NO TILL FARMING

Major topics to be discussed:

- History of no till farming
- Reasons for plowing
- No till practices for Hawaii: vegetable and tree crops

History of no-tillage farming

- **Ancient people and less developed civilization today practice no-tillage farming**
- **Currently a slash and burn method practiced in less populated areas provides a clean seedbed and readily available nutrients.**
- **This method is dependent on a long fallow or rotation period 10-15 years**

History of no-tillage farming

History of no-tillage farming

- **The concept of completely turning the soil over and burying all plant residues was largely a development of the late 18th century (i.e. 1780's)**
- **Thomas Jefferson, math formula for the moldboard plow, 1784**
- **Charles Newbolds patent for cast iron plow, 1796**
- **John Deere's introduction of manufactured steel plow, 1837**
- **Steam, followed by gasoline followed by diesel engines have brought plowing to the level we know today**

History of no-tillage farming

The beginning of the end for plowing in America

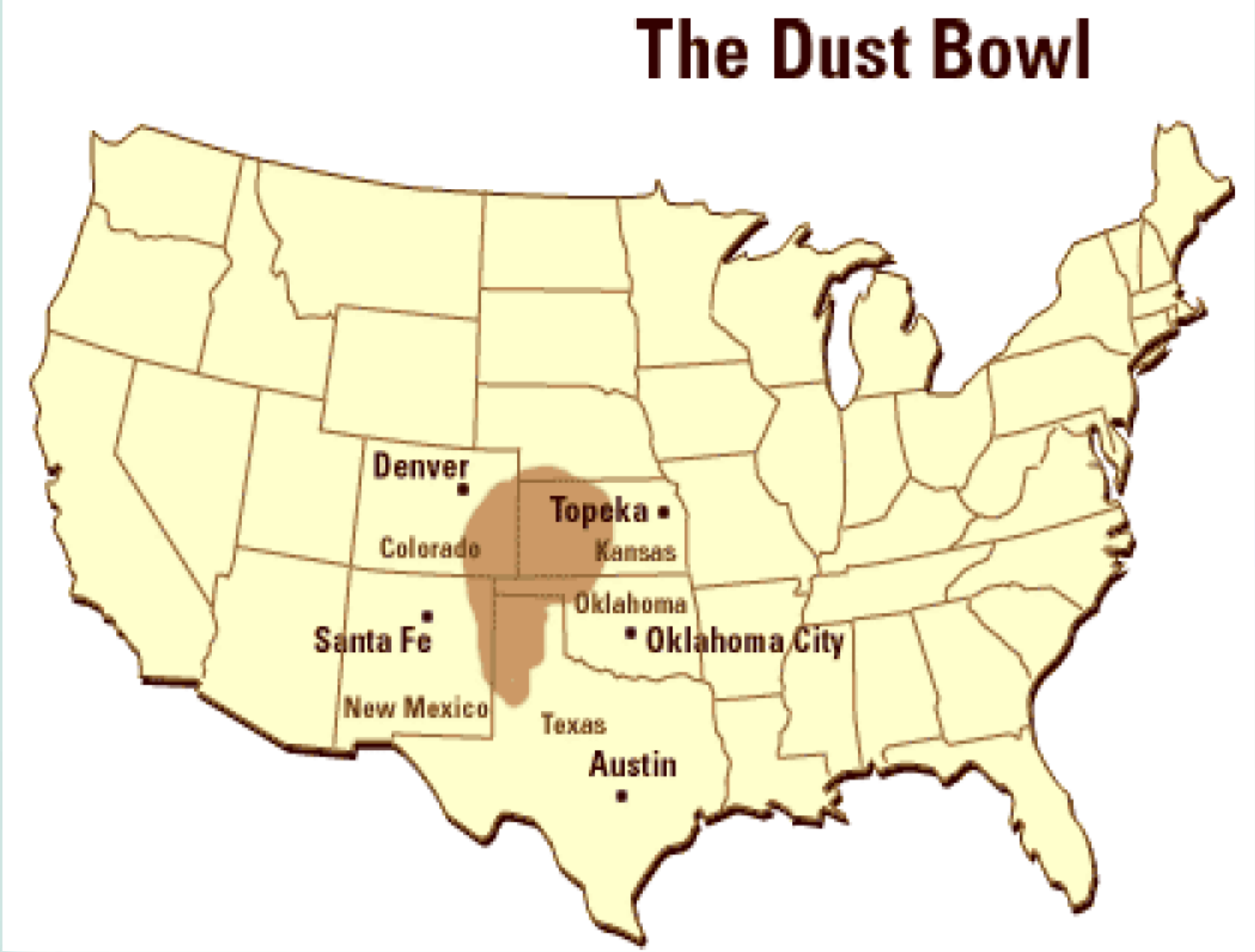
- **The dust bowl days of 1930's caused by a combination of environmental and man made factors.**
- **The pioneers had cleared virgin prairie with plows; long drought and high winds changed soil to dust and carried it away.**
- **The first nation wide environmental disaster**

History of no-tillage farming

The dust bowl days of 1930's

- May of 1934, worst dust bowl year, clouds of dust blocked the sun from Texas Plains through the Dakotas
- On May 12 1934, dust shut out the sun over the East Coast for five hours
- Dust reported settling on ships 300 miles out to sea
- In 1986, lights turned on in Melbourne Australia during the day, due to dust clouds
- 04/27/1935-The environmental disaster of the dust bowl resulted in the formation of the USDA Soil Conservation Service (now the NRCS National Resource Conservation Service) to help farmers reduce soil erosion by wind and water

History of no-tillage farming - Area of Dust Bowl



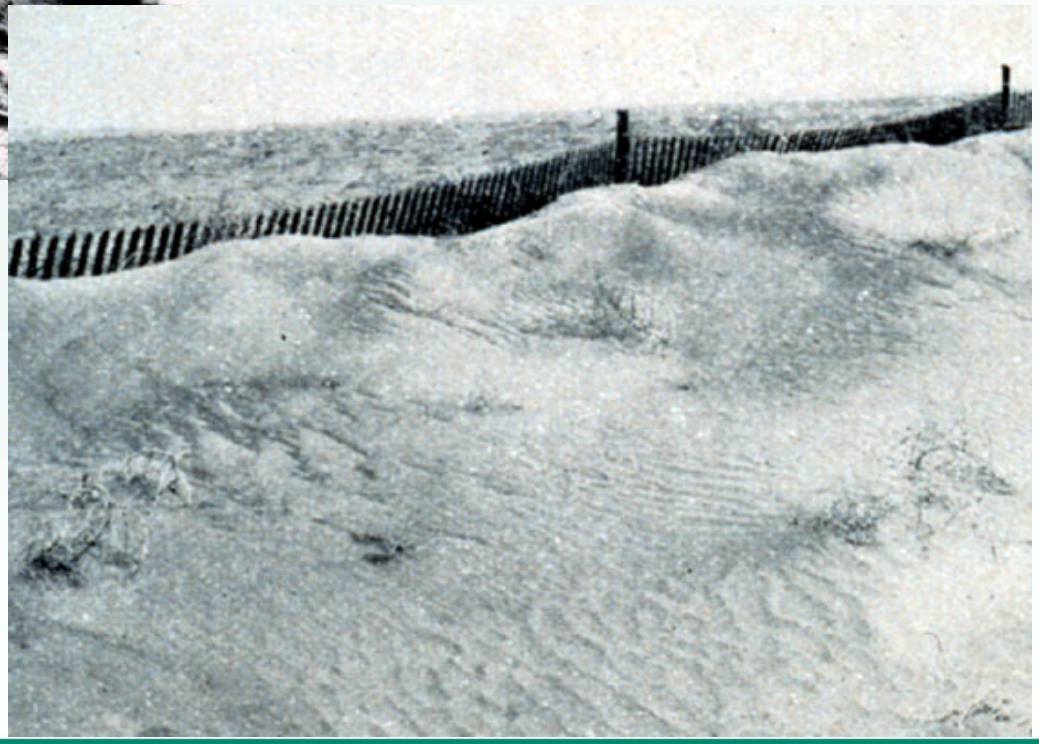
History of no-tillage farming

The dust bowl days of 1930's

- **May of 1934, worst dust bowl year, clouds of dust blocked the sun from Texas Plains through the Dakotas**
- **On May 12 1934, dust shut out the sun over the East Coast for five hours**
- **Dust reported settling on ships 300 miles out to sea**
- **In 1986, lights turned on in Melbourne Australia during the day, due to dust clouds**
- **04/27/1935-The environmental disaster of the dust bowl resulted in the formation of the USDA Soil Conservation Service (now the NRCS National Resource Conservation Service) to help farmers reduce soil erosion by wind and water**

History of no-tillage farming

History of no-tillage farming



History of no-tillage farming

History of no-tillage farming

History of no-tillage farming

History of no-tillage farming

The dust bowl days of 1930's

- **May of 1934, worst dust bowl year, clouds of dust blocked the sun from Texas Plains through the Dakotas**
- **On May 12 1934, dust shut out the sun over the East Coast for five hours**
- **Dust reported settling on ships 300 miles out to sea**
- **In 1986, lights turned on in Melbourne Australia during the day, due to dust clouds**
- **04/27/1935-The environmental disaster of the dust bowl resulted in the formation of the USDA Soil Conservation Service (now the NRCS National Resource Conservation Service) to help farmers reduce soil erosion by wind and water**

History of no-tillage farming

- **In: The Yearbook of Agriculture – 1934**
- **35 million acres “destroyed for crop production”**
- **100 million acres now in crops lost all or most of the topsoil**
- **125 million acres of land now in crops are rapidly losing topsoil**

History of no-tillage farming

- **Research during WW II resulted in the discovery of 2,4-D and related herbicides. The ability to kill plants chemically allowed for an alternative to plowing for seedbed preparation**
- **Paraquat, imported from England in the early 1960's, provide fast kill of above ground vegetation without leaving biologically active residues in the soil**
- **In 1966, Allis Chalmers introduced the first no-tillage planter**

History of no-tillage farming

SUMMARY: Working the soil to provide a vegetation free seedbed for crops has always been used in agriculture.

- **In some cases, animal power, human power or fire killed off existing vegetation.**
- **Plowing became more complete with modern machines of the late 1780-90's.**
- **Dust bowl days of 1930's cause a nation wide disaster, which prompted the federal government of take action.**
- **Herbicides replaced the need for the plow and now equipment designed specifically for no-tillage farming exists.**
- **The challenge for future farmers is to produce crops with reduced tillage and reduced chemical inputs**

Concepts of no-tillage farming

The primary reason to plow:

- **Incorporate soil amendments: lime, fertilizers and manures.**
- **Bury previous crop residue: sanitation for diseases and insects.**
- **Level soil from harvest of root crops or other deep ruts**
- **Plowed field looks clean, source of pride or ridicule from other farmers.**
- **Primary reason: provide a seedbed free of other living vegetation.**

In notill farming chemicals replace the plow in terms of seedbed preparation. No till planting is a more accurate description of anticipated form of reduced tillage farming in Hawaii.

Concepts of no-tillage farming

Concepts of no-tillage farming

The primary reason to plow:

- **Incorporate soil amendments: lime, fertilizers and manures.**
- **Bury previous crop residue: sanitation for diseases and insects.**
- **Level soil from harvest of root crops or other deep ruts**
- **Plowed field looks clean, source of pride or ridicule from other farmers.**
- **Primary reason: provide a seedbed free of other living vegetation.**

In notill farming chemicals replace the plow in terms of seedbed preparation. No till planting is a more accurate description of anticipated form of reduced tillage farming in Hawaii.

Concepts of no-tillage farming

Organic no till rice farming in "A 1 straw revolution":

- **In early October, before harvest of rice, broadcast seeding of white clover and fast-growing winter grain into ripening stalks of rice. The clover and barley sprout and are trampled during rice harvest but quickly recover**
- **After rice is harvested and threshed, the straw is spread over the fields, in a random manner**
- **Rice seed for next season is broadcast seeded into growing barley/white clover mixture. Seed is enclosed in a soil pellet. Roll moist seeds in clay powder**
- **In the spring, the barley is harvested and the straw returned to the fields**

Concepts of no-tillage farming

Organic no till rice farming in "A 1 straw revolution":

- **Water is allowed to stand in the rice fields for a week or 10 days. The flooding causes the weeds and clover to weaken and allows the rice to germinate and sprout up through the straw. The rice outgrows the weeds**
- **In this system, the floodwaters are used to setback the weeds and clover and give the rice a head start.**
- **This is similar to the use of a herbicide to kill or stunt weeds prior to seeding or transplanting with crop plants.**
- **Also, desirable crops are grown that suite the season of the year. This requires the farmer to be more sensitive to the cycle of the season and to know the best crop to grow for a particular season**

Concepts of no-tillage farming

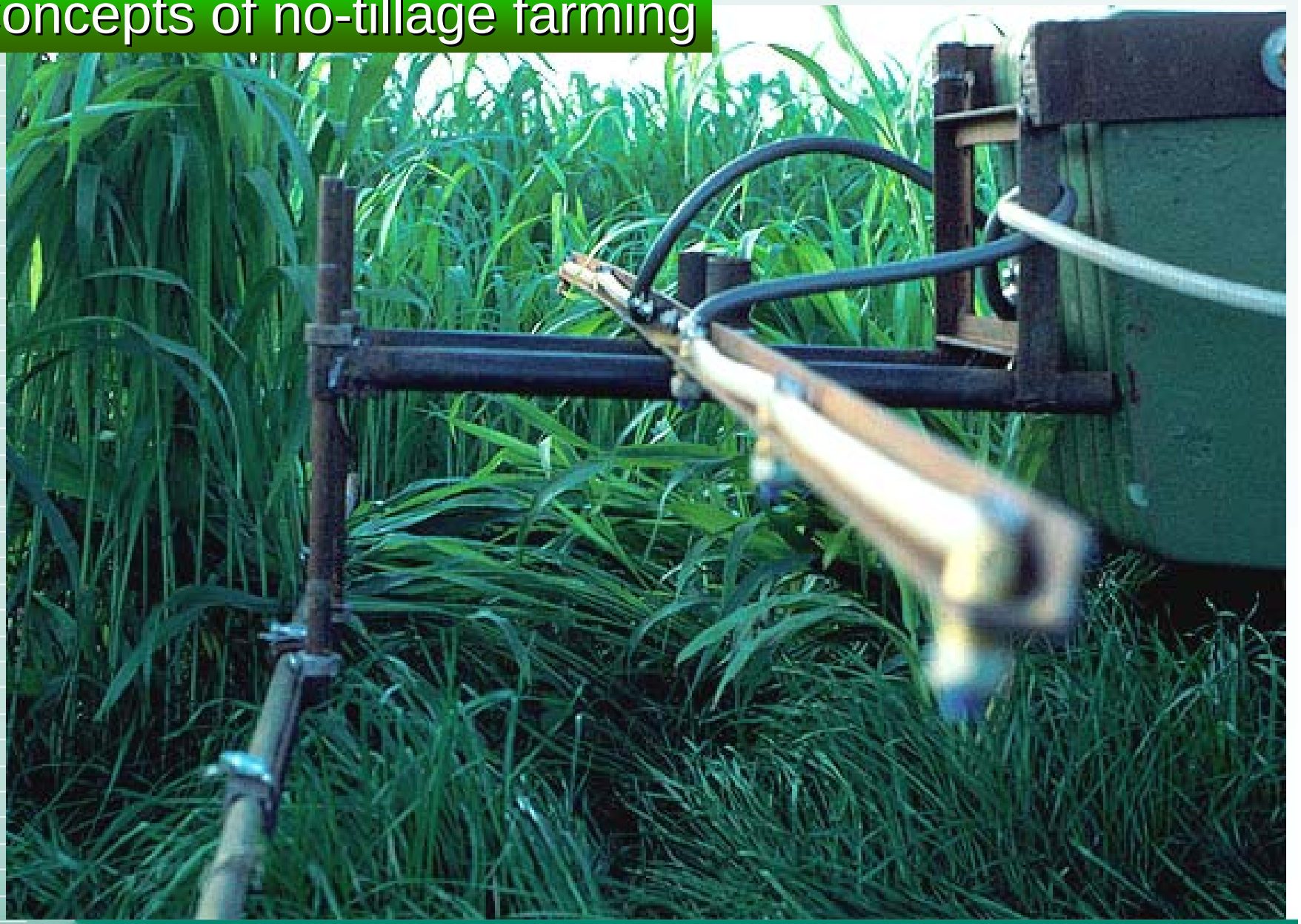
Hawaiian notillage farming for vegetable crops, basic requirements:

- **An accurate herbicide delivery system. To include adjustable boom height with front and back mounting of the boom**
- **A mower that can handle high grasses 4-6 ft.**
- **A method to spread seeds both as a broadcast planting and in rows, a source of seeds and dry cool rodent free seed storage**
- **The hardware setup for drip irrigation and fertilizer injection**
- **Lastly, a small disc or rotovator**

Concepts of no-tillage farming

Concepts of no-tillage farming

Concepts of no-tillage farming



Concepts of no-tillage farming

Hawaiian notillage farming for vegetable crops, basic requirements:

- **An accurate herbicide delivery system. To include adjustable boom height with fronts and back mounting of the boom**
- **A mower that can handle high grasses 4-6 ft.**
- **A method to spread seeds both as a broadcast planting and in rows, a source of seeds and dry cool rodent free seed storage**
- **The hardware setup for drip irrigation and fertilizer injection**
- **Lastly, a small disc or rotovator**

Concepts of no-tillage farming

Concepts of no-tillage farming

Hawaiian notillage farming for vegetable crops, basic requirements:

- **An accurate herbicide delivery system. To include adjustable boom height with fronts and back mounting of the boom**
- **A mower that can handle high grasses (4-6 ft.**
- **A method to spread seeds both as a broadcast planting and in rows, a source of seeds and dry cool rodent free seed storage**
- **The hardware setup for drip irrigation and fertilizer injection**
- **Lastly, a small disc or rotovator**

Concepts of no-tillage farming

Concepts of no-tillage farming

Concepts of no-tillage farming

Hawaiian notillage farming for vegetable crops, basic requirements:

- **An accurate herbicide delivery system. To include adjustable boom height with fronts and back mounting of the boom**
- **A mower that can handle high grasses (4-6 ft.**
- **A method to spread seeds both as a broadcast planting and in rows, a source of seeds and dry cool rodent free seed storage**
- **The hardware setup for drip irrigation and fertilizer injection**
- **Lastly, a small disc or rotovator**

Concepts of no-tillage farming

Hawaiian notillage planting of vegetable crops:

- **Start after your last crop of the summer, somewhere around October, November or December**
- **Prepare the soil with a light disking, very important to have pH, calcium and phosphorous at optimum levels for plant growth.**
- **Seed a ground cover (one that can be killed later either by mowing or herbicide)**
- **You must seed a high rate to avoid weed competition with cover crop**
- **Layout drip line either on the surface or 1-2 inches below. Use thickest drip available. Thickness specified as mil, higher mil # = thicker plastic**

Concepts of no-tillage farming

Concepts of no-tillage farming

Hawaiian notillage planting of vegetable crops:

- **Start after your last crop of the summer, somewhere around October, November or December**
- **Prepare the soil with a light disking, very important to have pH, calcium and phosphorous at optimum levels for plant growth.**
- **Seed a ground cover (one that can be killed later either by mowing or herbicide)**
- **You must seed a high rate to avoid weed competition with cover crop**
- **Layout drip line either on the surface or 1-2 inches below. Use thickest drip available. Thickness specified as mil, higher mil # = thicker plastic**

Concepts of no-tillage farming

Concepts of no-tillage farming

Hawaiian notillage planting of vegetable crops:

- **Start after your last crop of the summer, somewhere around October, November or December**
- **Prepare the soil with a light disking, very important to have pH, calcium and phosphorous at optimum levels for plant growth.**
- **Seed a ground cover (one that can be killed later either by mowing or herbicide)**
- **You must seed a high rate to avoid weed competition with cover crop**
- **Layout drip line either on the surface or 1-2 inches below. Use thickest drip available. Thickness specified as mil, higher mil # = thicker plastic**

Concepts of no-tillage farming

Concepts of no-tillage farming

Hawaiian notillage planting of vegetable crops:

- **Layout drip line either on the surface or 1-2 inches below. Use thickest drip available. Thickness specified as mil, higher mil # = thicker plastic**
- **Allow ground cover to grow, mow if necessary to maintain a low height and stop seed formation.**
- **Choice of ground cover is an important management decision (management of weeds, diseases or insects**

Concepts of no-tillage farming

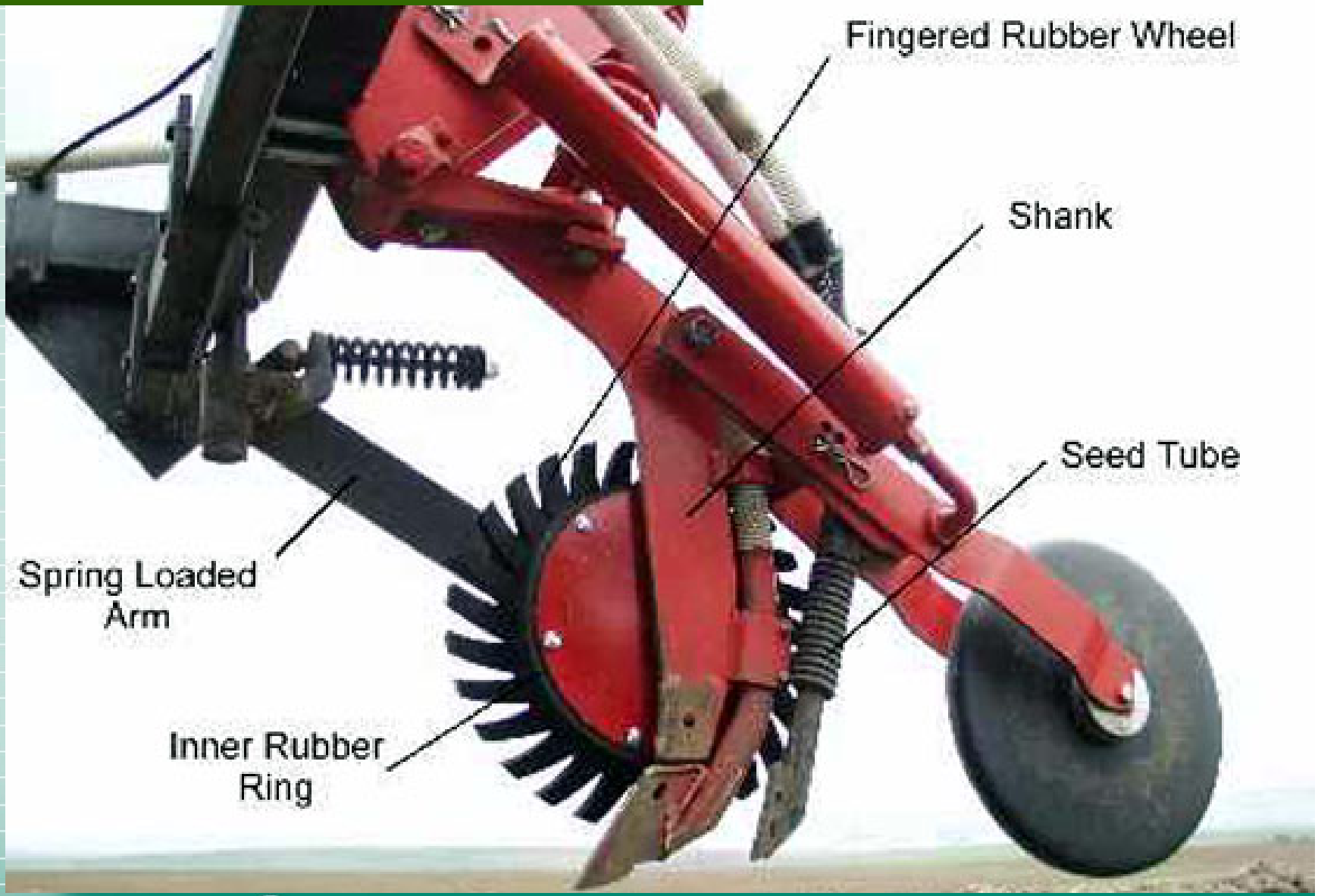
Hawaiian notillage planting of vegetable crops:

- **Before planting the next cash crop, kill off ground cover.**
- **End result is a field with a thick layer of mulch with drip lines protected from degradation by light.**
- **Drip lines also offer direct placement of nutrients for growth of crop.**
- **Seed or transplants will be placed directly into dead ground cover with as little soil disturbance as possible**

Concepts of no-tillage farming

College
University

Concepts of no-tillage farming

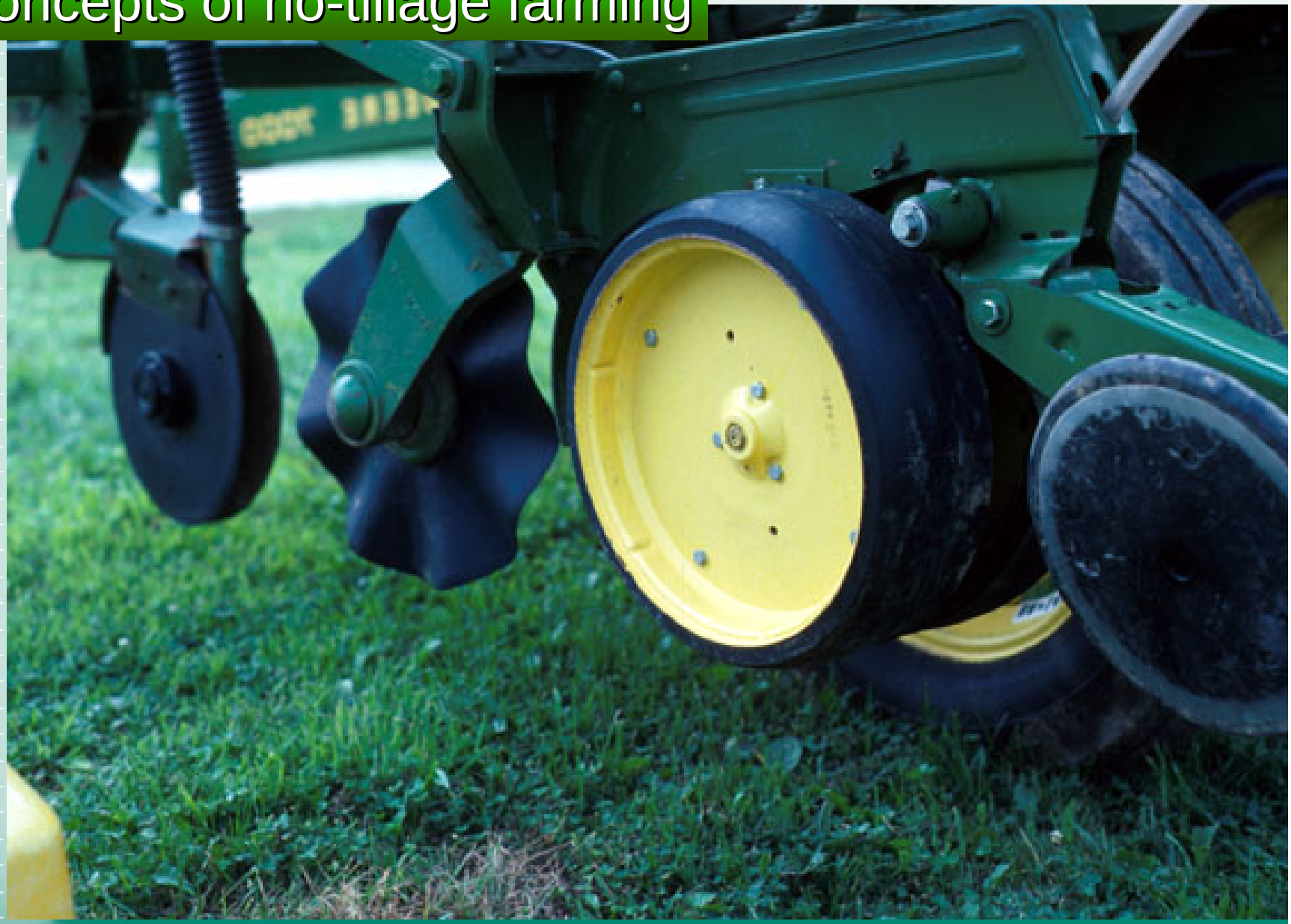


Concepts of no-tillage farming

Concepts of no-tillage farming

Concepts of no-tillage farming

Concepts of no-tillage farming



Concepts of no-tillage farming

Concepts of no-tillage farming

College of Tropical Agriculture and Human Resources
University of Hawai'i at Mānoa

Concepts of no-tillage farming

Concepts of no-tillage farming

Concepts of no-tillage farming

Concepts of no-tillage farming

Concepts of no-tillage farming

Concepts of no-tillage farming

Concepts of no-tillage farming

Hawaiian notillage planting of vegetable crops:

- **To apply residual herbicide, either use granular material or make your own by binding to fertilizer of organic residue.**
- **Sprays in no-tillage have a hard time penetrating the mulch layer.**
- **Overhead irrigation can help to wash herbicides off of surface mulch and onto soil surface.**
- **If mulch is thick enough, weeds are minimal. Think of novel ways to re-seed ground cover in as little soil disturbance as possible**

Concepts of no-tillage farming

Concepts of no-tillage farming

Hawaiian notillage for fruit or forestry:

- **You have some old cane land in Hamakua or Puna or Pahala or Wailuku or wherever**
- **If sugar and grassy weeds are present, roll, crush or mow all vegetation. When regrowth occurs, apply Roundup (in combo with Garlon for perennial broadleaf weeds), may need more than one spray application to get all perennial weeds.**
- **Old dead cane should be worked into the soil and not scrapped off into holes or gulches (this is the standard procedure in Hawaii)**
- **Obtain a soil test and amend the soil for long term pH adjustment. For pH adjustment use a coarse ground coral in combination with a very fine lime. The fine lime will give quick effect and the coral will provide pH adjustment for 5-7 years**

Concepts of no-tillage farming

Site preparation

- Mow prior to rainy season
- Allow succulent regrowth
- Apply contact herbicides, Mix Rounup with Garlon for broad spectrum kill
- Repeat regrowth and kill cycle 2-3 times

Site preparation

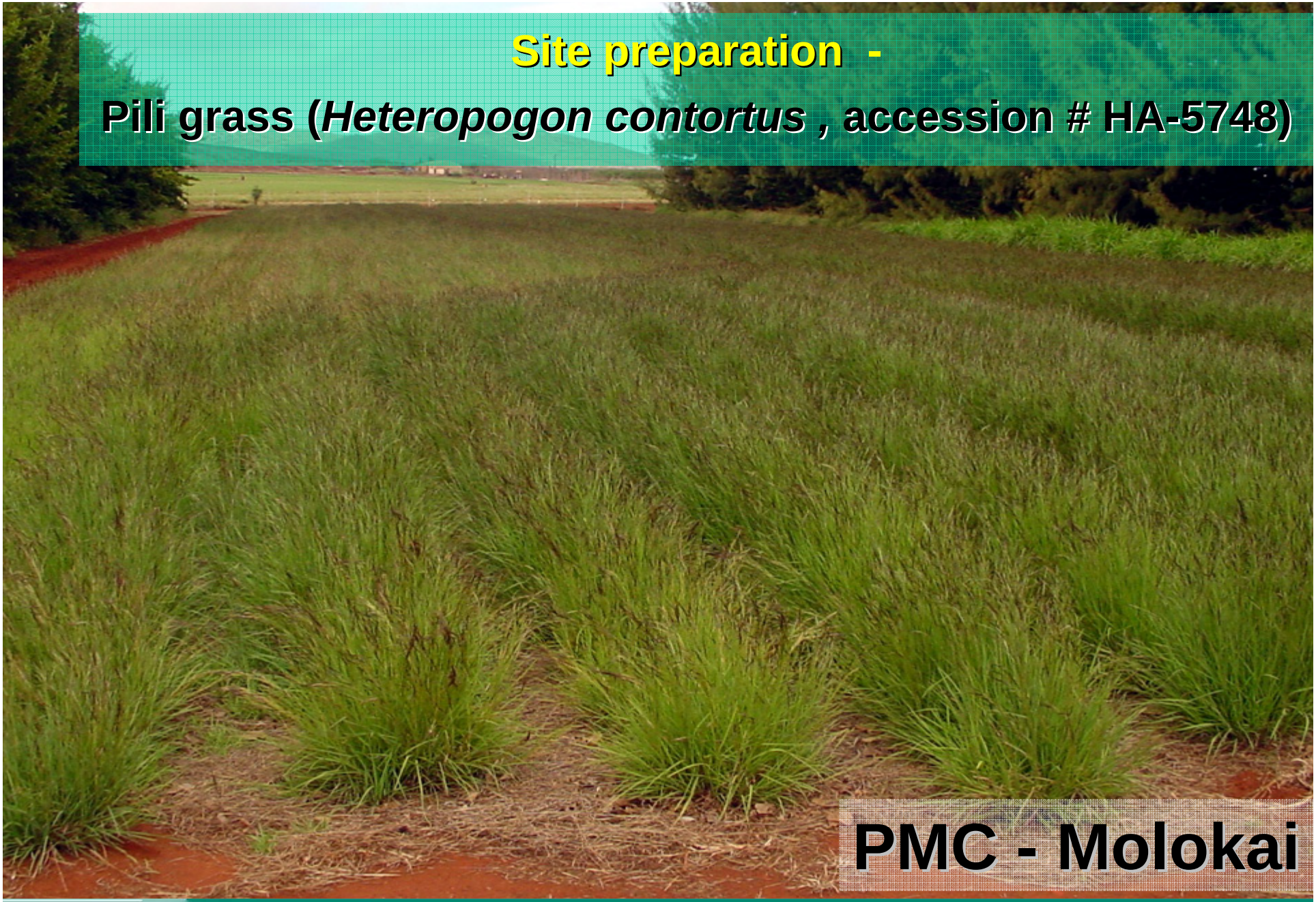
1. Mow tall vegetation
2. Allow succulent regrowth
3. Apply systemic herbicides
4. Reapply to reduce soil seed bank

Site preparation- ground cover selection

- Replace weedy vegetation
- Species that naturally resists weedy invasion
- Non invasive preferred, native species most desirable
- Adapted to mowing, source of crop mulch
- Available seed source
- Established using herbicides with forestry site on label

Site preparation -

Pili grass (*Heteropogon contortus* , accession # HA-5748)



Pili grass establishment

1. Produce vigorous transplants for field planting

Pili grass establishment

2. Prepare seedbed for field establishment

O.H. irrigation

Weed flush

Seedling establishment

Activate pre-herbicides

Pre plant fertilization

Enhance Weed flush

Nutrient bank for Pili

Pili grass establishment

3. No-till planting – 42 days after seeding to trays

Pili grass establishment

3. No-till planting

Low trash improves activity of pre-herbicides

High trash prevents herbicide attachment to soil reduces activity

Pili grass establishment

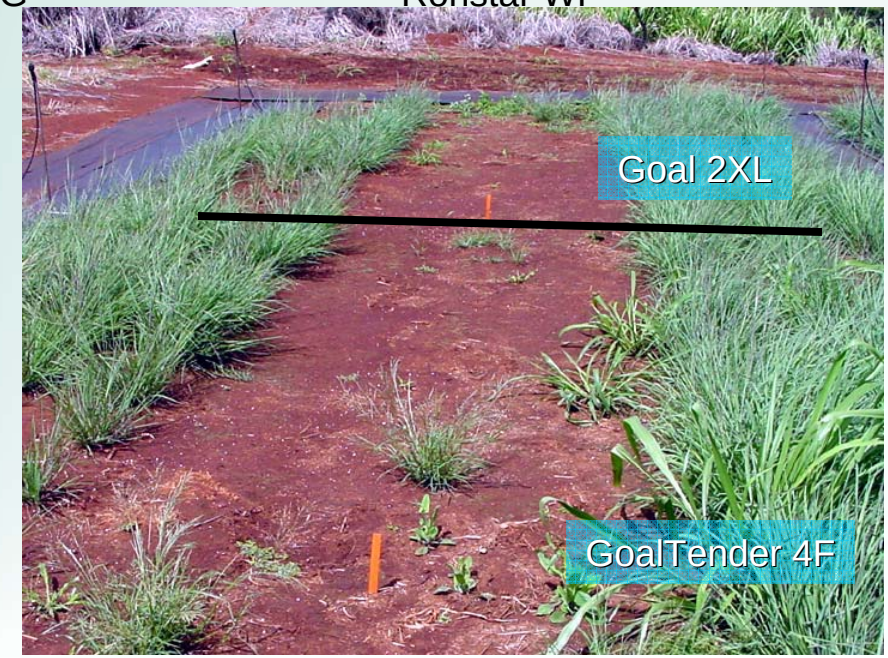
4. Apply pre-herbicides and irrigate

4. Apply pre-herbicides and irrigate
Pili grass establishment

Pendulum WDG

Ronstar WP

Ronstar G



46-DAS

Mulching the tree crop row.
Pili – 78 days after planting

Mulching the tree crop row
Mow Pili and move mulch to crop row.






Proper Pili Grass Mowing Height.

Applying Preemergence after 1st mowing

Liquids and WP

Granular Ronstar

Planting trees – select the strongest, weak ones never catch up

Planting trees

Fertilizers = 100g 0-46-0
2-Agriform 21g tabs (21-10-05)
Per tree

Planting trees

Long Pili grass stems reduce stress and support plants in wind

Teak response to pre-herbicides
81 DAS-02

Pendulum WDG

Ronstar WP

Ronstar G

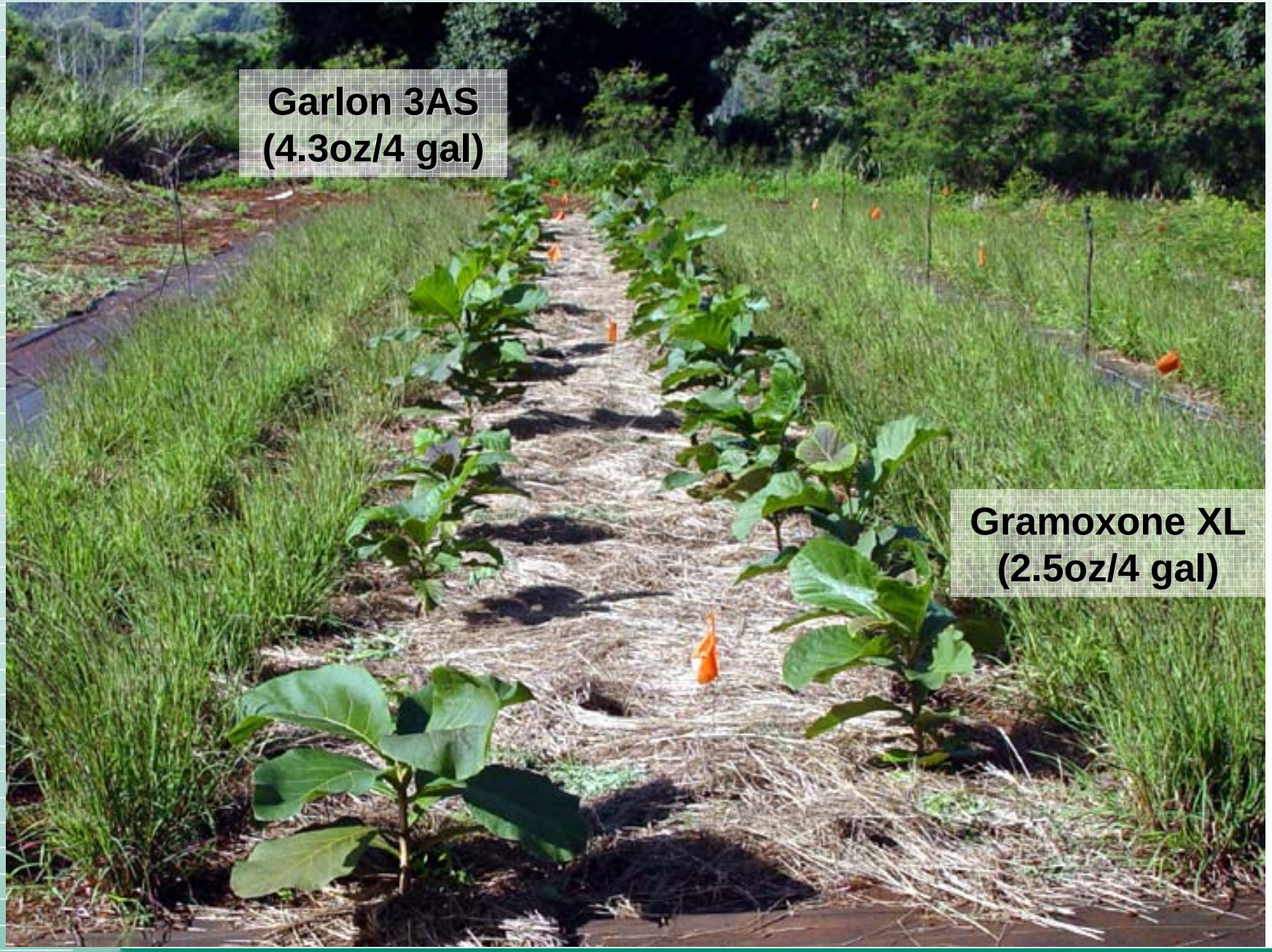
GoalTender 4F

Goal 2XL

Pigs can ruin your day

Weeds invade exposed soil

College of Tropical Agriculture and Human Resources
University of Hawai'i at Mānoa


Garlon 3AS
(4.3oz/4 gal)
Gramoxone XL
(2.5oz/4 gal)

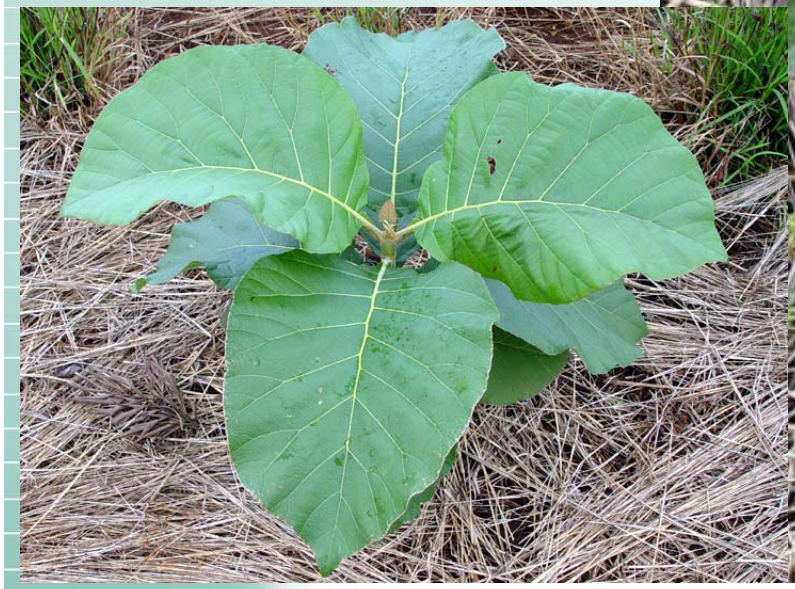
College of Tropical Agriculture and Human Resources
University of Hawai'i at Mānoa

College of Tropical Agriculture and Human Resources
University of Hawai'i at Mānoa

College of Tropical Agriculture and Human Resources
University of Hawai'i at Mānoa

College of Tropical Agriculture and Human Resources
University of Hawai'i at Mānoa

College of Tropical Agriculture and Human Resources
University of Hawai'i at Mānoa



College of Tropical Agriculture and Human Resources
University of Hawai'i at Mānoa

College of Tropical Agriculture and Human Resources
University of Hawai'i at Mānoa

Do it all over again???

1. Start weed flush prior to winter rains
2. Plant Pili in early spring to maximize mulch
3. 1st & 2nd mowing keep mulch in Pili stand
4. More weed Flush/Kill cycles in crop row during Pili establishment and initial mowing
5. Consider pig fence to avoid mulch movement
6. Double tree order to improve selection at planting
7. Mow Pili 4-6 inches, NOT LOWER

Concepts of no-tillage farming

Hawaiian notillage for fruit or forestry:

- **You have some old cane land in Hamakua or Puna or Pahala or Wailuku or wherever**
- **If sugar and grassy weeds are present, roll, crush or mow all vegetation. When regrowth occurs, apply Roundup (in combo with Garlon for perennial broadleaf weeds), may need more than one spray application to get all perennial weeds.**
- **Old dead cane should be worked into the soil and not scrapped off into holes or gulches (this is the standard procedure in Hawaii)**
- **Obtain a soil test and amend the soil for long term pH adjustment. For pH adjustment use a coarse ground coral in combination with a very fine lime. The fine lime will give quick effect and the coral will provide pH adjustment for 5-7 years**

Concepts of no-tillage farming

Hawaiian notillage for fruit or forestry:

- **Obtain a soil test and amend the soil for long term pH adjustment. For pH adjustment use a coarse ground coral in combination with a very fine lime. The fine lime will give quick effect and the coral will provide pH adjustment for 5-7 years**
- **The entire orchard site is seeded to a grass or grass + legume mixture and well fertilized.**
- **As the ground cover grows, it is cut and moved into future orchard planting rows. Continue this operation for a long as it takes to build a thick mulch layer.**