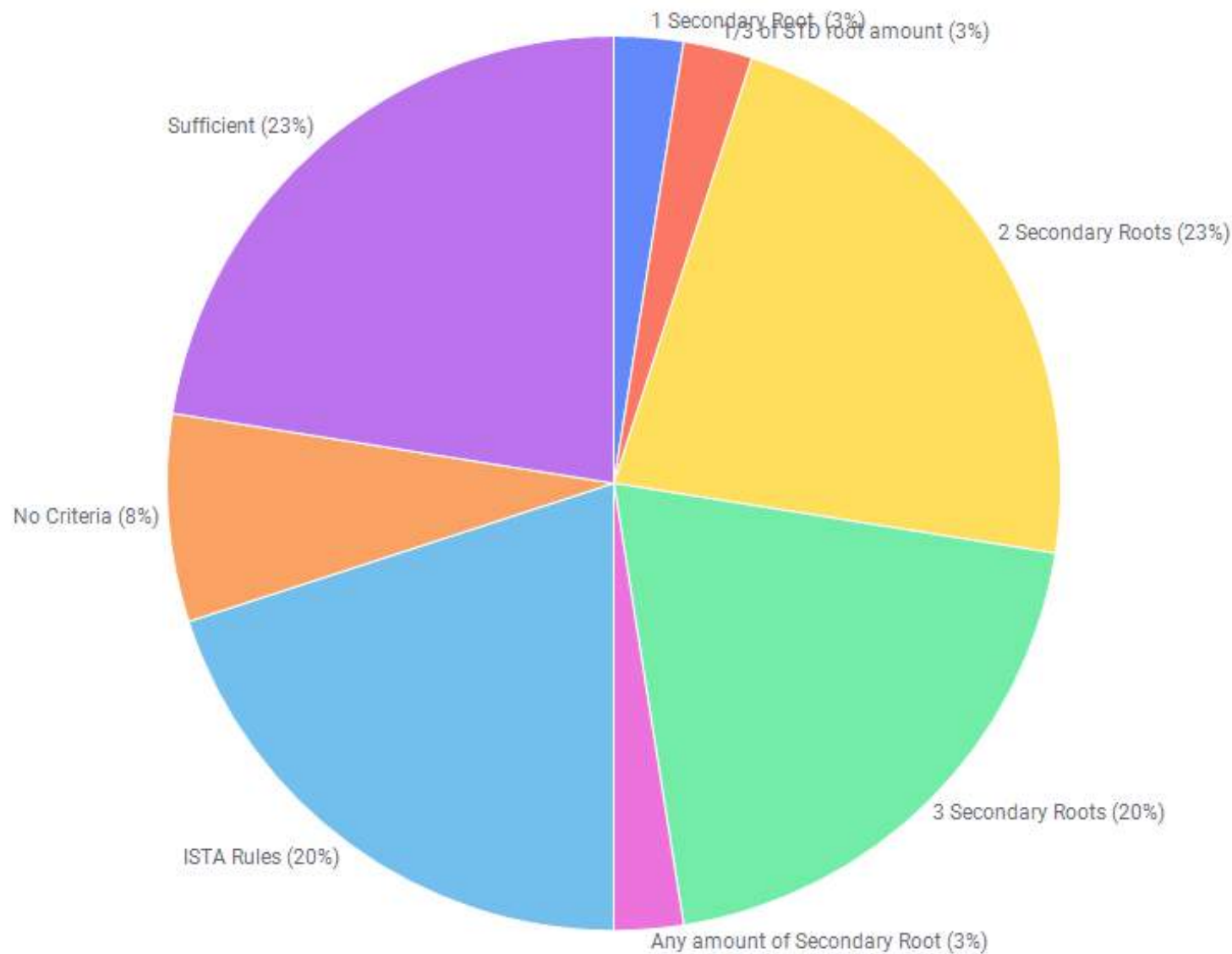
Due to this difference between structure sizes and the placement in the towel, it would not be recommended to use structure length as a basis of evaluation.



2024 Root Survey Results

Thank you to those that participated!



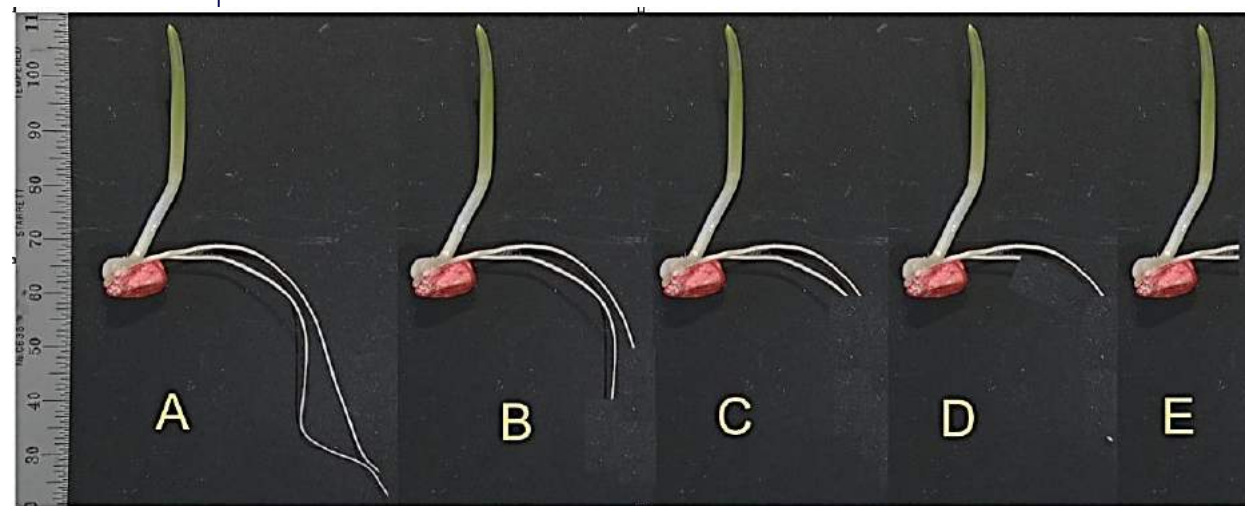
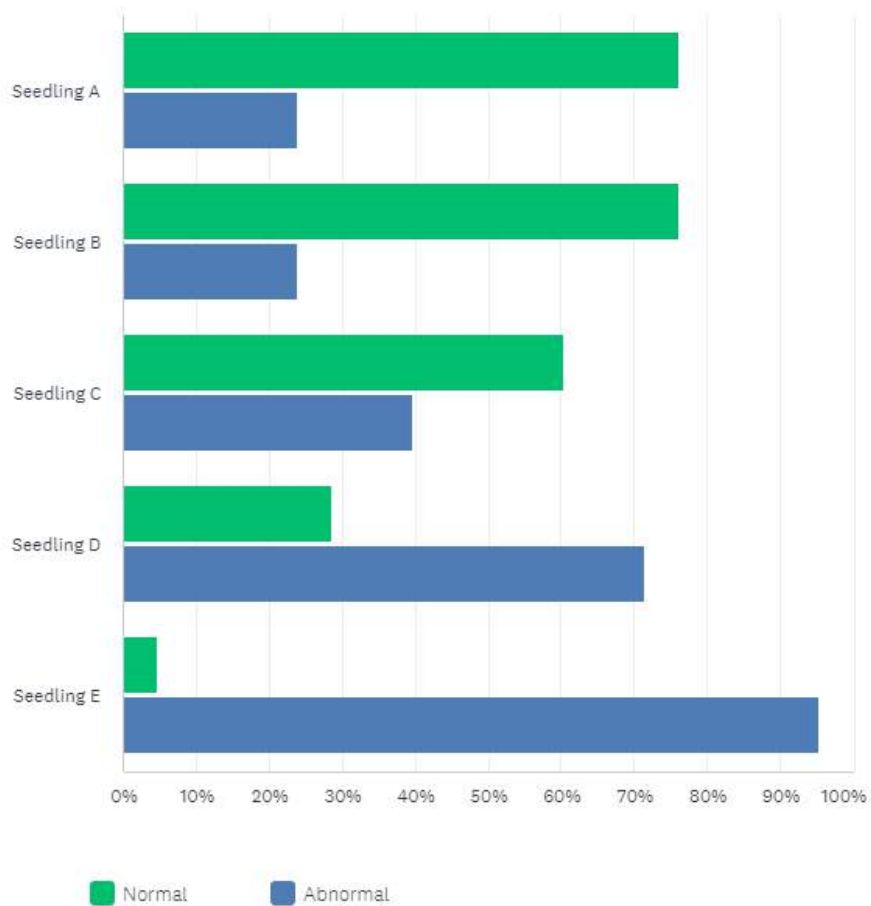


Over 50% of the respondents have established criteria or have criteria that still contains some ambiguity

Using your internal evaluation criteria please evaluate these seedlings- (this is not a proficiency). Please only assess root.

Question 6

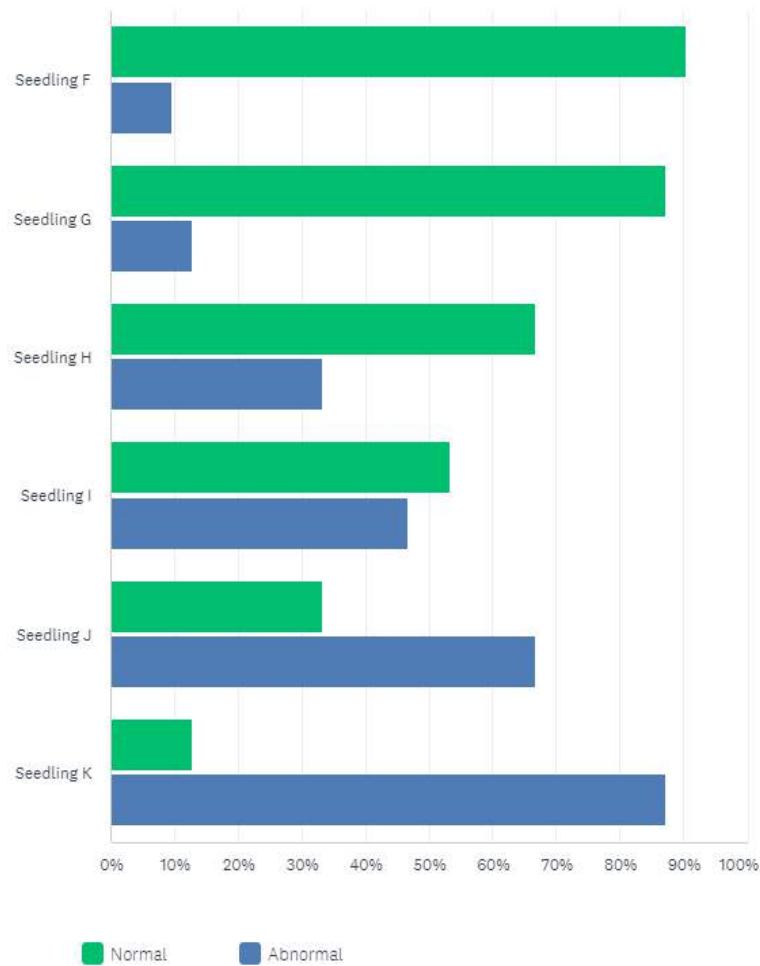
Answered: 63 Skipped: 4



Using your internal evaluation criteria please evaluate these seedlings- (this is not a proficiency). Please only assess root.

Question 7

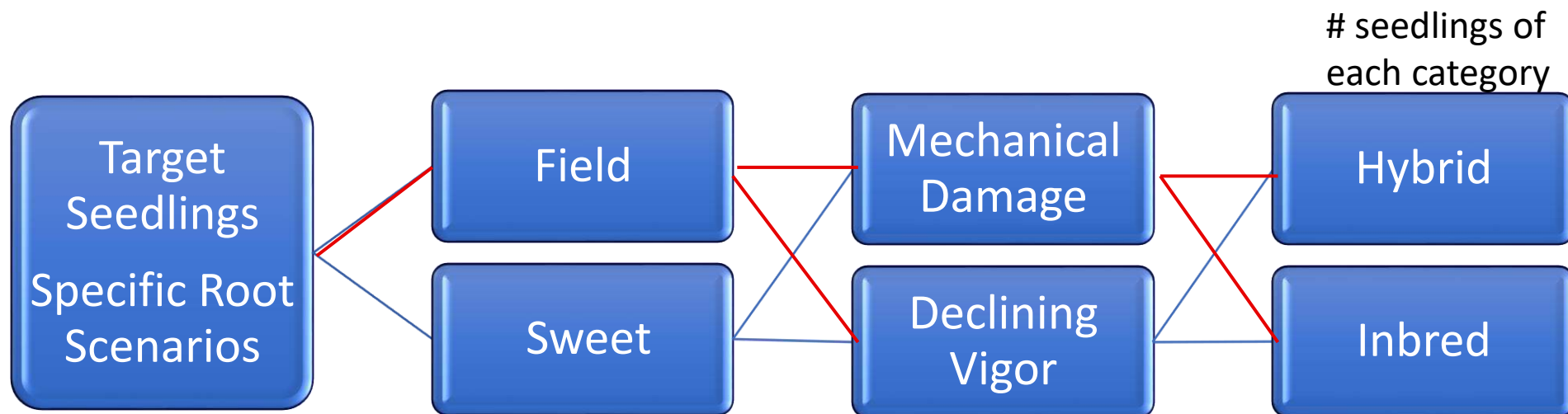
Answered: 63 Skipped: 4



Proof of Concept Experiment

Selecting seedlings lacking primary root and growing them out to understand root growth patterns post seedling stage

This would also help to establish a grow out method that could be executed by different labs in different regions.



At what stage can the plant be assessed as satisfactory in the field?

Can this be accomplished in chamber/greenhouse?

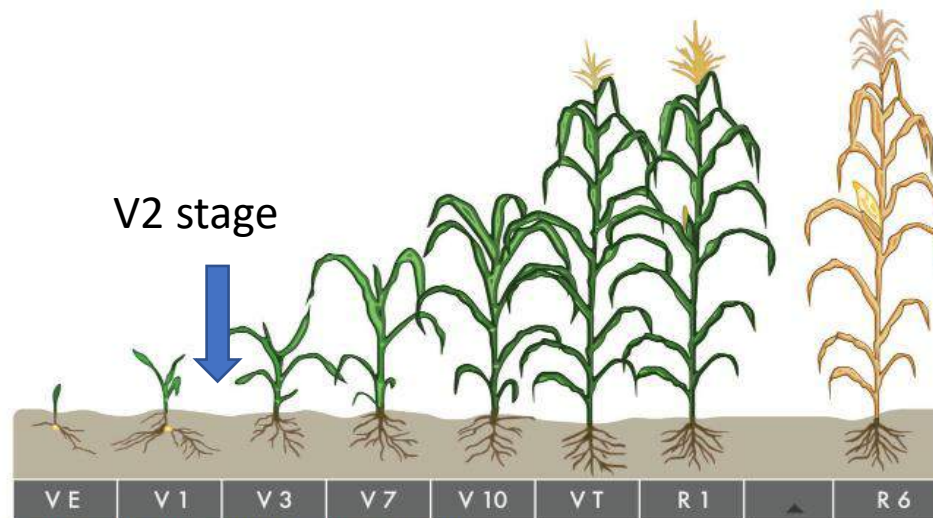
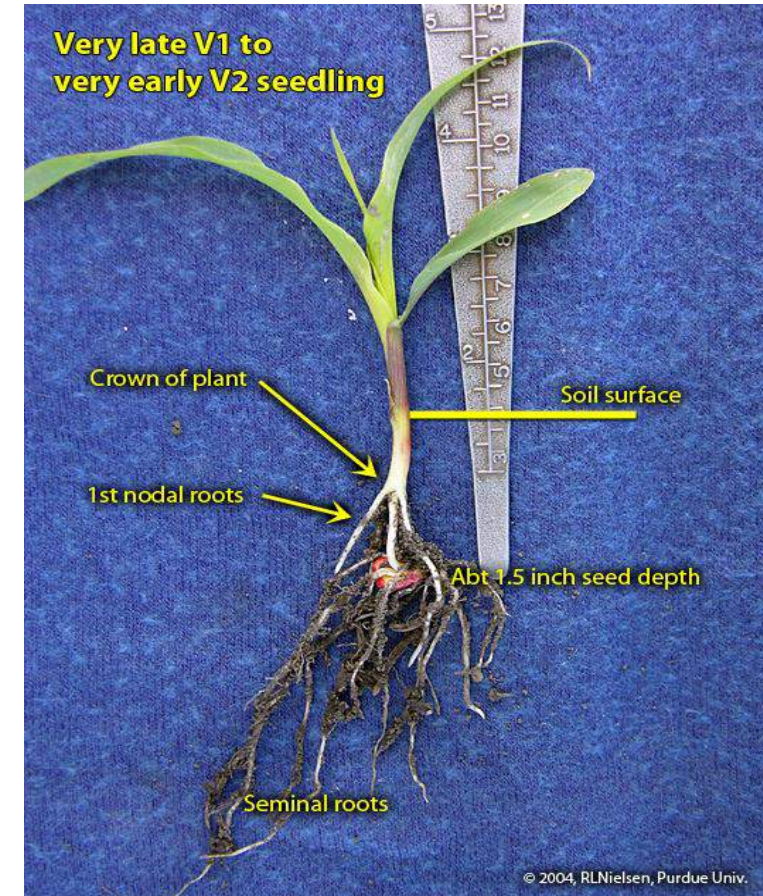


Figure 1. Corn growth stages from emergence to maturity.



www.agry.purdue.edu/ext/corn/news/timeless/roots.html

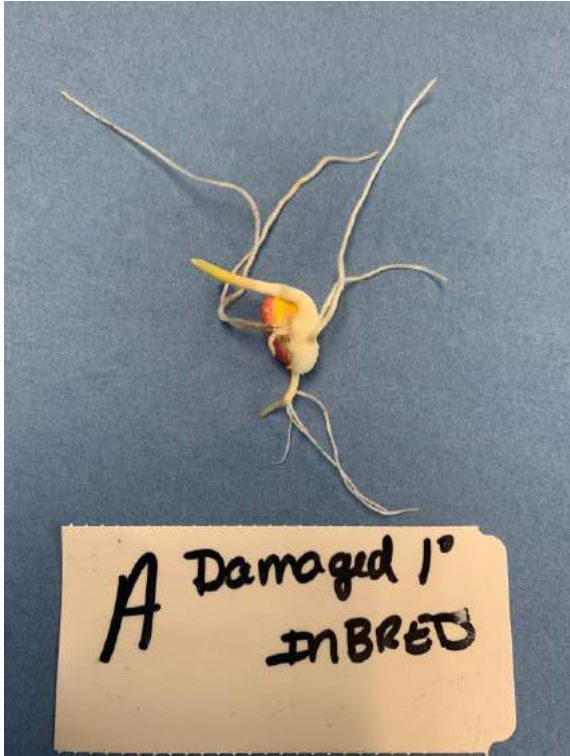
POC Experiment

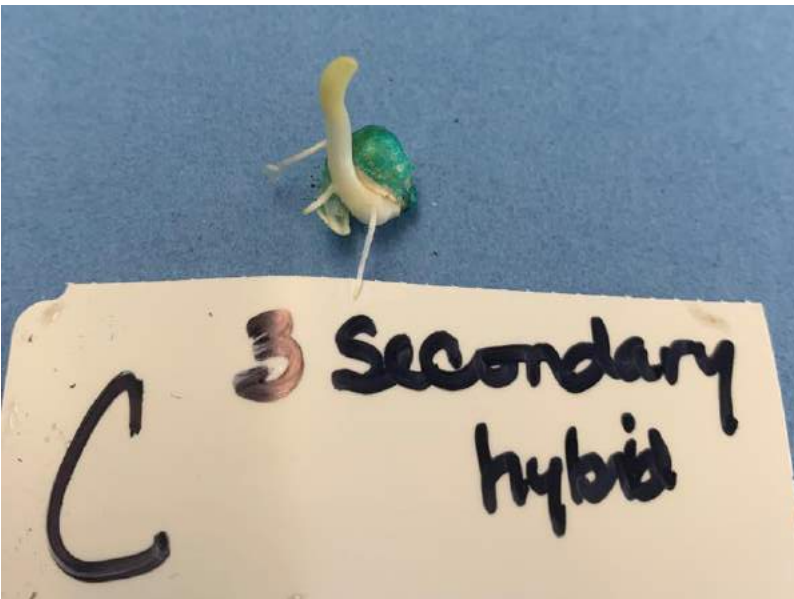


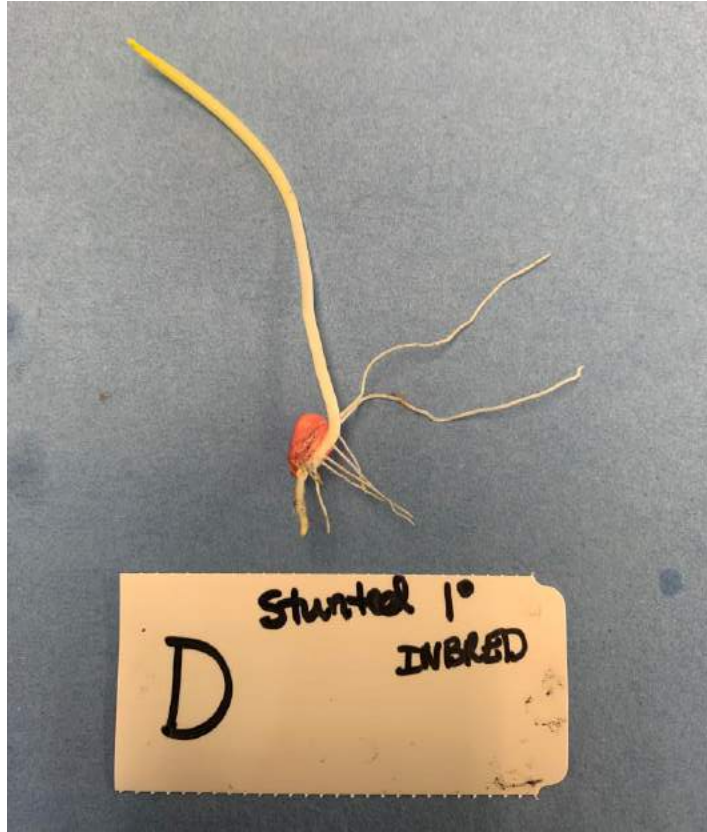
Seedlings were selected from 7-day germination samples that had varying root growth patterns

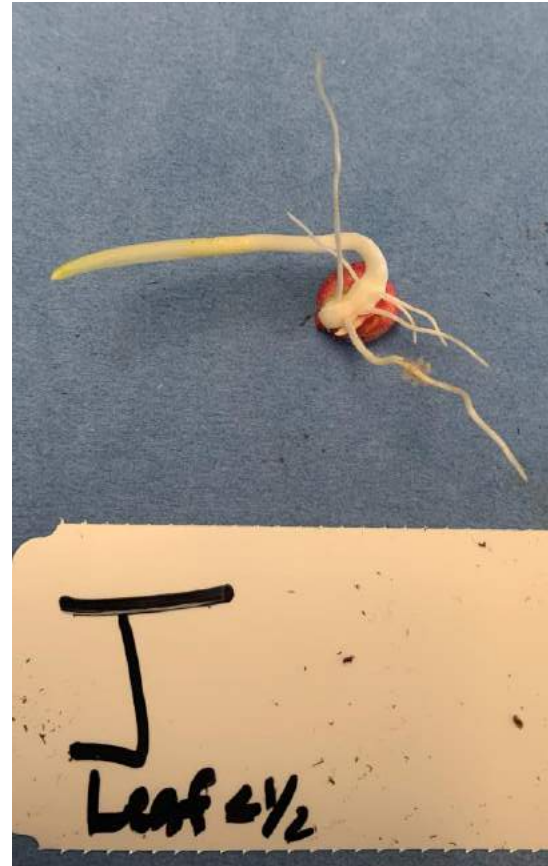
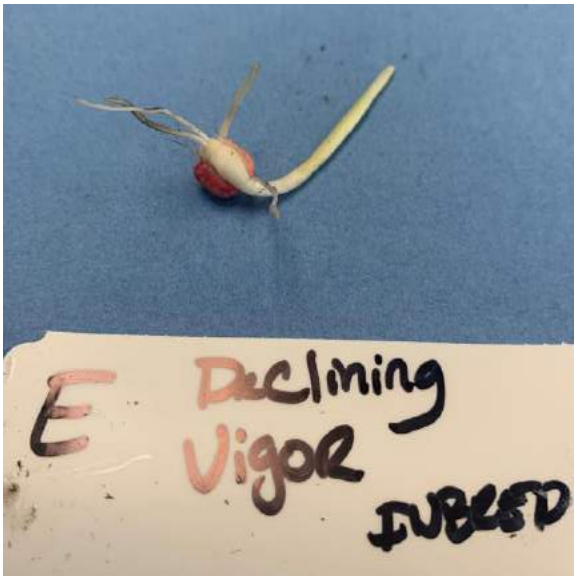
Samples were transferred to organic media and grown in a germination cart with light

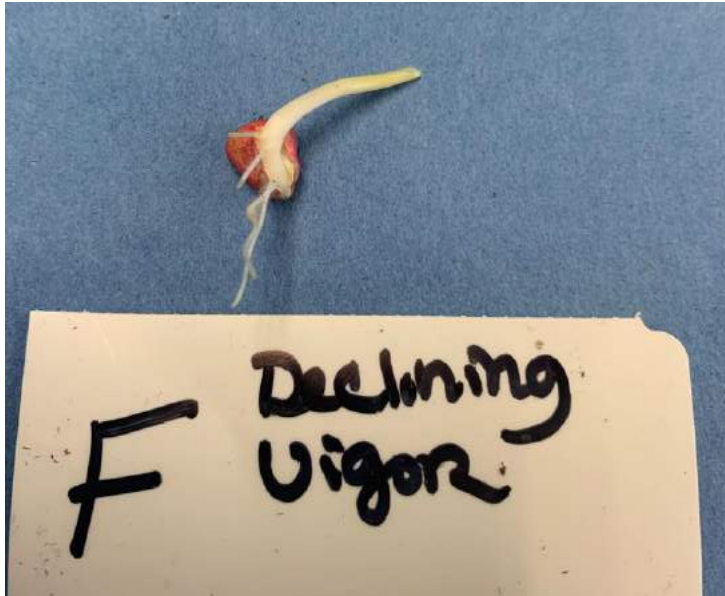
Seedlings were assessed on day 11 post transfer for root growth

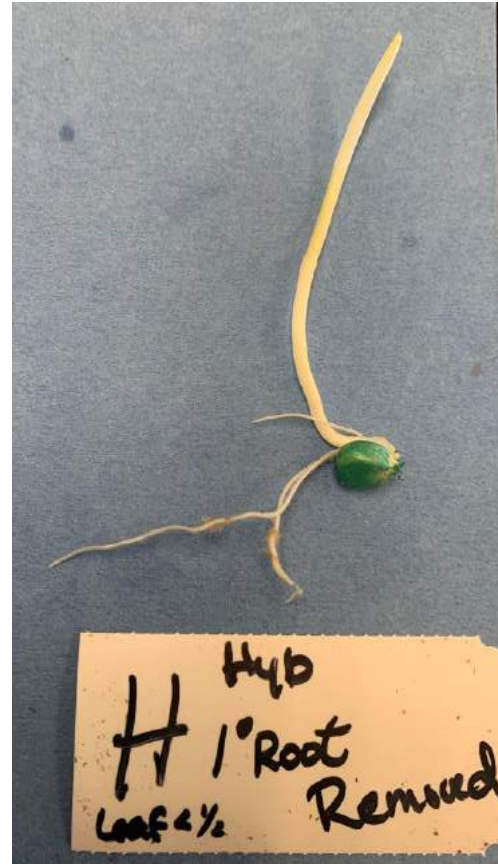
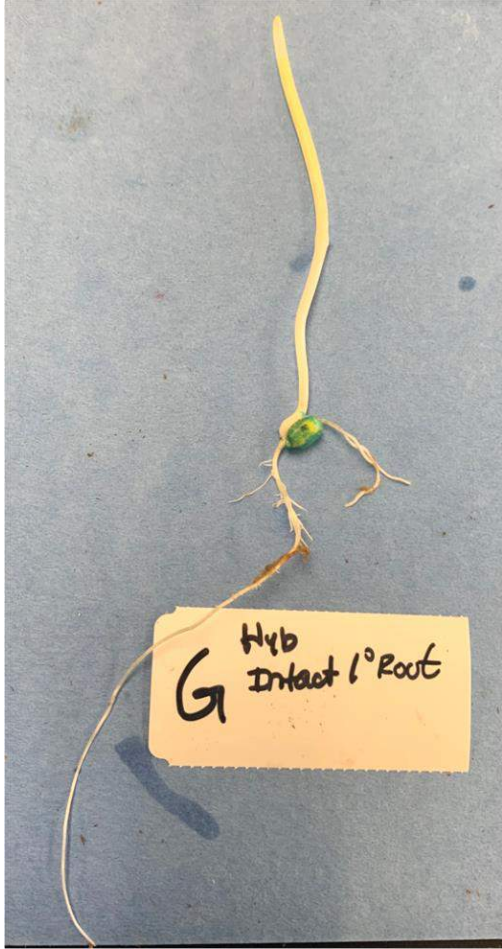












Next Steps....

Decision to proceed with experiments to identify the specific evaluation criteria

Or

Decide that identifying the specific criteria is too complex or potential impacts too large and leave the current rule as is...

There is some evidence in the experiment to suggest an examination of leaf less than half of the length of the coleoptile rule





Thank you !

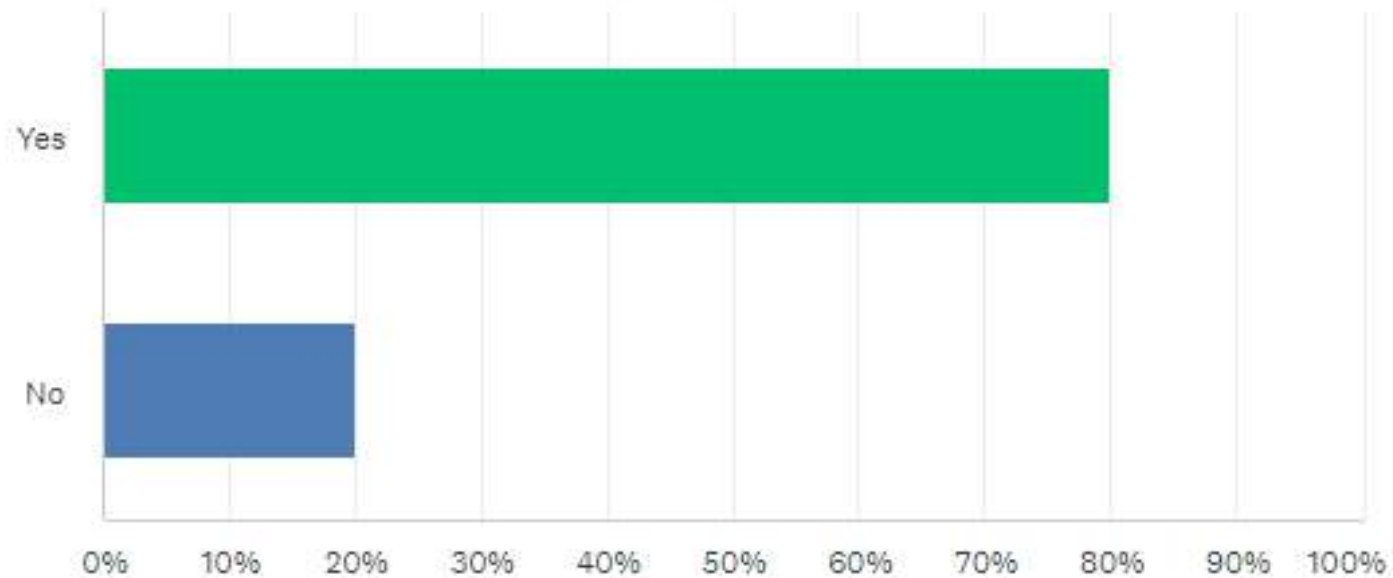
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67 participants took survey

Is Zea mays in your current scope of accreditation?

Answered: 65 Skipped: 2



Is in-lab established criteria the same for all types of *Zea mays*?

Is the criteria the same for field, sweet, inbred and hybrid seed?

Answered: 61 Skipped: 6

