



Upland Taro

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In the Beginning ...

Taro originated in the Indo-Malaysian Peninsula over 50,000 years ago.

Domestication in the Western Pacific occurred independently in many areas prior to Polynesian arrival. Grown in Hawaii for 2000 years, many cultivars are based on mutations.

Genetics

All Hawaiian cultivars can be narrowed to 4-5 original Polynesian introductions based on genetic mapping. This is a concern from the standpoint of susceptibility to diseases and the introduction of invasive species, especially Alomae and Bobone, killing viruses from the Solomon Islands.

Growing Systems

- Wetland (lo'i) – a water pass-through system where corms are submerged. Slower maturing.
- Upland (mala) – a planting system that's usually rain-fed and utilizes soil and mulch as growing media. Usually faster maturing.

Modern Mala System Ho'olehua, Molokai



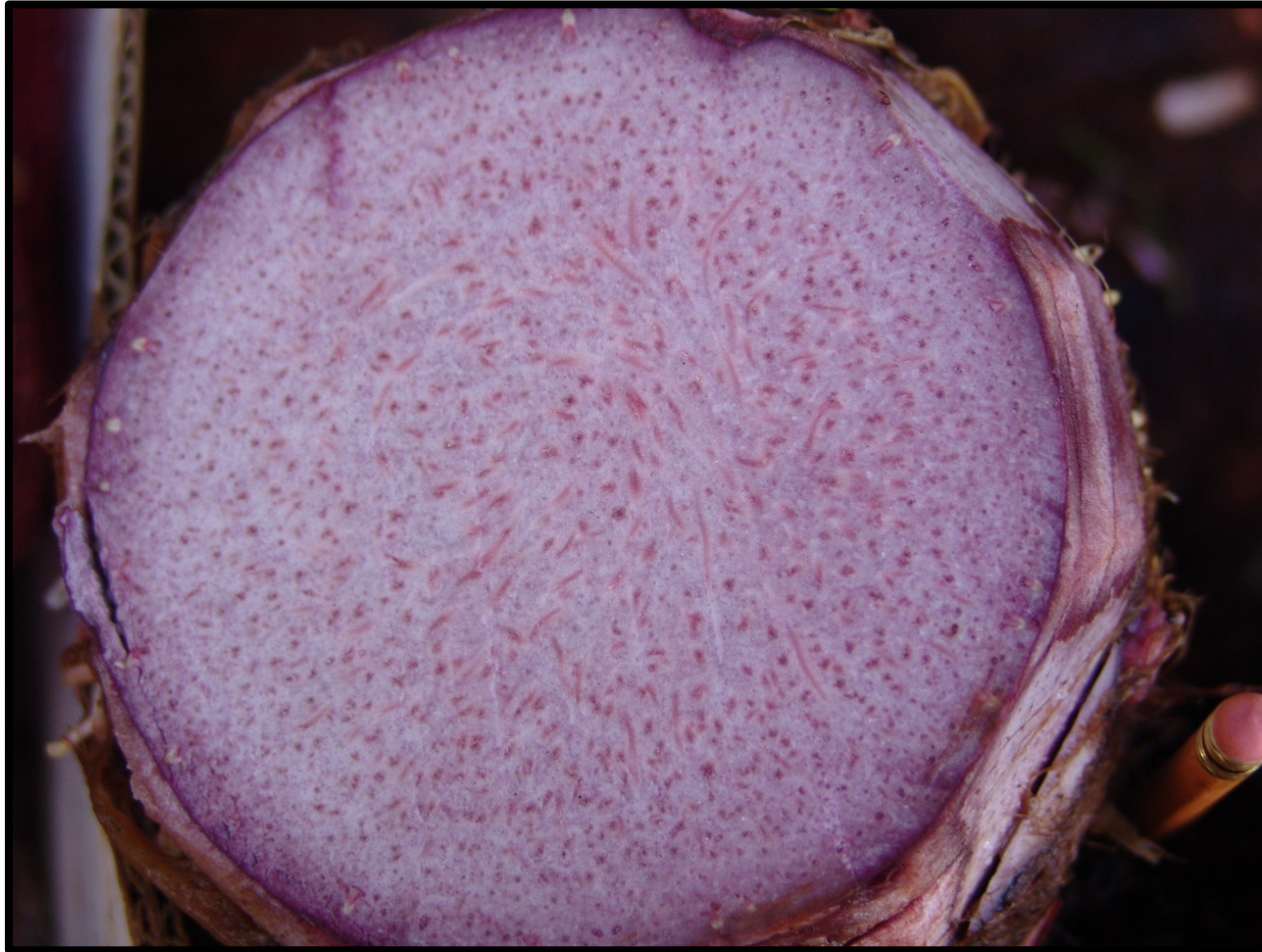
Hawaiian Taro Cultivars

- About 90-100 Hawaiian cultivars left of the 200+ selections.
- Many cultivars lost due to market demands and changing eating habits.
- At end of Kapu System, demand moved to ali'i taro; including purple and Lehua types.

Corm and Poi Color

- Main corm and poi colors are white, pink, purple, and yellow.
- Much more white and off-white cultivars than purple ones.
- Purple color is recessive. (only 7% purple in a white X purple cross).
- Poi color is also influenced by skin color.

Market Wants Purple Corms



Propagation

- Taro is propagated vegetatively.
- Only way to have ready access to planting material is through continuous planting and sharing with others.
- There's a need to preserve ALL the varieties for future generations.

Keiki = Banana Seed

Technical term for banana planting material is a keiki. Similar to huli.



Huli = Taro Seed



Identification Based On:

- General characters – height, maturity, unique characteristics
- Leaf blade, shape, & orientation
- Piko color
- Petiole and leaf edge (lihi) color
- Apex (kohina) color
- Corm fiber and skin color
- Inflorescence

Leaf Shape –
one of the
characteristics
used to identify
a cultivar



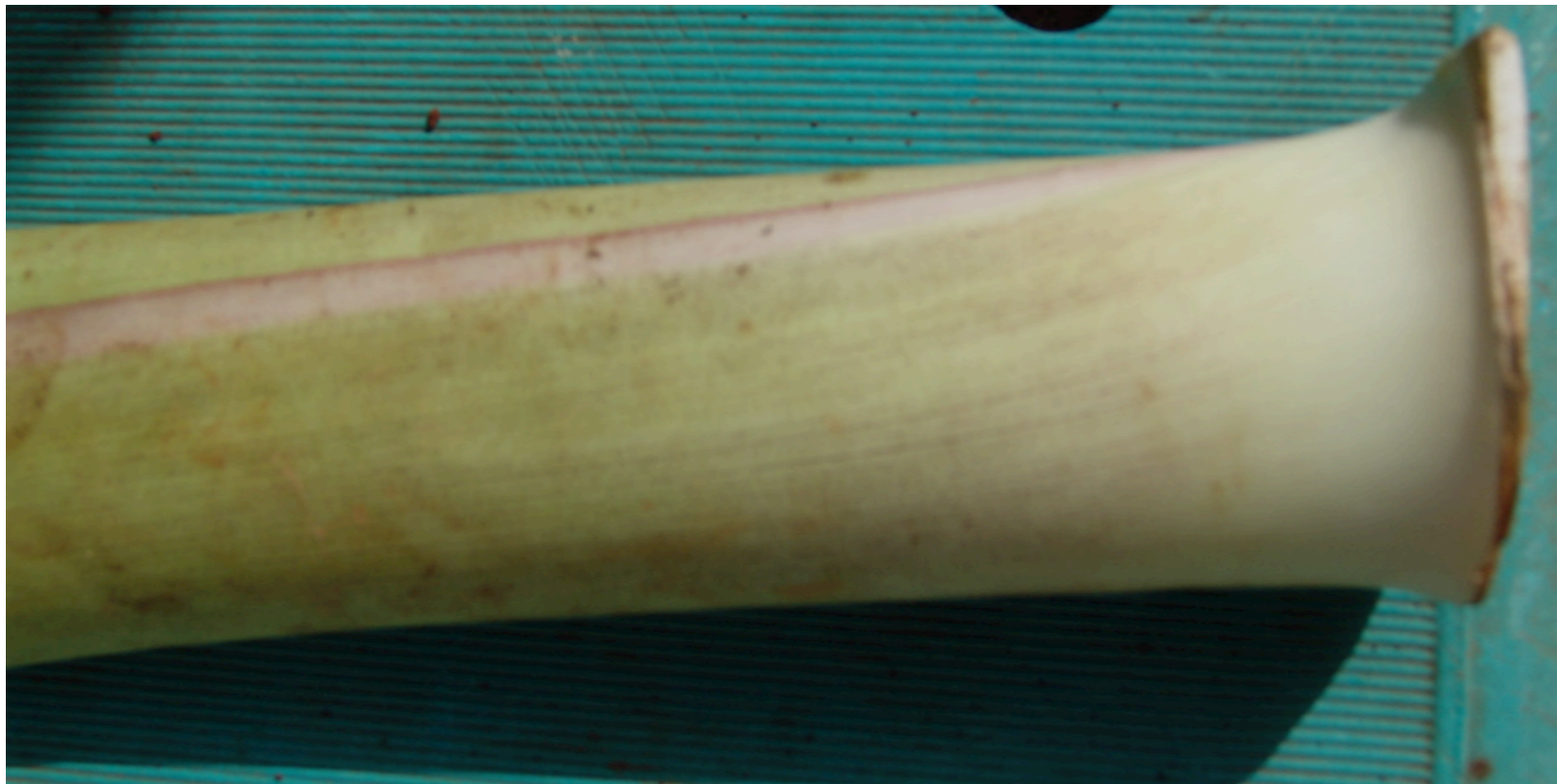
Some Taro Families

- Mana (branching corms) – upland, drought tolerant, rubbery consistency, table or kulolo
- Piko (unique leaf shape) – late maturing, can be stored, once very popular
- Lauhoa (large leaf) – upland, drought-tolerant, large corms, non-acrid, table or kulolo
- Lehua (reddish poi) – early maturing, dual-purpose, main wetland poi variety, doesn't store well in field

Mana ulu - Mana leaf can be identified as long & skinny with upright habit and V connected to the piko. Corms also will branch (mana).



Mana ke'o ke'o – leaf edge (lihi) red with pinkish band; white base. Light reddish brown stripes.



Mana ke'oke'o - Buds (makamaka) in pairs on corm with pinkish stripes.



Leaf Margin (Lihi) - Ele ele makoko: broad greenish margins, purple kohina (ring) at base. Lilac-pink near kohina for 3-4 cm upward.



Lauloa – Drought-Tolerant



Lauloa eleele ula



Eleele makoko



Planting Material

Only two ways to have planting material available year-round:

- 1. Grow Your Own – Always set aside a few rows for planting material.*
- 2. Develop a network of growers who share planting material.*

Preserving Huli

The key to preserving planting material is to prepare a new planting area before you harvest. This is critical.

Another strategy is to grow huli rows.

Huli Rows (Center)



Preparing Huli

- In either growing system, planting material can become infected with diseases and microorganisms.
- Trim all discolored areas to control the spread of diseases such as Pythium or pests such as Nematodes.
- Dip huli in chlorine-based dip; 1 part chlorine to 10 parts water for 3 minutes.

Planting Strategy – Drip System

- Sort huli by size.
- Plant smallest huli closest to water source then plant next largest and so on.
- Harvest largest from end of line, then tie up line to irrigate the remainder.

Irrigation at Planting

- Huli should be calloused, dry overnight. Do not plant freshly harvested huli.
- When first planting, huli has no roots. Do not overwater! Bottom will rot.
- Wet initially, then let dry before irrigating.
- Plant extra huli at the end or beginning of line. Pull out to check rooting. Once good rooting has occurred, then irrigation can be increased.

Planting



Wetland Poi Varieties Today

- **Maui Lehua** – purple poi, early maturing, poor storage in field due to rot. (Hanalei)
- **Moi** – excellent taste, can be stored in field, whitish poi, medium maturity. (Maui, Oahu)
- **Piko uaua** – grey poi, can be stored in field, dense corms, strong roots, late maturity. (Waipio)
- **Api'i** – dense, grey poi, (Waipio)

Traditional Poi Taro Varieties

Apowale, ***Apuwai***, Eleele makoko, Eleele naioea, Elepaio, ***Haokea***, Hapu'u, ***Kai Ala***, ***Kai kea***, ***Kai Uliuli***, Kalalau, Kuoho, Lauhoa eleele-ula, ***Ohe***, Lehua eleele, Lehua ke'oke'o, ***Lehua maoli***, ***Lehua palai'i***, Manini kea, ***Moi***, Nihopu'u, Pololu, Pa'akai, Papapueo, ***Pi'i ali'i***, Piko eleele, ***Piko kea***, Piko ke'oke'o, Piko lehua api'i, ***Piko uaua***, ***Piko uliuli***, Uahiapele, Ulaula kumu, Ulaula moano

Moi Varieties



Maui Lehua = Lehua maoli hybrid



What Cultivars to Grow

Depends on:

- Growing conditions
- Use – poi, table, kulolo, or leaf
- Luau – Bun long preferred, but any works
- Home use – any variety can fit
- Early and late varieties – can have taro over a longer period of time.
- Availability of planting material

Luau = leaf



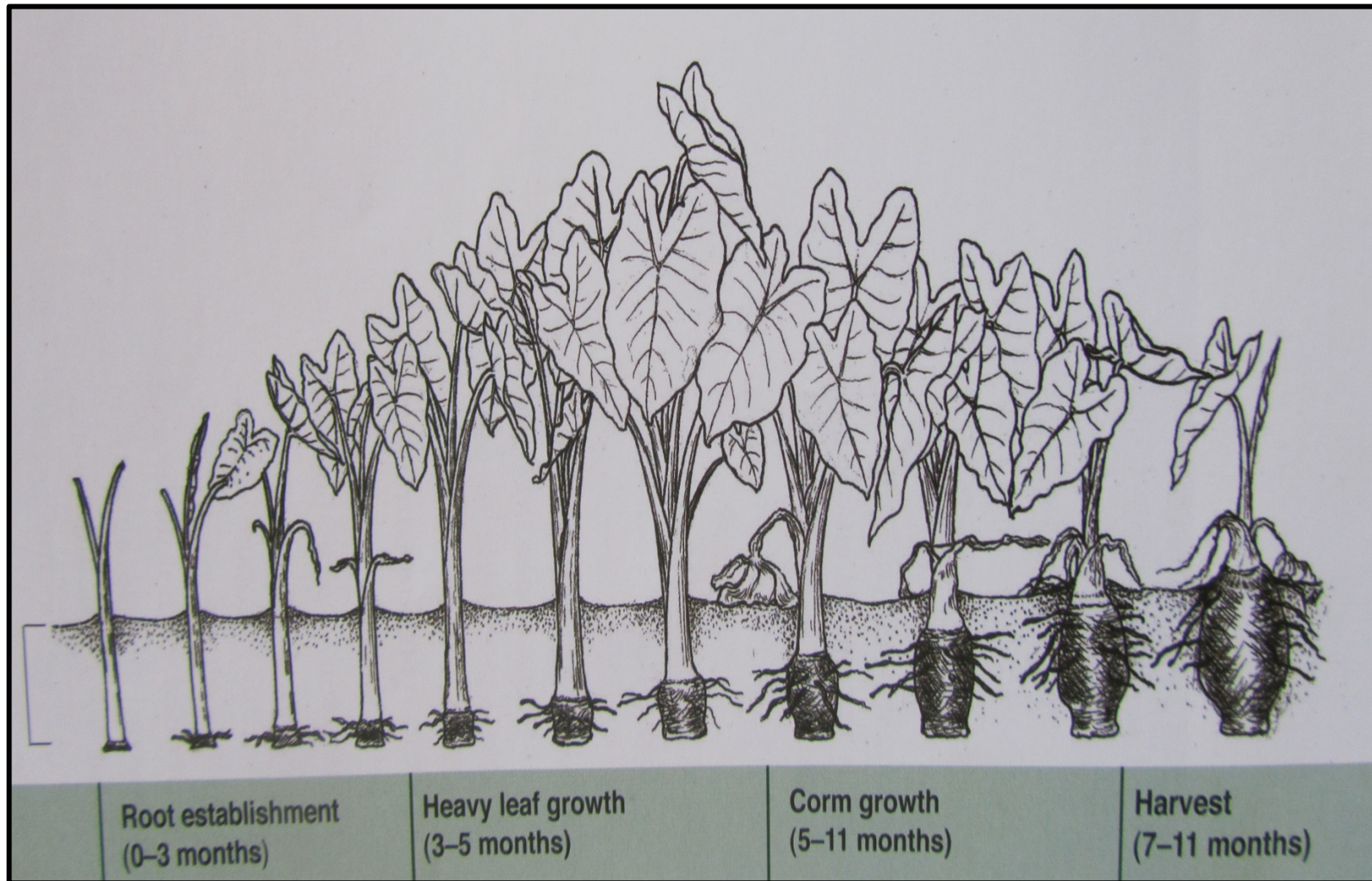
Growing Luau

- Protect from wind
- Cut leaf maximum of once a month
- Feed after harvest to induce leaf production and to keep leaf soft and pliable
- Leave center leaf
- Variety is personal preference
- Late maturing varieties = longer harvest

Luau Varieties

Bun Long, Haokea, Piko eleele,
Aweu ***Lauloa palakea eleele***,
Lauloa group, O'opukai, ***Mana
ke'oke'o***, Mana group, ***Mana
ke'oke'o***, Kalalau, ***Apuwai***,
Lehua maoli, Hapu'u, Piko lehua
api'i, Wehiwa

Taro Cycle - Upland



Growth Cycle

Example – Mana ulu: 8 month cycle

- Month 1: Plant huli – weed control
- Month 2-5: Active vegetative growth - plant can grow to 6+ feet
- Month 6-8: Active corm growth - height decreases; swelling of corm.
- Harvest: Month 8 – height 2-3'

Mana ulu at Harvest=8 months



Determination of Harvest Time

- Plants will reach its maximum height in 6-7 months for those maturing in 12 months. For 8-9 month varieties, its about 4-5 months.
- Plants will start to drop in height and the base of corm (kohina) will start to constrict or close, forming a dome. Huli will be the diameter of a silver dollar where it attaches to the corm.
- Can be harvested earlier to allow for time to harvest large fields.

Months to Harvest - Upland

- Mana ulu, Lehua ele ele 7-8 months
- Pi'i ali'i, Ele ele makoko 8-12 months
- Maui lehua, 9+ months
- Lau loa varieties 9-12 months
- Moi, Mana varieties 10-12 months
- Piko varieties 12+ months

This is approximate. Factors include season of planting, windward/leeward, elevation, etc.

What Can Go Wrong?

**Leaf Blight, Irrigation
Clogging, Weeds,
Nematodes, No Seed, Mealy
Bugs, Ants, Mites, Slugs,
Corm Rot, Storms, Injury,
Sickness, Loss of Labor,
Water Shortage, New
Disease, Wrong Variety,
Injury, New Insect, Marketing
Problems, Equipment
Breakdown Contamination**

Taro with Banana Windbreak



Rain + Cold = Leaf Blight



Phytophthora colocasiae



Pros and Cons of Taro Hybrids

- Key to developing genetic resistance, especially leaf blight (*Phytophthora*)
- Hybrid vigor resulting in higher yields
- Possible loss in poi quality
- May gain one resistance and lose another
- Genetics not well understood in taro. Not straightforward; unique

Moi X Palau : Piko ulaula : Pauakea



Pa'akala Hybrid - Ngeruuch (Palau)
X Maui Lehua at 12 mos. = 20#



Hybrid 99-4



Selecting Cultivars

Based on personal preference:

- Lehua: maoli, Maui, palai'i, ke'oke'o, 'ele'ele
- Mana: ulu, ke'oke'o, lauloa
- Lauloa: ke'oke'o, 'ele'ele ula,
- Piko: kea, ke'oke'o, ulaula, uaua
- Eleele: naioea, makoko
- Other – Moi, Bun long. Pi'i Ali'i
- New UH Hybrids – 99-6, 99-7, 99-9, Pa'akala, MP6, 2000-141

Mala Weed Control

Your Biggest Challenge!!!

Strategies

- Mulches – natural and inorganic
- Sterile Seed Bed
- Tillage to decrease weed load
- Timing of planting

Furrow & Hand-Weeding



Weed Control: Plastic Mulch & Cultivating



Pest Control

- *The key to pest control is to grow a healthy plant.*
- *Understand pest biology and natural controls, as well as environmental conditions conducive and detrimental to certain pests.*
- *Identify at least a few control strategies for each.*

Aphids



Mealy Bugs



Aphids & Mealy Bugs

- For Aphids, watch Nitrogen status. High N will attract them. Pests react to plant stress.
- Control - fatty soaps: Safers and Impede
- Mix with Diatomaceous Earth for added punch
- Control Ants – need attractant + killer. Two types of ants, sugar and protein lovers. Boron is a good killer. Attractant for protein lovers is peanut butter, sugar for sugar lovers.

Snails & Slugs



Snails and Slugs

- Can be major problem on upland taro. Collect at first rains. Pound nail into tip of old tool handle, and sharpen. Copper is toxic to both; pennies made before 1982 are useful. Organic control - Iron Phosphide

Root-Knot Nematodes



Nematode Control Strategies

The key is to disrupt their life cycle:

- Cover crops – sunn hemp, sorghum-sudan hybrid grass, cow peas cv. Iron and Clay
- Fallow but potential for soil loss from erosion, wind/rain
- Increase organic matter

Pest Stress

- Taro Leaf Hopper – parasites – Egg Sucking Bug (Mirid)
- Mites – good air circulation, wider spacing, resistant varieties, overhead irrigation
- Rose beetle – picking at night, neem/DE
- Mice/Rats – baiting, plant spacing, thick drip

Windbreaks

Windbreaks are critical to the protection of upland taro, especially windy areas such as Kohala, Ho'olehua, Kahului. Sorghum-sudan hybrid grass are fast growing, planted by seed. Crop can be planted 40 days after seeding. Panax is a longer term option; ready in 6-9 months after planting

Sorghum-Sudan Grass Windbreak



Sorghum-Sudan Windbreak

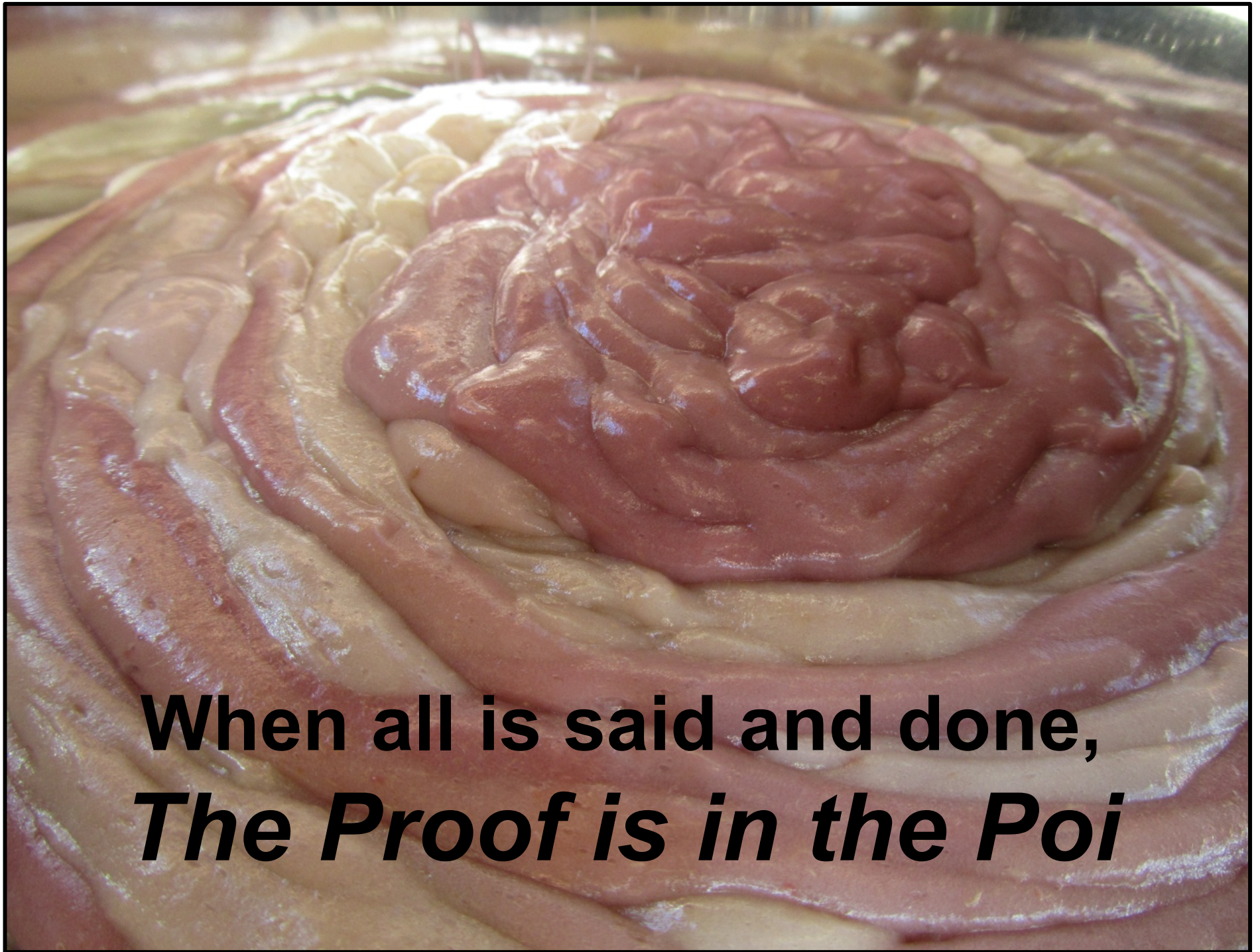
Sow 2 months prior to planting huli. Use hand seed planter with radish seed plate. Can be cut and re-grown (ratoon). Can be used for animal feed or to build soil organic matter. Root-knot nematode-resistant

Harvesting



Ready for Market





**When all is said and done,
*The Proof is in the Poi***