Development of a Mechanical Undercutting System to Minimize Sweetpotato Skinning during Harvest

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Disclaimer

- Do not try this at home.
  - This data is very preliminary. We are still developing and testing the system. If you replicate this system at home you do so at your own risk.

- Mention of company or product names is for presentation clarity and does not imply endorsement by the authors or their affiliations, nor exclusion of other suitable products.

Justification

- Sweetpotato Producers:
  - High-value crop with future growth.
  - Industry demand needs continuous supply all year.
  - Harvest and postharvest storage critical to maintaining supply.
  - Skinning and abrasions of roots during harvest and handling contribute 20-25% of storage losses.

Justification

- Sweetpotato producers currently use a de-vining system to manage skin set.
- De-vining is currently not a viable option for bulk harvesting systems.
- A new method is needed to increase skin set for both bulk harvesting and traditional harvesting systems.

Justification

Why Undercutting?

- Used in other cropping systems
  - Plant maturity
  - Skin set
- In tandem with de-vining
- Leave vine intact for bulk harvesting
- Mechanical as opposed to chemical

Objectives

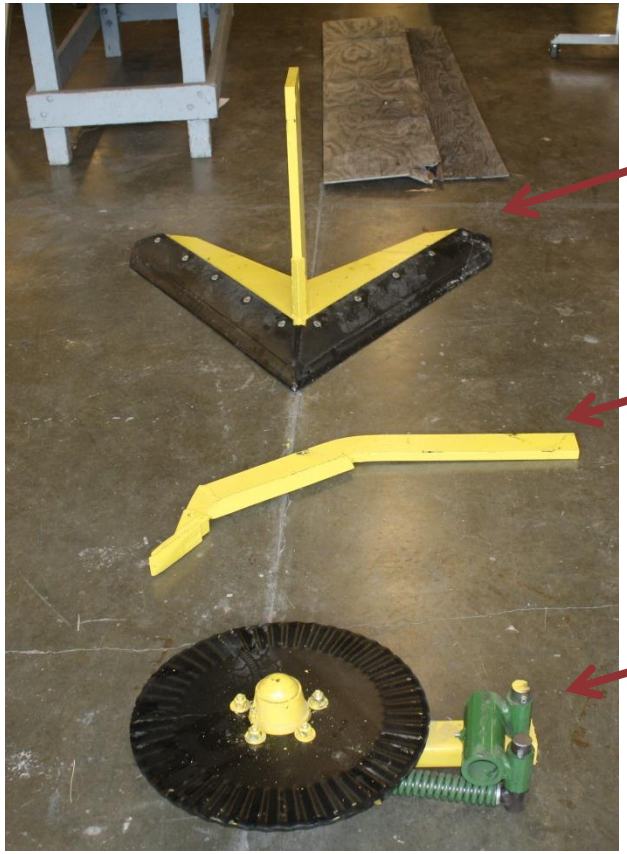
- To develop and test mechanical undercutter systems for use in sweetpotato primarily made from off-the-shelf components.
- To assess the influence of a mechanical undercutting system by quantifying skin set of sweetpotato.

Machine 1

- Developed from components from Roll-a-Cone Manufacturing (Tulia, Tx.). Attached to a toolbar designed and built in house.

- Implement covers two 40in rows and is adjustable for standard row spacing applications.

Machine 1 Components

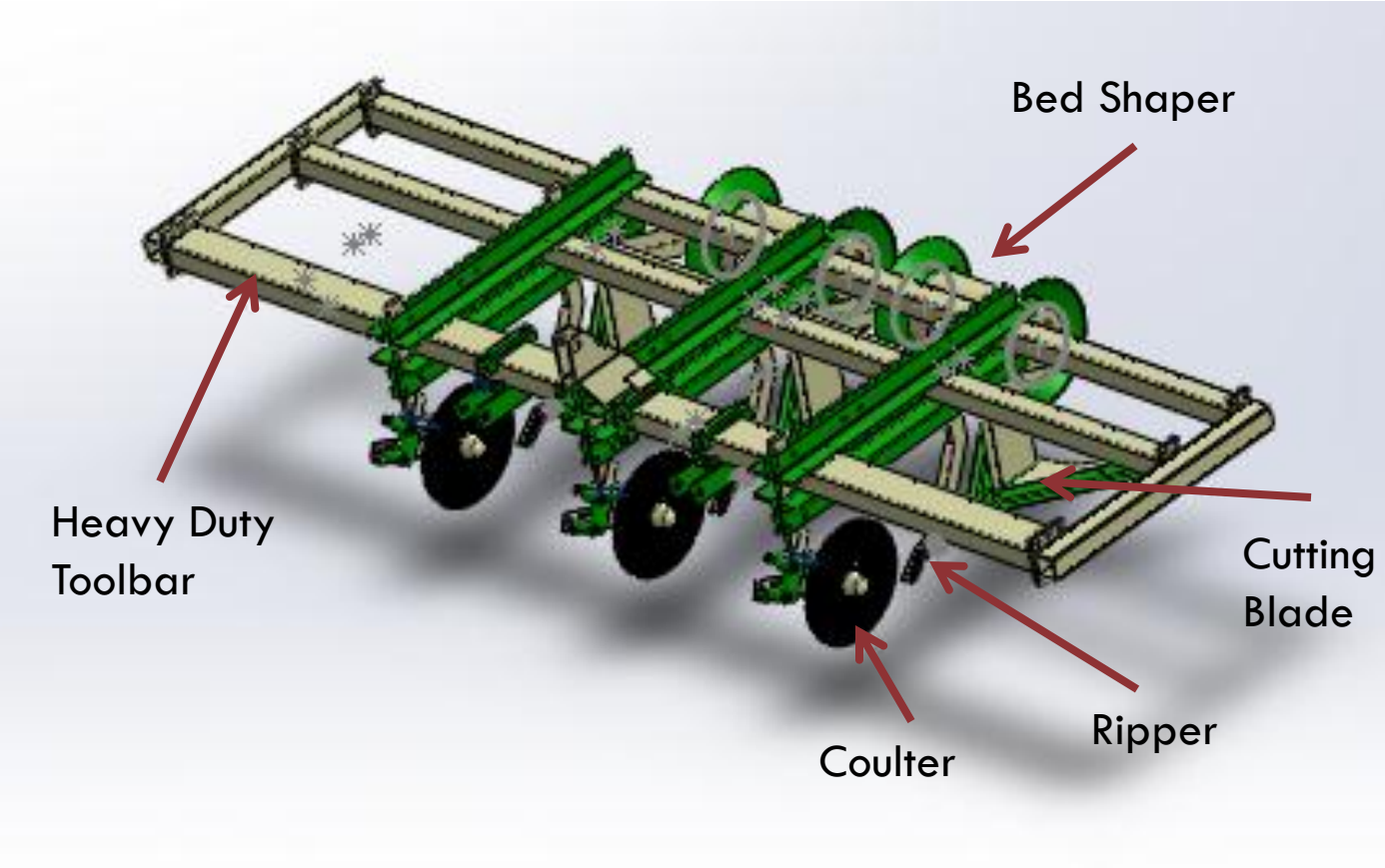


Razor Plow Shank and Blade

Standard Ripper Shank

Coulter

Machine 1 Components



Machine 2

- Even more readily available option to producers
- Created from a modified drop off sweetpotato harvester built by Easley Mfg. (Houston, Ms.)
- Harvesting chains and hydraulics were removed and digging blade modified slightly for undercutting
- Bed shapers added to stabilize rows

Machine 2 Components

Procedure

- Experimental Design
  - Two Varieties (Beauregard "B-14“, Evangeline)
  - Four Reps
  - Split-Plot
  - Main Treatment
    1. De-vining
    2. No De-vining
  - Sub Treatment
    1. No undercutting
    2. Undercutting with Machine 1
    3. Undercutting with Machine 2

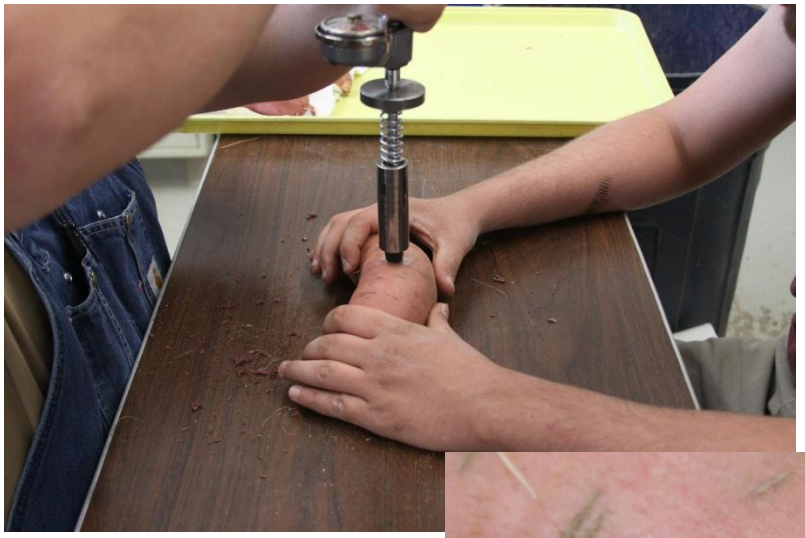
Procedure

- Pontotoc Ridge-Flatwoods Branch Experiment Station, Pontotoc, MS
- Plots managed under typical grower practices
- De-vining and Undercutting occurred on same day
- Plots harvested on 3 and 6 days after treatments with skin measurements on day of harvest
- Significant rainfall event occurred between harvests
- 5 roots randomly selected per plot with 2 skin readings per root

Procedure

- Skin strength measured with modified Halderson tester (Halderson & Henning, 1993; Lulai & Orr, 1993)

Procedure



Machine Operation

- Operating Depth
  - 8-10”
- Operating Speed
  - 4-5 MPH (Yes, really.)
- Toolbar should be near level with gauge wheels to stabilize at operating depth

Machine 1 Testing

Machine 2 Testing

Post Undercutting

Post Undercutting

De-vined

Vined

Experiment Results

Results

- Evangeline Variety
  - No significant difference among main and sub treatment effects.
  - Higher mean skin set than B-14

TRT	Eva Mean	B-14 Mean
De-vined		
None	2.20	1.86
Machine 1	2.19	1.74
Machine 2	2.24	1.78
Vined		
None	2.32	1.82
Machine 1	2.21	2.02
Machine 2	2.22	1.81

Day 6

Results

- Machine 2
  - No significant differences among main and sub treatment effects.
  - No different from control.
- Further adjustment may have been needed for optimal undercutting

Results

Type 3 Tests of Fixed Effects

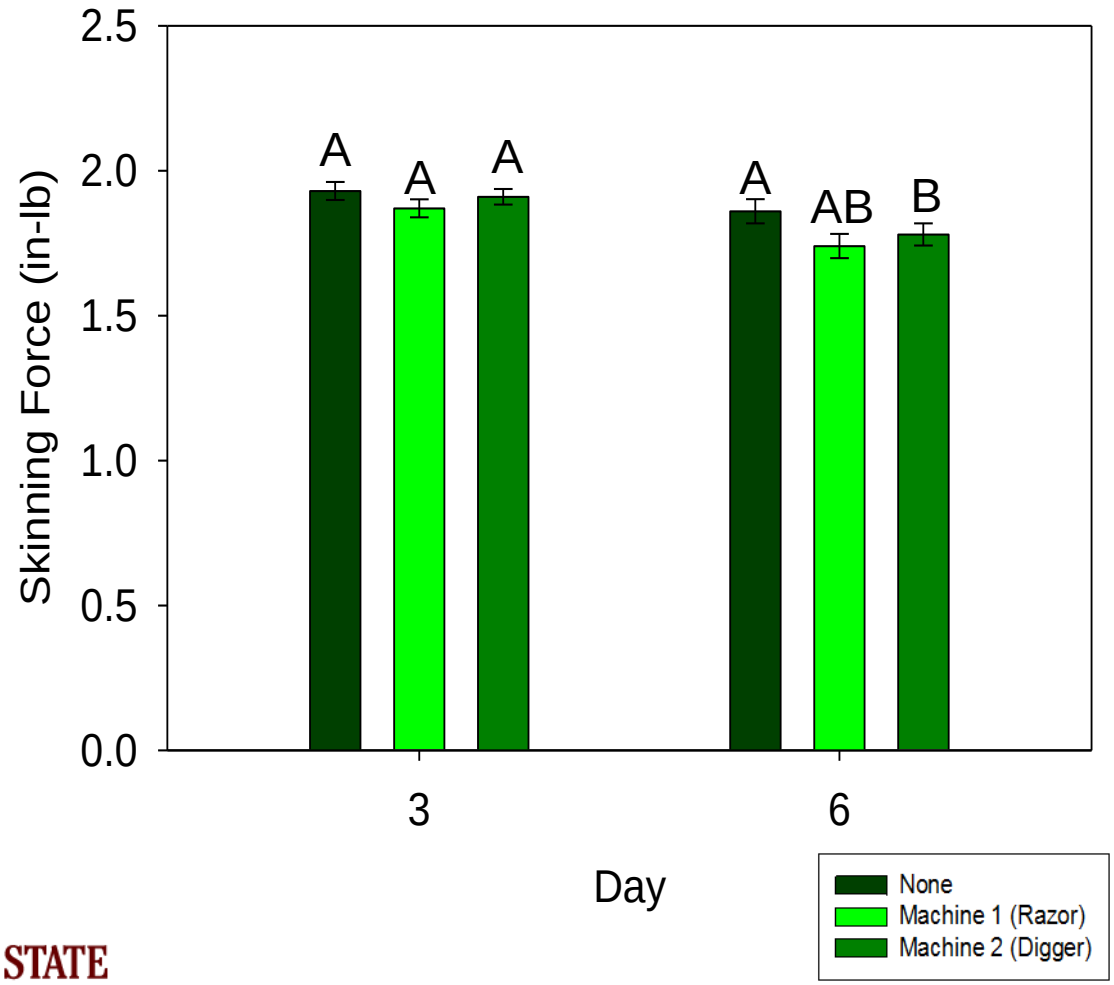
Day 3

Effect	Pr > F
Main (Vine Condition)	0.0881
Sub (Undercutting)	0.0523
Main*Sub	0.3141

Day 6

Effect	Pr > F
Main	0.1304
Sub	0.0893
Main*Sub	< .0001

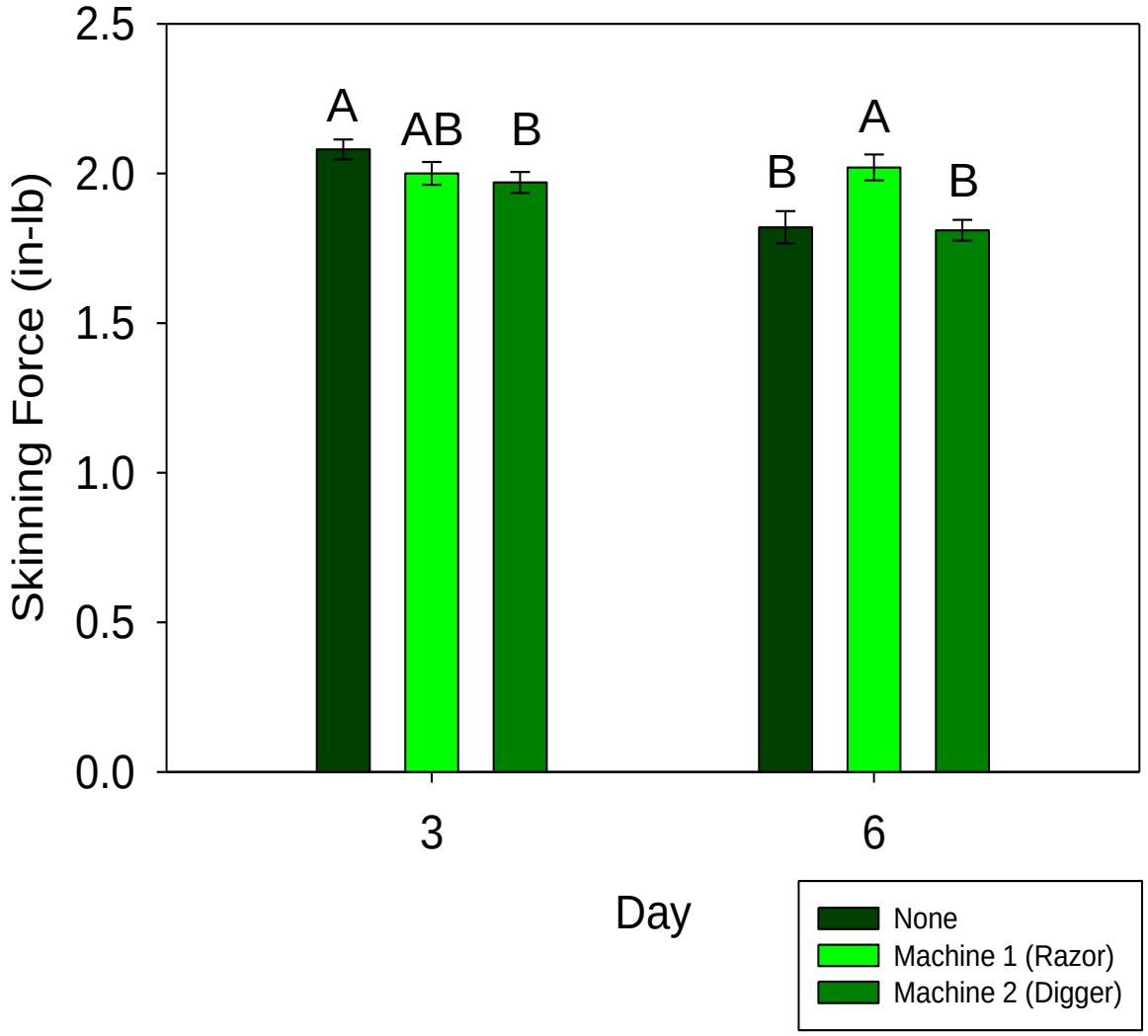
De-Vined



n = 40
Standard Error

Vine-On

n = 40
Standard Error



B-14 – Day 3 - LSDs

Treatment		Control			
Main	Sub	Main	Sub	Estimate	Pr > t
DV	Easley	DV	None	-0.019	0.6664
DV	Razor	DV	None	-0.062	0.1707
V	None	DV	None	0.151	0.0342
V	Easley	DV	None	0.041	0.5119
V	Razor	DV	None	0.073	0.2513

B-14 – Day 6 - LSDs

Treatment		Control			
Main	Sub	Main	Sub	Estimate	Pr > t
DV	Easley	DV	None	-0.078	0.1566
DV	Razor	DV	None	-0.123	0.0265
V	None	DV	None	-0.038	0.5558
V	Easley	DV	None	-0.055	0.3914
V	Razor	DV	None	0.160	0.0232

Conclusions

- Evangeline variety did not respond to treatment
- Machine 2 (digger) no significant effects
- B-14 responds to Machine 1 (Razor) with vine-on
- Razor undercut plots maintained skin strength after rainfall
- 10.9% increase in skin strength

Future Work

- Continued Refinement of Implement
- Repeat Study
  - Examine Time Effects (Day 3,4,5,6,7,etc.)
- On-Farm Study with Scaled-Up Implement

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