NO TILL FARMING FOR ORGANIC GROWER TPSS-DEPARTMENTAL SEMINAR J. DEFRANK 12/01/17

Topics to be discussed:

History of no till farming
No till planting for organic crop producers
Future research



- Ancient people and isolated subsistent cultures practice no-tillage farming
- A slash and burn method to prepare for crops involves burning existing vegetation to kill living plants and release nutrients, crops planted no-till
- S&B method dependent on long fallow period of 10-15 years between crop cycles



- 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



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



- 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





The dust bowl days of 1930's

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- 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



- 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
- Oil embargo 1973-1974 required renewed interest in no-till farming to reduce fuel for land preparation



- SUMMARY: Working the soil to provide a vegetation free seedbed for crops has been a standard practice in modern agriculture.
- Animal power, human power or fire killed off existing vegetation in preparation for crop plantings
- 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 plow, equipment specifically for no-tillage farming stimulated by 70's oil embargo





PARAQUAT J OT /A X.TT 12 OF AME LEXANE/SENCORE J PT. DURL 3/6 PATS. SOTBEAN SEED PROTECTANT NO.

CHEVRON CHEMICAL COMPANY



















Evaluation of allopathic chemicals in crop residues for weed control

No-till planting to keep organic compounds at soil surface for maximum effect.

1979. DeFrank's M.S.-MSU

Concepts of no-tillage farming



No-till taro planting-1985



Concepts of no-tillage farming







Weed pressure increases once surface mulch dissipates



Published by Rodale Press in 1978



Organic no-till rice farming

- Winter barley and white clover fall seeded into maturing rice
- All rice straw returned after harvest, winter grain grows
- Mid-Nov-Dec, add soil pellets containing rice
- In spring barley harvested
- Flood water to stunt legume, favors rice growth.

Hawaii adaption-living grass mulch suppression with selective herbicides



Concept evolution Using light exclusion as agent of weed control to prepare organic vegetable crop plantings

Discovery of purple nutsedge control with woven fabric





Unexpanded nutsedge leaf tip easily pokes through tight film





Loose debris free woven mat snags shoot tips

Purple Nutsedge

Yellow Nutsedge

Unexpanded leaf tips snag in woven weed mat
Extra heat speeds up growth

3. Key to stopping nutsedge is loose fabric that is lifted by shoot tips, prevents pushing through

Floating fabric on soil surface was key to purple nutsedge germination and failure to poke through woven fabric

- 1. How do you keep large sheets of fabric in place?
- 2. Use common easy to find materials
- 3. System scalability to larger commercial growers











Shade house construction materials adapted for garden use

Aluminum clip base attached to shade house frame.

Wiggle wire holds fabric in clip base







Extending the wiggle wire beyond the clip base results in puncture holes



Securing fabric to water filled hoses using shade house construction materials



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Securing fabric to water filled hoses using shade house construction materials


Clip base attached to water filled lay flat water hoses secures 12 ft. x 100 ft. Sheets of plastic fabric at Halawa Native Seed Nursery - 2017





Light exclusion to produce a stale seed bed using durable black plastic woven fabric

Stale seed bed developed with irrigation and fertilization used to stimulate weed growth prior to cash crop planting.

1-2 cycles of weed flush followed by weed kill can eliminate up to 85% of the weed seeds in the top .5 to 1 inch of soil surface.

Light exclusion used to kill weeds without chemicals



Cover 0, 7, 14 days after tilling +fertilization and irrigation.









Good weed kill w/ 1-week of cover

14 days of weed growth

14 days weed growth + 1-wk cover

Contract 2 Real for

3-wks weed growth



With small annual weeds or short term cover crops 7 days of cover can provide weed free site preparation



Can the use of durable fabrics be used in larger scale crop production?



Consider the concept of a crop module instead of a crop field Basic size of crop module is 2 planting beds Row length = tarp roll, 300 ft. Width of beds = 6 ft. Width of tarp = 8-10 ft.



Begin weed flushing on open beds with fertilizers and irrigation 1-side of fabric sheet embedded in soil – Turn the page farming



Cover weeds/rotational crop and reveal weed free side ready to plant.



Crop planted with transplants or using hydro seeding, avoid soil disturbance, sub-soil has weed seeds!





Post harvest weeds and crop residues are covered as preparation for next crop cycle



Clean bed ready for a new cash or soil improving rotational crop



Adding a surface mulch to stale seed bed enhances weed control in longer term row crops

- 1. Mulch crop grown outside of crop production area, cut and applied cash crop areas.
- Mulch crop grown with animal waste to convert leachable nutrient into slow release plant-based forms
- 3. Legume mulches to add N
- 4. Pest controlling chemicals in mulch: marigolds or bio-tech forms. Remove the Frankenstein from food crops.





2017 Mulch compare study Sunn Hemp vs Sorghum

- 1. Start with weed flushing with fertilizer and irrigation
- 2. Hard to control weeds like morning glory grow.
- 3. With maximum weed germination cover to kill off with tarping





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Planting mulch crops for use on stale seed bed crop area





Cut mulches to retain large pieces prevent blowing off of crop area































Corn transplants to get a head start on weeds

09/13/2017



20 days after transplanting





20 days after transplanting- sorghum mulch





42 days after transplanting sorghum mulch





20 days after transplanting









20 days after transplanting sunn hemp mulch







42 days after transplanting sunn hemp mulch





Cover crops can be mowed/crimped then covered to kill understory weeds. Cash crop planted into nutrient rich organic mulch.



Cover crop: This is a commercial mix containing 15% oats, 30% bell beans, 20% purple/hairy vetch mix, and 35% Magnus peas.





Nematode management and cover crop termination with tarping

- 1. Nematodes activate in response to root exudates
- 2. Susceptible plants infected
- 3. Prior to reproductive phase, cover crop terminated with tarping.



Comparing rolling/cripping To light exclusion + crimping for cover crop termination

Experiment with different Rollers/crimpers and recurrent rolling



Two-stage roller/crimper. Kornecki, 2011. US patent no.: 7,987,917 B1.



Four-stage roller/crimper. Adopted by an organic farm in Great Britain. Kornecki, 2011, US patent no.: 7,987,917 B1.



Spiral roller/crimper.



Smooth drum roller /w glyphosate.



Treatments Crimp + 14 day cover Crimp + 07 day cover Crimp + 0 day cover



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07/28/

Compared cover crop seeding in furrows to surface seeding and hydro mulch cap





Hydromulch cap to cover surface seeded cover crops Hydro mulch = recycled cardboard






Hydro seeding has traditionally been used to seed road cuts or other hard to reach sites

Hydro seeding mix includes seeds, mulch (recycled paper + processed straw), tacifier, nutrients and growth stimulants.







5-Species Cover Crop

- 1. Black oats
- 2. Buckwheat
- 3. Cow peas
- 4. Black mustard
- 5. Forage radish

Surface seeding w/hydro mulch cap worked as well as conventional furrow planting











Cover cropped rolled to allow tarp to lay flat





Sand filled lay flat hose handy for smaller plot work

09/06/2017







Roll and 2 week cover

20 days after transplanting





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Roll and 1 week cover

20 days after transplanting





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Roll only no cover with tarp

20 days after transplanting





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SUGGESTED FUTURE RESEARCH

- 1. Expanded cover crop termination studies to identify optimum growth termination stages and cover duration.
- 2. Evaluate off-site mulch types or mixtures for crop and pest response.
- 3. Develop hydro seeding for vegetable crop establishment in organic no-till plantings.
- 4. Use tarping to develop vegetable crop production on Hawaii lands not suitable for conventional cultivation, such as lava lands on the Big Island.
- 5. Somebody invent **nano-fabric** for use in farming applications;
 - a) Durable material and very light weight
 - b) Adjustable opacity and/or color options via electrical current
 - c) UV resistant and recyclable on-site



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On line video and slideshow: http://www.ctahr.hawaii.edu/deFrankJ/index.htm

