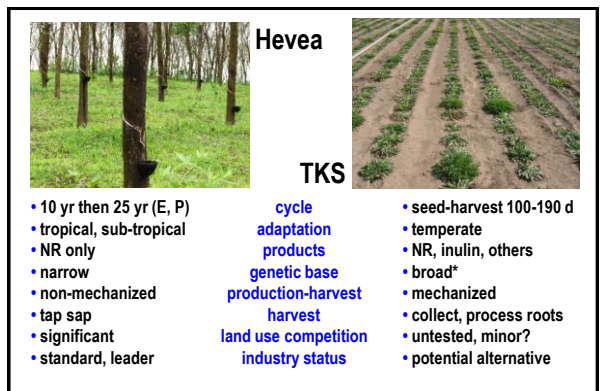
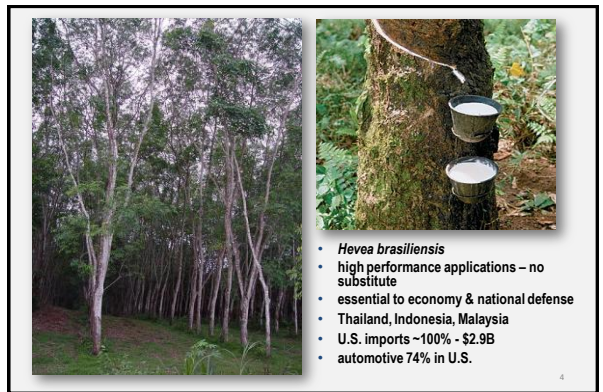
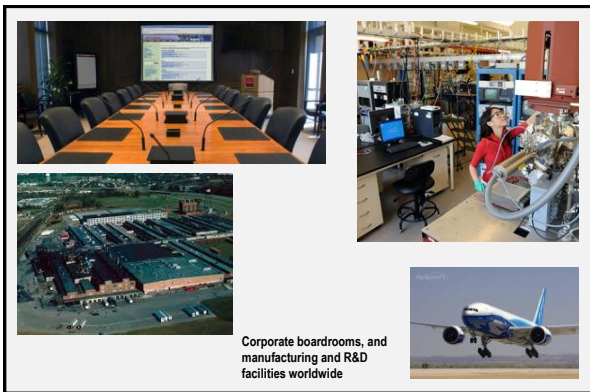


## **MATTHEW D. KLEINHENZ**

Dr. Matt Kleinhenz earned his M.S. and PhD degrees in Horticulture at the Ohio State University and University of Wisconsin-Madison, respectively. He joined the faculty in the Department of Horticulture and Crop Science at The Ohio State University-Ohio Agricultural Research and Development Center in 1998. Dr. Kleinhenz holds a 60-40 extension-research appointment focused on enhancing vegetable cropping systems design and implementation but he also contributes to the introduction of new commercial crops. It is this latter aspect of his work that he will outline today; specifically, Matt has been asked to summarize efforts to convert a naturally occurring plant into a foundational component of a global industry centered in North America.



## New Crop-based Economic Opportunity Development: TKS as a Model

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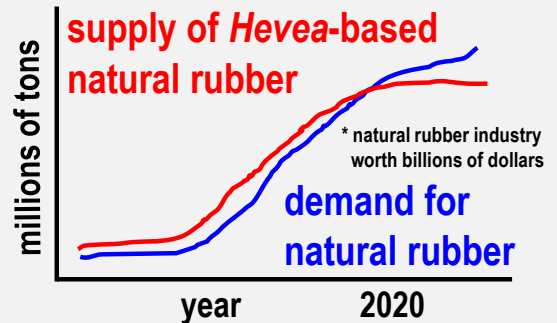
Matthew D. Kleinhenz  
Horticulture and Crop Science



A brief overview of process and lessons learned,  
not a technical summary.

## Process/Lesson: 1. “market pull” a strength

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## Process/Lesson: 1. “market pull”

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Economic models and pilot Life Cycle Assessment support continued activity.


## Process/Lesson: 2. evidence of feasibility key

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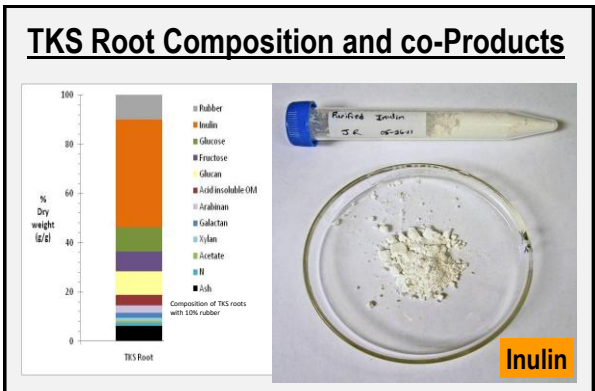
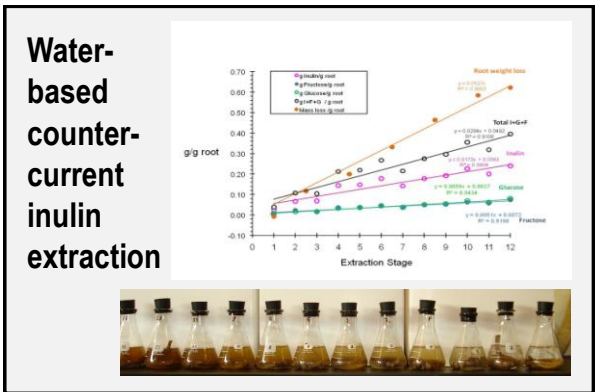
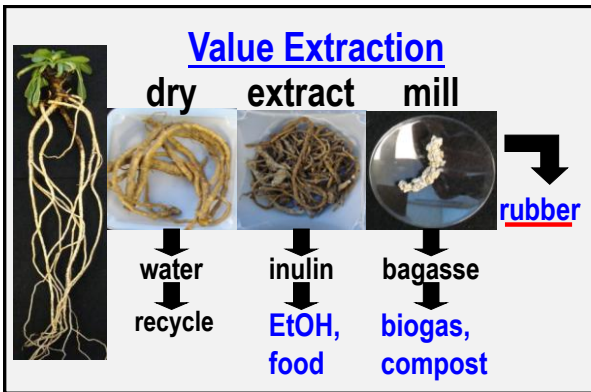
# TKS

- previously tested (U.S. Emergency Rubber Project early 1940s, Russia)

APRC APPLIED POLYMER RESEARCH CENTER at the University of Akron




“TKS rubber has processing and vulcanizate properties similar to SIR 20.”



# Bagasse Energy Content

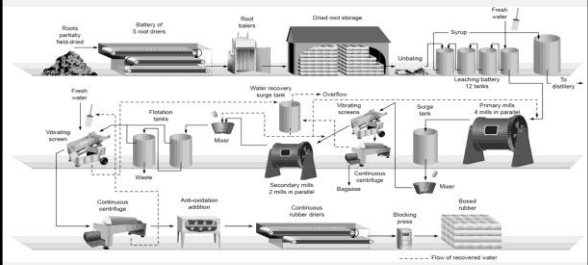
Root Bagasses  
Post-latex      Post-rubber



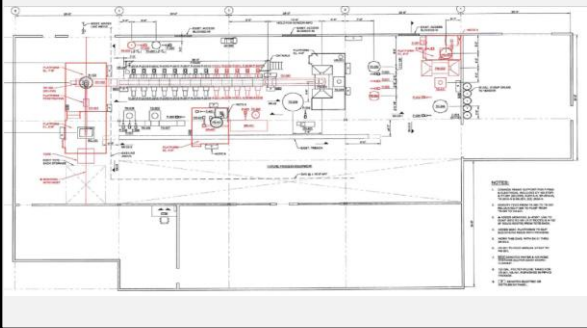
	Energy Content	
J.g <sup>-1</sup>	18,135 ± 43	22,984 ± 59
BTU/lb	7,797 ± 18	9,843 ± 25

Higher value likely due to inulin and lignin content

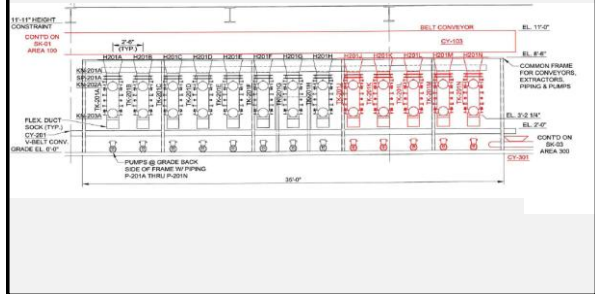
## Pilot Plant Design and Construction



## TKS Roots to Rubber Pilot Plant Process Equipment Layout



## Pilot Plant Extractor

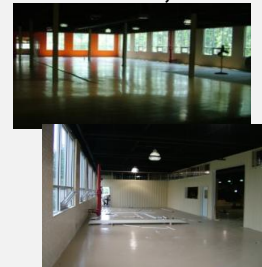


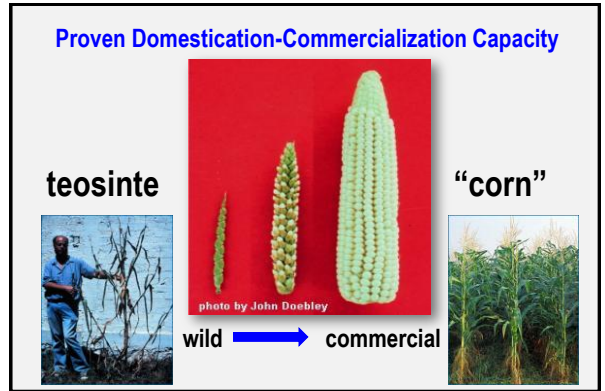
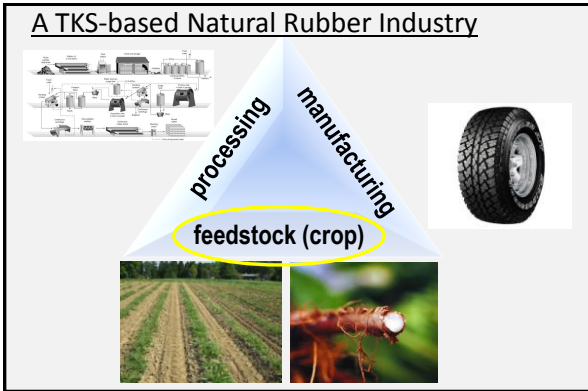
## Prototype Extraction Unit



## Pilot Plant Building

- 8,000 ft<sup>2</sup> facility located in Wooster, OH
- multifunctional
- some renovations complete, others underway
- equipment on hand, in construction
- occupancy in 2012

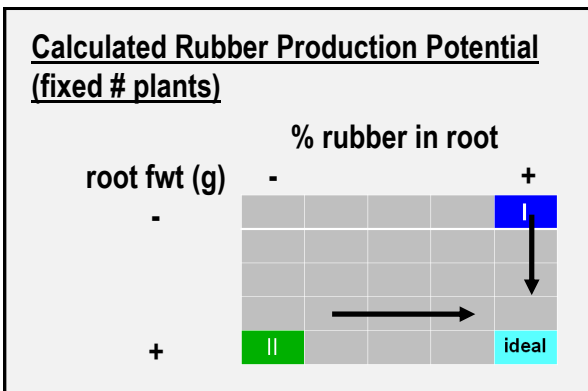
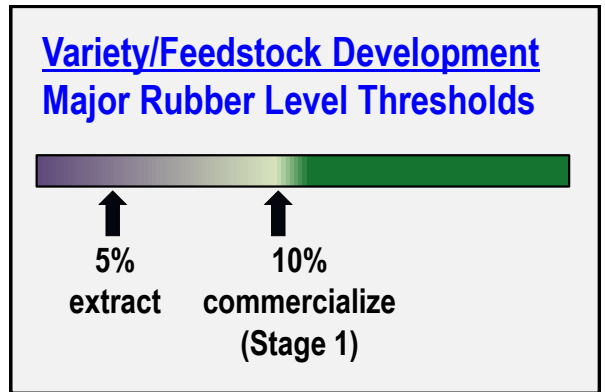




### Seeding through Root Processing

Rubber production per acre is a function of an 8-component, stage-based formula.

**Goal ...** maximize efficiency at each stage





Sponsors and others must be convinced that:

1. TKS is not weedy and
2. crosses with weedy types will not create a super-weed.

“Do no harm.”



“We”

**Process/Lesson:**

**3. partner recruitment, retention essential**

Building a TKS-based Natural Products Industry



Building a TKS-based Natural Products Industry



**PENRA**  
 “The Program of Excellence in Natural Rubber Alternatives”

<http://oardc.osu.edu/penra/>



**Organizational Capacity**

- can address all points in the value chain (e.g., biological feedstock development, in-field management, root processing, product utilization)
- includes industry, government, university liaison effort

**Process/Lesson:**  
**4. need for sponsors undeniable**

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**Process/Lesson:**  
**5. shared plan, follow-through a cornerstone**

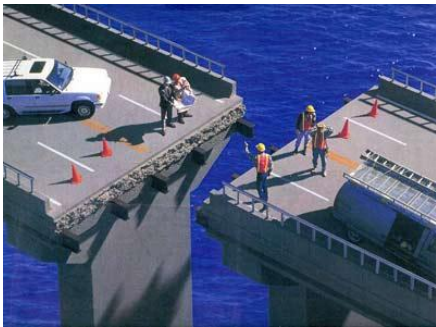
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**Complex  
processes  
viewed in  
many  
ways**

## Issues/Questions

- private and public sector roles
- relative emphasis on R & D
- priorities
- timeline (especially key in biologically-based projects)



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