ENGINEERED UNITS FOR PROCESSING AMARANTH IN DEVELOPING COUNTRIES

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Calvin College

A quick introductory orientation

Calvin College – Origins

1857 Est'd by the Christian Reformed Church (CRC) in W. MI

1876 Calvin College and Seminary founded

1900 Education and pre-professional programs offered

Calvin College - Characteristics

- distinctively Christian
- academically excellent
- liberal arts college
- shapes minds for intentional participation in the renewal of all things

Aims to be

- Profoundly Academic
- Purposefully Renewing
- A Spirited Community
- Generating Promising Futures
- A Remarkable Investment

Engineering: 4000 Students, ~970 graduated annually
~370 Engineering Students, Graduating ~65/yr

Concentrations: Chemical
Civil (Structural and Hydrology) and Environmental
Electrical (Analog, Power Systems) and Computer (Digital)
Mechanical (Th. Systems, Machine Design, Vibrations)

Amaranth

comes to

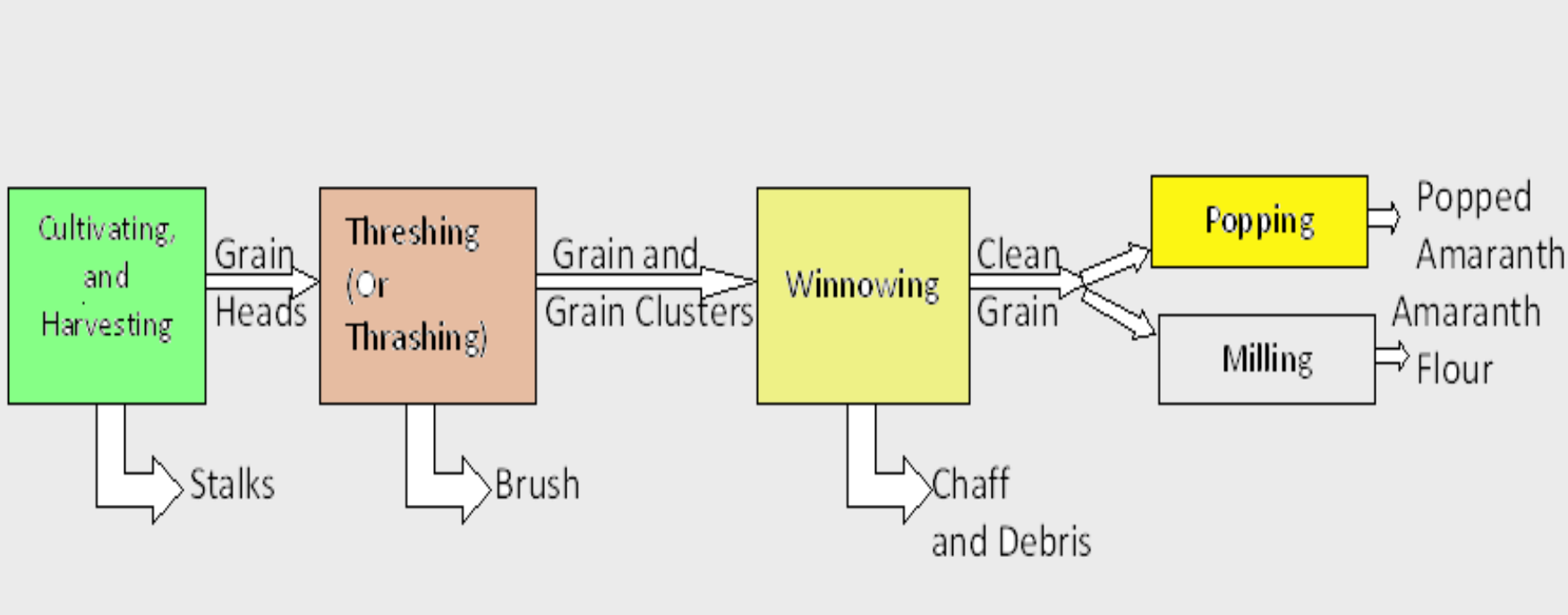
Calvin College

Amaranth comes to **Calvin College**

Merging of Two Vectors

- Pigweeds: Amaranth
  - A. Cruentus
  - A. Hypochondriacus
  - (A. Caudatus)
  - Plainsman
- Developed since ~**1976** by USDA, RIEF*, NGO's, others
- Aubrey sees at RIEF ~**1982** and meets experts
- CRC –World Relief Committee in **2004** came to Calvin College Engineering for a design of a "seed cleaner"
- **2005** Grain Winnower
- **2007** Large Grain Popper
- **2008** Thresher
- **2009** Sm. Grain Popper-1
- **2011** Sm. Grain Popper-2

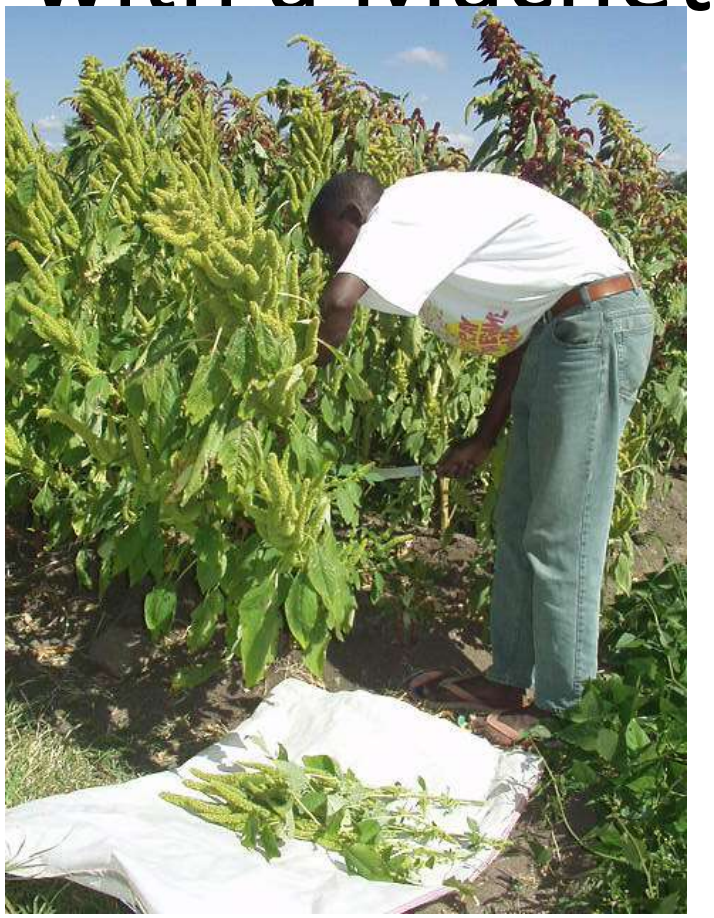
Amaranth Production Cycle for Developing Countries



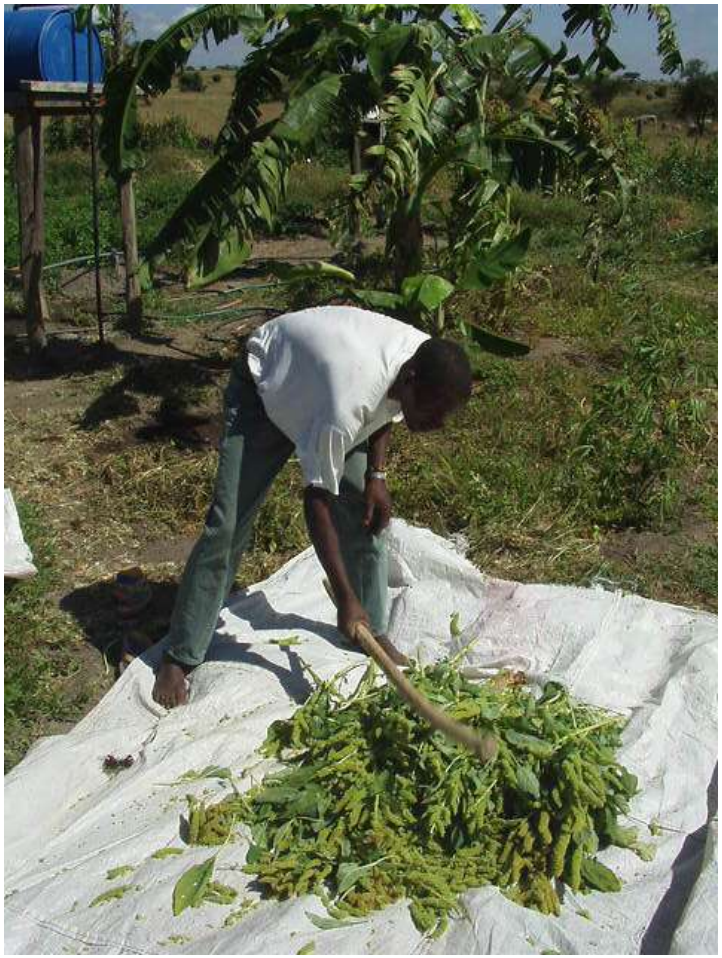
Standard Specifications for Amaranth Processers

- **Safe** and transparent to unskilled, untrained operators, maintenance staff, transportation workers
- Minimal complexity
  - Operated by about 2 women and/or pre-teen age boys (about 2 x 0.05 HP); efficient
  - Simplified construction; uses local shop capabilities
- Easy maintainability – using local skills and parts
- Pictographic Manuals for Operation and Maintenance
- Transportable over rough "roads"
- Low Cost – affordable within farmer's economics

Harvesting Cultivated Amaranth with a Machete



Amaranth Threshing in Kenya



Amaranth Post Threshing in Kenya

Amaranth Seed Recovery After Threshing

Concept Design for Amaranth Thresher

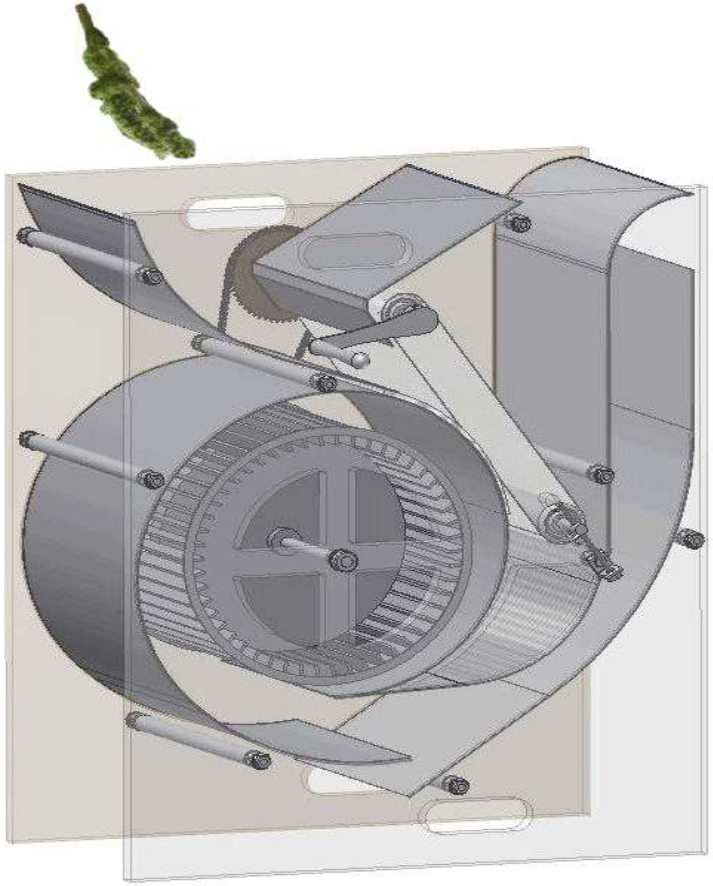
Conceptual Amaranth Thresher

- Some useful design ideas
  - Perforated metal to abrade grain heads and allow grain to fall through to collector
  - Threshed grain could be further threshed to process small, broken off heads
- Requires ~3 Hp to operate = fueled engine, not people cranking or bicycling
- Costly to construct; not easy to build and maintain

Amaranth Grain Cleaner

- Processes grain clusters and caps on grains
- Hand crank powered (or pedal powered)
- Light weight; easy for 2 women to relocate

Amaranth Seed Cleaner



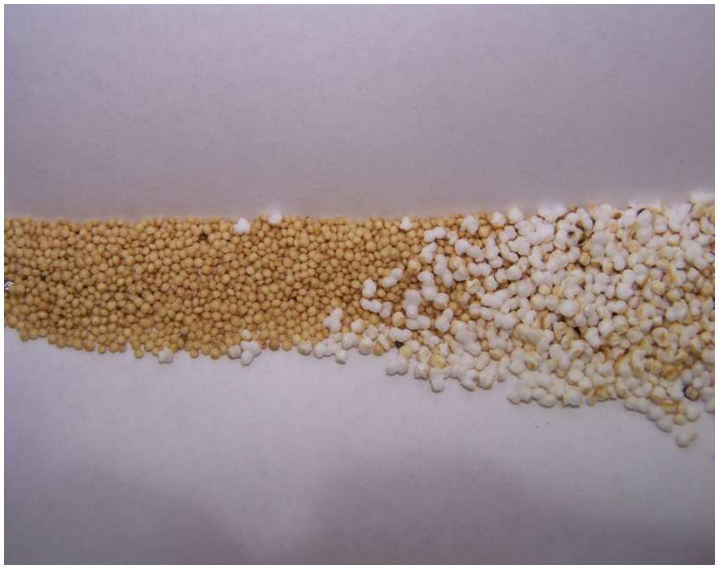
Amaranth Grain Cleaner

Amaranth Seed Cleaner in Mexico

Amaranth Seed Cleaner

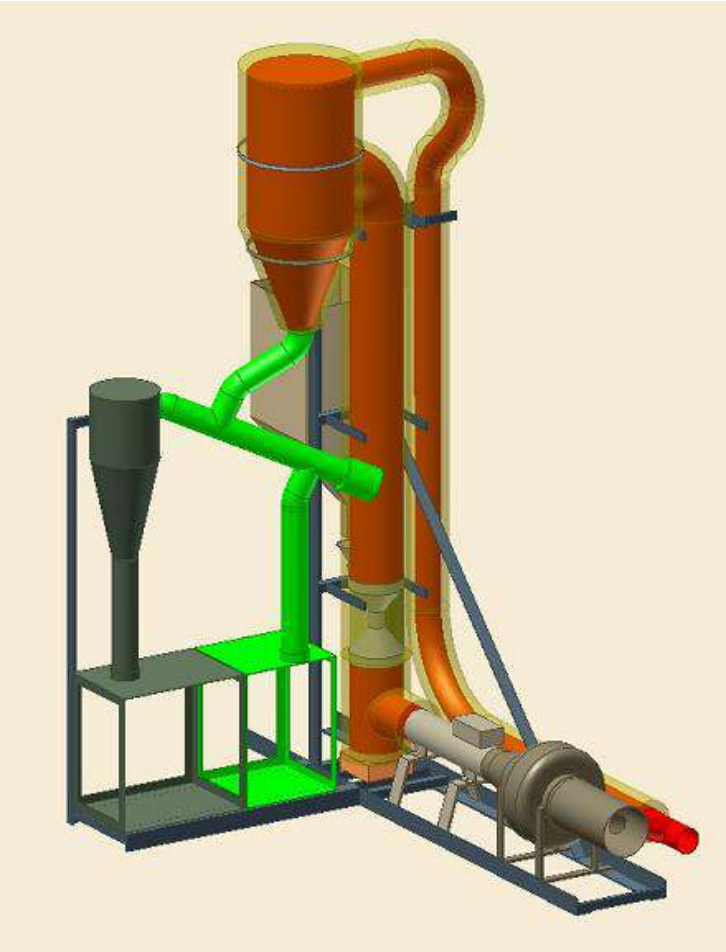
- High grain recovery (92%)
- Cleaning Quality = commercial quality
- Confused for a thresher; people tried to charge whole heads!
- Some wanted pedal powering
- Moist amaranth will “gum up” in winnower

Amaranth Grain Popper



Amaranth Popped out to Clam Shell

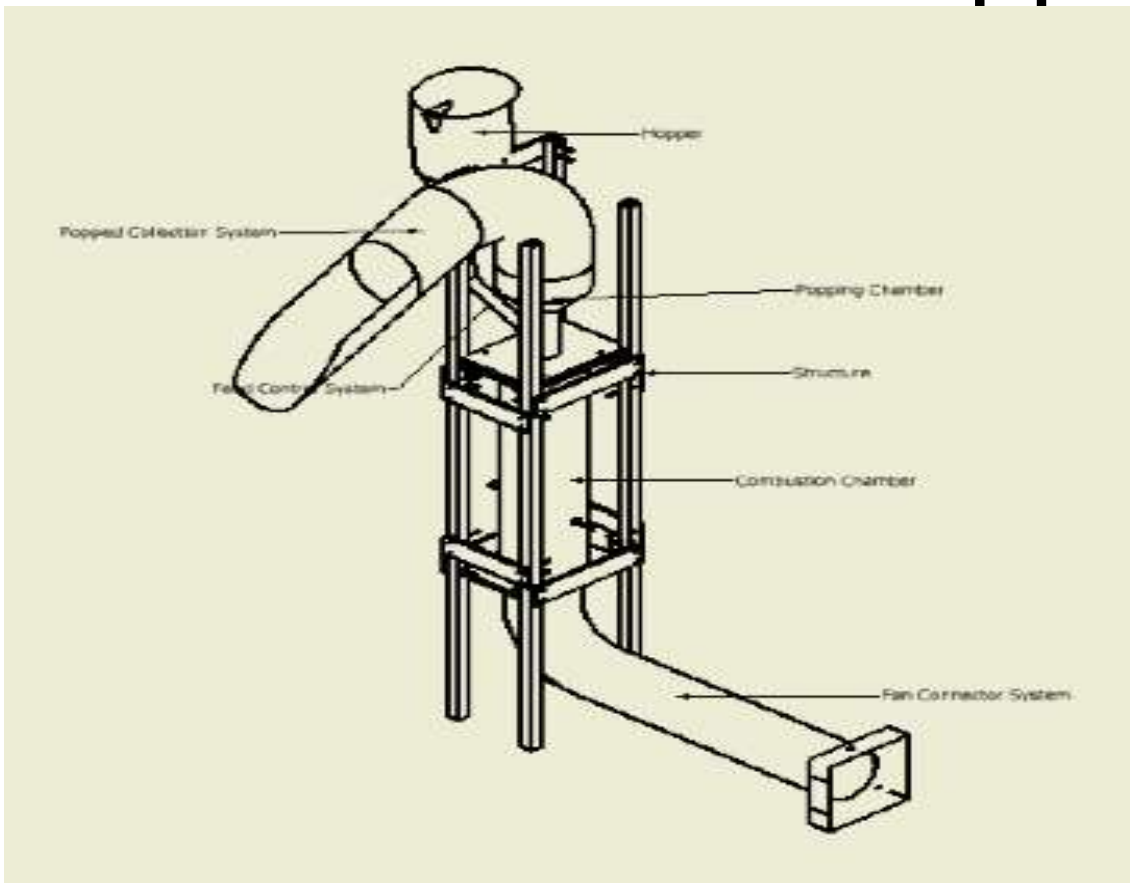
Amaranth Popping Machine



Small Scale Amaranth Poppers

- Goal = 2 to 5 lb/hr
- Simple; easy to build, clean and maintain
- Services either:
  - Nuclear Family Feeding (8 – 20 diners); or
  - Micro-business selling popped amaranth, “health” bars (amaranth with nuts, dried fruits, honey, molasses, etc.)

Small Scale Amaranth Popper -



Small Scale Amaranth Popper - 1

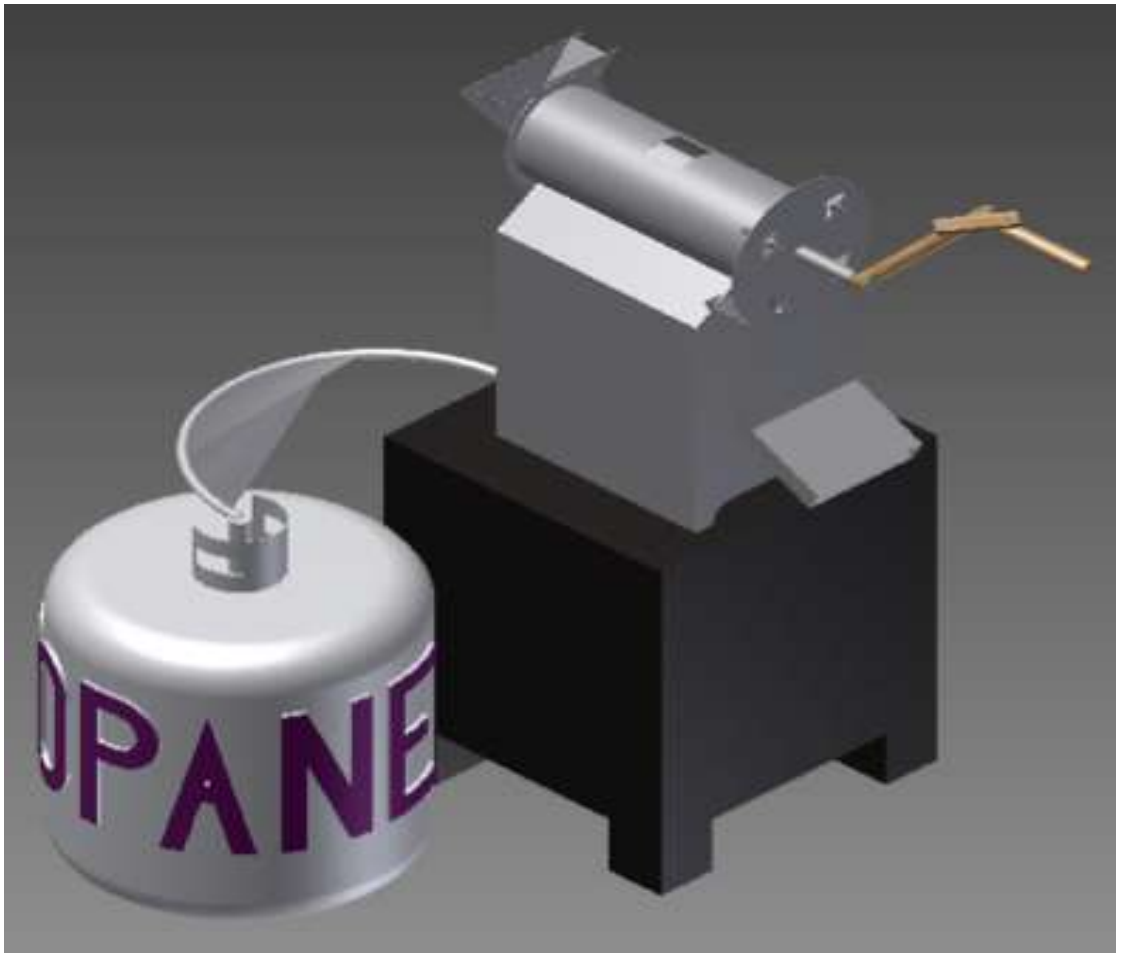
- Video

http://www.youtube.com/watch?v=D7yT7B09l-M

Small Scale Amaranth Popper - 1

- Pops ~5 lbm/hr
- 50+% popped; mediocre quality
- Thermal damage to blower system possible
- High Energy Consumption

Small Scale Amaranth Popper - 2



Small Scale Amaranth Popper - 2

- Important Design Features
  - Popping chamber is wire mesh to promote convection heating
  - Large chimney for sufficient airflow
  - Insulation for efficiency
  - Feed runs through inner chamber rod initially and then falls into mesh chamber
  - Tube propane burners for even heating

Small Scale Amaranth Popper - 2

Small Scale Amaranth Popper - 2

- 5 lb/hr, with 2 parallel chambers
- >80% popped
- 240-250oC
- 15 seconds inside oven
- Propane-heated
- Operated by one person
- $40 of materials to build
- Can be built and operated easily

Popping Production Issues

- Influence of fuel on health quality of amaranth
- Possible fuels
- Moisture management of feed amaranth
- Field deployment

Thank You

- To about ~12 students, directly; many others indirectly
- Calvin College administration, faculty and staff
- Dick Dugger
- David Brenner
- ECHO, esp. Stan and Beth Doerr
- CRC-WRC, esp. Tom Post and Hillcrest-CRC (Bob Beute)
- Amaranth, esp. Sykes, PhD, P.E. Calvin alumnus, especially

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Thanks for listening!