Winning the Battle Against Weeds: an Integrated Approach to Sustainable Weed Control

Mark Williams
Department of Horticulture
University of Kentucky
mark.williams@uky.edu


UK Horticulture
Research Farm
Organic
Farming Unit

UK Organic Farming Unit

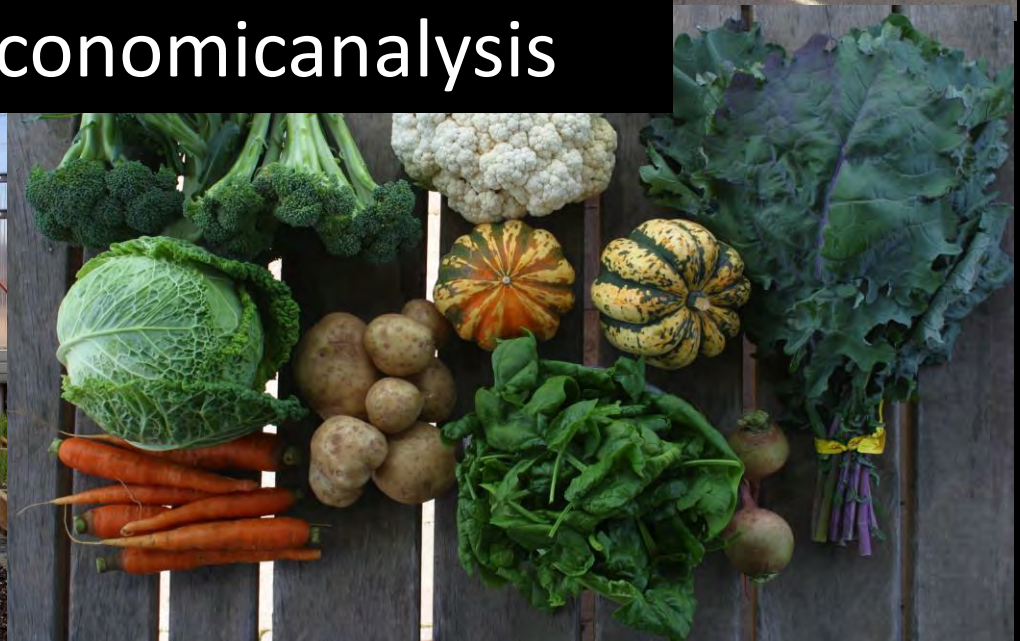
- Started in 2003 with ¼ acre
- Currently 30 acres
- Maury silt loam soil
- Research – applied and basic science on 3-5 acres, High Tunnel Research Facility
- Extension – e.g. GAP/FSMA training, CSA Bootcamp
- Education – apprenticeship
- Highly diversified
- Small to medium scale
- Intense weed pressure

SAG 397: Apprenticeship in Sustainable Agriculture

- 200 hours of farm work
- Weekly classes
- 2007: 4 Apprentices and 42 Shareholders
- 2017: 12 Apprentices and 225 Shareholders; two farm stands
- ~12 acres in production in 2017

Wholesale Production – approx. 1-2 acres

1. https://ukcsa.wordpress.com
2. http://www.uky.edu/ccd/tools/budgets/ukcsaeconomicanalysis



University of Kentucky Center for Crop Diversification
http://www.uky.edu/ccd/tools/budgets/ukcsaeconomicanalysis

University of Kentucky
College of Agriculture, Food and Environment
Agricultural Experiment Station

SR-111

Economic Analysis of the University of Kentucky Community Supported Agriculture Organic Vegetable Production System

Tiffany Thompson and Mark Williams, Department of Horticulture; Tim Woods and Carl Dillon, Department of Agricultural Economics; Ric Bessin, Department of Entomology

July 2017

Contents

TABLE 2: Start-Up Costs

MACHINERY

Tractors	Purchase Year if Known	Purchase Price	Comparable New List Price
95-HP Kubota M9540	2011	$43,707	$55,000
50-HP Kubota L5030	2004	$20,850	$26,609
17-HP Kubota B1700	1999	$10,992	$9,971
Zero-turn mower	2015	$5,000	$8,699
Subtotal		**$80,549**	**$100,279**

Implements by Category	Purchase Year if Known	Purchase Price	Comparable New List Price
Soil Management			
H & S manure spreader model 125	2005	$4,975	$8,699
Tye Pasture Pleaser no-till grain drill	2007	$3,000	$8,500
Edwards 8' flail mower	2010	$5,000	$10,000
12' tandom disc harrow	2000	$1,800	$4,000
Maschio 7.75' B-230 rototiller with rear-basket depth control	2013	$9,735	$10,000
Imants 5.9' 27-series spader	2008	$19,139	$25,000
Monroe Tufline 2-shank subsoiler	2015	$1,915	$1,915
Custom 8' field cultivator	2000	$1,000	$1,200
Plasticulture Production System			
Rain-Flo model 2600 plastic mulch layer	2008	$6,545	$6,600
Rain-Flo model 1600 water wheel transplanter & 9 planter wheels	2005	$3,420	$3,500
IH Farmall 140 with straight-tooth cultivators, small hilling discs, and Danish S-tines	1974	$4,500	$4,500
Rain-Flo Challenger model 1800 mulch lifter	2005	$1,950	$2,000
BCS + flailmower	2011	$6,858	$6,900

FIELD HAND TOOLS	Purchase Price	Quantity	Total Cost	Useful Economic Life (yrs)[1]
T-Post driver	$31	3	$93	15
T-Post puller	$90	2	$180	15
Digging forks	$83	4	$332	15
Loppers	$50	2	$100	15
Soil-knives	$22	6	$132	15
Hand-weeders (A.M Leonard Horticultural Tool and Supply Company, Piqua, OH)	$29	6	$174	15
Wheel-hoes	$400	2	$800	15
Scuffle-hoes	$55	10	$550	15
Grub-hoes	$50	2	$100	15
Shovels	$36	6	$216	15
Specialty hoes	$40	4	$160	15
Spyker model P20-9010 broadcast spreader	$219	1	$219	15
Andersons SSD drop-spreader	$250	1	$250	15
TOTAL FIELD HAND TOOLS			**$3,306**	

DELIVERY SUPPLIES	Purchase Price	Quantity	Total Cost	Useful Economic Life (yrs)[1]
2 12' x 12' Swift Instant Shelter Pop-Up EZ-Up Tents	$103	2	$206	3
6 folding tables	$40	6	$240	3
Signs and sign clips	$3	30	$90	3
TOTAL DELIVERY SUPPLIES			**$536**	

TOTAL PURCHASE PRICE	**$326,056**
TOTAL COMPARABLE NEW LIST PRICE	**$465,910**

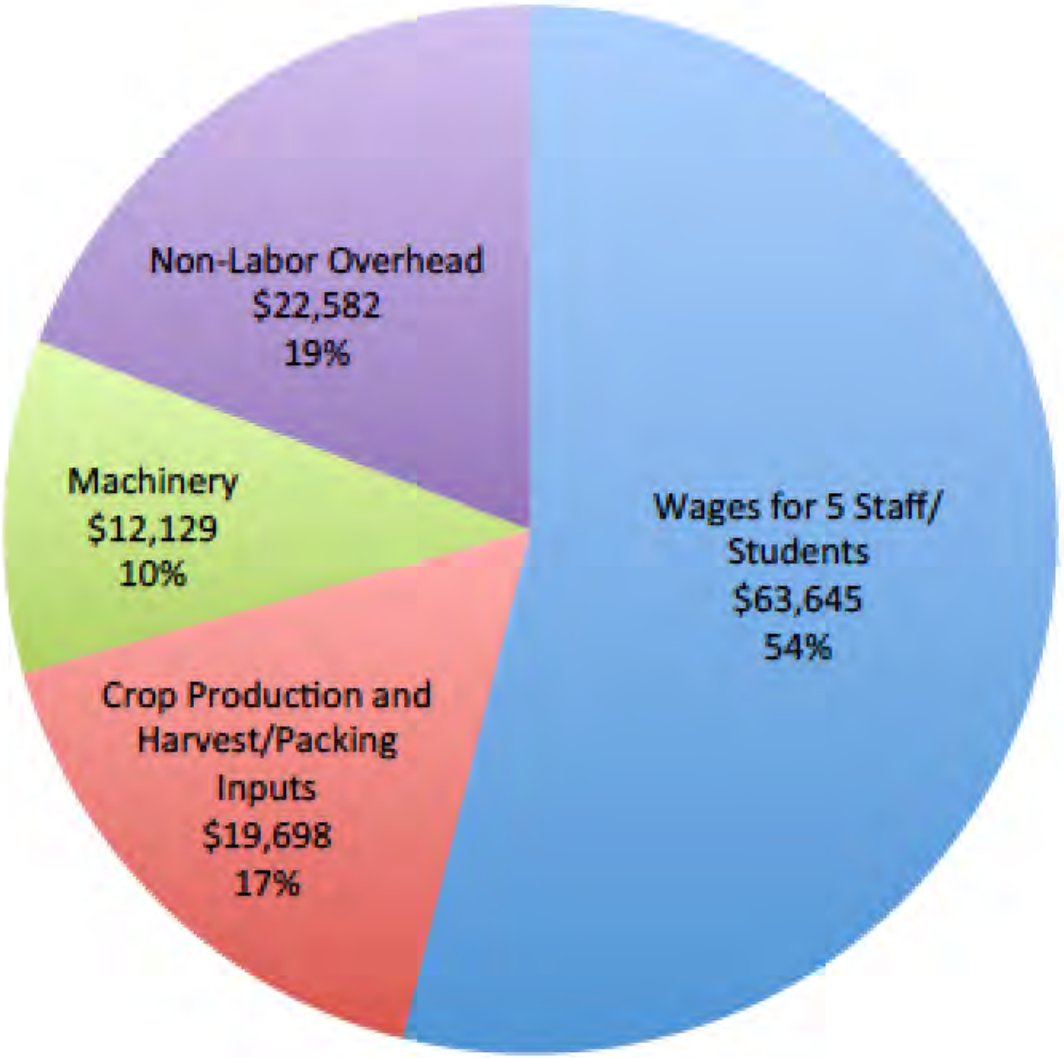
TABLE 5: Crop Production Costs Required for 225 CSA Members

Crop	Pounds per Member	Pounds per 225 Members	Average Yield (lbs / row foot)	Acres Grown	Crop Production Costs
Beans, Green	9	2,025	0.4	0.2	$2,499
Beets	14	3,150	1.2	0.1	$1,280
Broccoli	16	3,600	0.6	0.3	$2,881
Brussels Sprouts	4	900	0.5	0.1	$1,240
Cabbage	14	3,150	1.5	0.1	$1,108
Carrots	15	3,375	0.7	0.3	$3,086
Cauliflower	5	1,125	0.6	0.1	$1,013
Chard, Swiss	4	900	1.1	0.0	$616
Corn, Sweet	18	4,050	0.5	0.4	$2,547
Cucumbers	14	3,150	2.1	0.1	$2,434
Eggplant	8	1,800	2.0	0.1	$1,406
Garlic	4	900	0.2	0.3	$4,490
Greens, Kale/Collards	10	2,250	0.8	0.1	$2,718
Greens, Salad	14	3,150	0.4	0.4	$5,568
Herbs, Summer Annual	5	1,125	0.7	0.1	$794
Kohlrabi	10	2,250	0.9	0.1	$1,401
Leeks	3	675	0.3	0.1	$2,043
Lettuce, Head	12	2,700	1.3	0.1	$1,103
Muskmelon (Cantaloupe)	16	3,600	2.4	0.2	$3,111
Onions, Bulb	18	4,050	1.0	0.2	$2,900
Peppers	18	4,050	2.0	0.2	$3,276
Potatoes	18	4,050	0.8	0.3	$5,489
Potatoes, Sweet	12	2,700	3.2	0.1	$1,340
Roots, Radish/Turnip	10	2,250	0.7	0.2	$1,507
Scallions	4	900	0.4	0.1	$2,234
Squash, Summer	25	5,625	4.0	0.2	$4,277
Squash, Winter	35	7,875	3.1	0.4	$5,354
Tomatoes	35	7,875	6.5	0.2	$5,232
Watermelon	20	4,500	6.5	0.1	$867
You-Pick	10	2,250	2.5	0.1	$1,139
TOTAL	**400**	**90,000**		**5.5**	**$74,952**

TABLE 8: Whole Farm Budget for 225 CSA Members		
Cultivated Acres	5.5	
CSA Shares Sold	225	
REVENUE		
CSA Income @ $649 / Share	$146,025	
80 25-lb Tomato Boxes Sold at $25 / Box	$2,000	
Total Revenue	**$148,025**	
Total Revenue / Acre	*$26,768*	
EXPENSES	**Total Cost**	**% of Total**
Wages for 5 Staff/Students (4824 hrs. @ $13.19 / hr.)		
Crop production	$34,024	28.8%
Overhead (CSA delivery and other non-crop tasks)	$29,620	25.1%
Subtotal	$63,645	53.9%
Crop Production and Harvest/Packing Inputs		
Direct-seeded and transplant seed	$4,385	3.7%
Transplant production costs	$2,183	1.8%
Compost	$1,935	1.6%
Fertilizer	$2,965	2.5%
Plastic mulch	$492	0.4%
Drip tape	$1,443	1.2%
Cover crop seed	$994	0.8%
Pesticides/Fungicides	$1,222	1.0%
Irrigation supplies	$543	0.5%
Other crop management inputs	$2,268	1.9%
Wash water sanitizer	$439	0.4%
Plastic bags, paper sacks, twist ties, tomato boxes	$828	0.7%
Subtotal	$19,698	16.7%
Machinery		
Variable	$4,131	3.5%
Fixed	$7,999	6.8%
Subtotal	$12,129	10.3%
Non-Labor Overhead	$22,582	19.1%
Total Expenses	**$118,054**	100.0%
Total Expenses / Acre	*$21,348*	
NET RETURN TO MANAGEMENT		
Net Return To Management	**$29,971**	
Net Return to Management / Acre	*$5,420*	

TABLE 8: Whole Farm Budget for 225 CSA Members		
Cultivated Acres	5.5	
CSA Shares Sold	225	
REVENUE		
CSA Income @ $649 / Share	$146,025	
80 25-lb Tomato Boxes Sold at $25 / Box	$2,000	
Total Revenue	**$148,025**	
Total Revenue / Acre	*$26,768*	
EXPENSES	**Total Cost**	**% of Total**
Wages for 5 Staff/Students (4824 hrs. @ $13.19 / hr.)		
Crop production	$34,024	28.8%
Overhead (CSA delivery and other non-crop tasks)	$29,620	25.1%
Subtotal	$63,645	53.9%
Crop Production and Harvest/Packing Inputs		
Direct-seeded and transplant seed	$4,385	3.7%
Transplant production costs	$2,183	1.8%
Compost	$1,935	1.6%
Fertilizer	$2,965	2.5%
Plastic mulch	$492	0.4%
Drip tape	$1,443	1.2%
Cover crop seed	$994	0.8%
Pesticides/Fungicides	$1,222	1.0%
Irrigation supplies	$543	0.5%
Other crop management inputs	$2,268	1.9%
Wash water sanitizer	$439	0.4%
Plastic bags, paper sacks, twist ties, tomato boxes	$828	0.7%
Subtotal	$19,698	16.7%
Machinery		
Variable	$4,131	3.5%
Fixed	$7,999	6.8%
Subtotal	$12,129	10.3%
Non-Labor Overhead	$22,582	19.1%
Total Expenses	**$118,054**	100.0%
Total Expenses / Acre	*$21,348*	
NET RETURN TO MANAGEMENT		
Net Return To Management	**$29,971**	
Net Return to Management / Acre	*$5,420*	

Fig. 19 Expense Categories for 225 CSA Members




50’
300’

Cover Crops

Cover Crops

- Short and long term weed control
- Cool season: rye/vetch, oats/pea
- Warm season: Sudex, buckwheat
- Multi-species mix when possible
- Allelopathic crops are critical, as is establishment
- Cover crops drive the rotation

Weed the Soil Not The Crop

Weed The Soil Not The Crop

A Slide Presentation by Anne & Eric Nordell

A Holistic Plan For Weed Management
Rotational Cover Cropping
Alternative Tillage Techniques

TO PURCHASE COPIES CONTACT
Anne & Eric Nordell
3410 Rt. 184
Trout Run, PA 17771
$15.00 per DVD + $3.00 S&H

Edited by Gerace Video
Satisfaction Guaranteed
570-494-1126
2880 Heshbon Road
Williamsport PA 17701


FOR RENT
FLOYD CO. CONSERVATION DIST
FOR INFORMATION CALL (606) 889-390

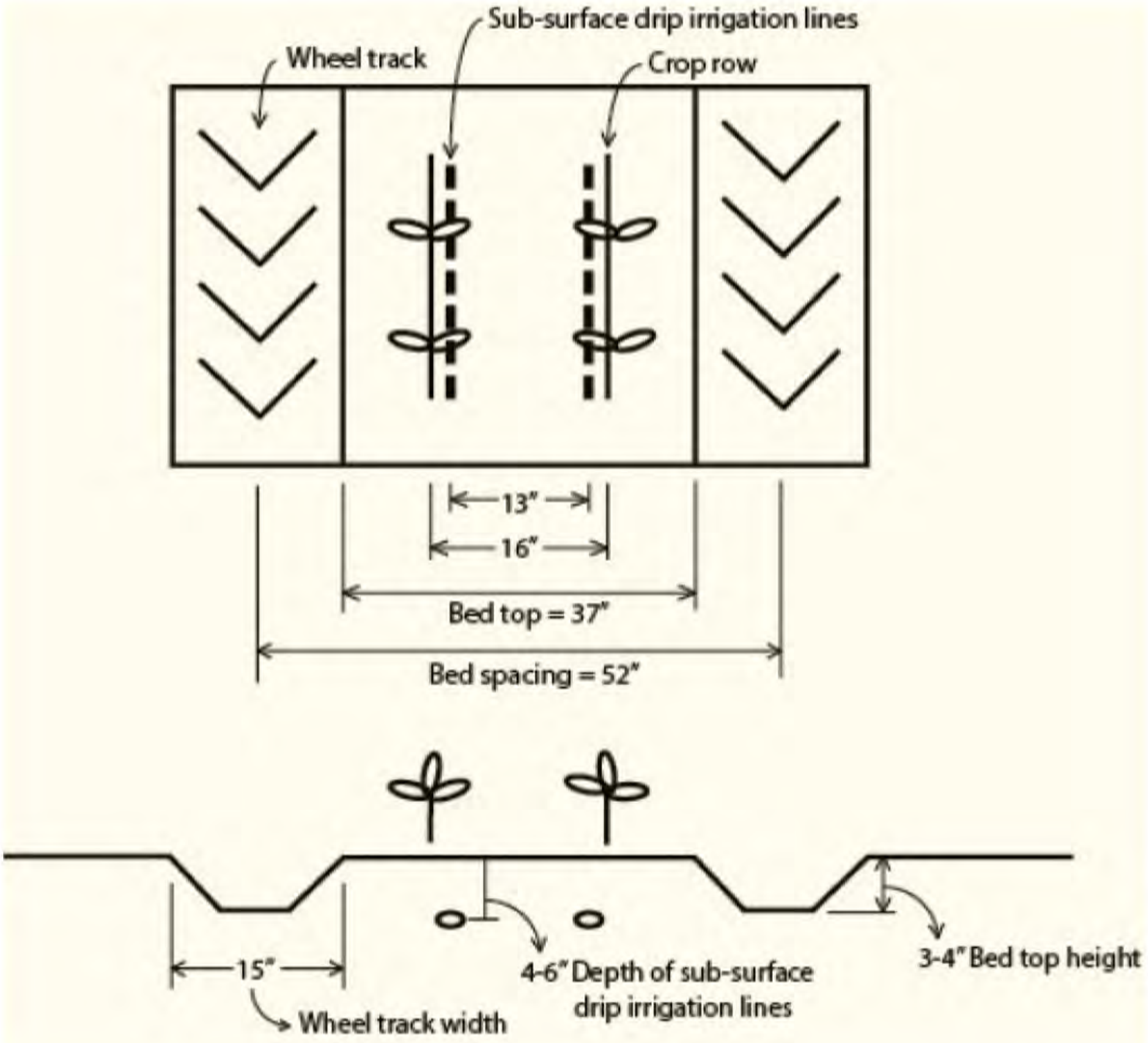
Plasticulture Production – 8 beds per plot on 6’ centers

Farmall 140 with Custom Plastic Cultivation System


KUBOTA

Bare Ground Production

- 10 beds/ plot
- 52” wheel centers
- 37” bed tops
- 3-4” bed heighth
- Double rows on 16” center to center spacing


Sub-surface drip irrigation lines
Wheel track
Crop row
13"
16"
Bed top = 37"
Bed spacing = 52"
15"
Wheel track width
4-6" Depth of sub-surface drip irrigation lines
3-4" Bed top height

Sub-surface Drip Tape Injection System

- 10 mil T-tape
- 8” emitter spacing
- 4-5” depth
- 2 lines per bed
- $5,100

Pinnacle Organic, San Jose, CA.

Rain-Flo

- 3 rows
- 0-10” injection depth
- $3,200

Subsurface Drip Applicator

Heavy duty build for large acreage

Adjustable row centers 36 inches to 68 inches

Features

- Heavy duty subsurface drip applicator with Category II and III 3- point hitch
- Depth adjustable from 4 inches to 17 inches
- Adjustable 36 inch to 68 inch row centers
- Shear bolt for rocky soil
- Convenient storage platform
- Drip attachment has an adjustable on demand disc brake
- Replaceable shank tooth, and shin guard
- Replaceable wear plate on side and bottom of shank
- 2” ID Stainless steel drop tube
- Optional adjustable rear closure disk

41

DRIP TAPE APPLICATORS

False and Stale Seedbeds: The most effective non-chemical weed management tools for cropping and pasture establishment

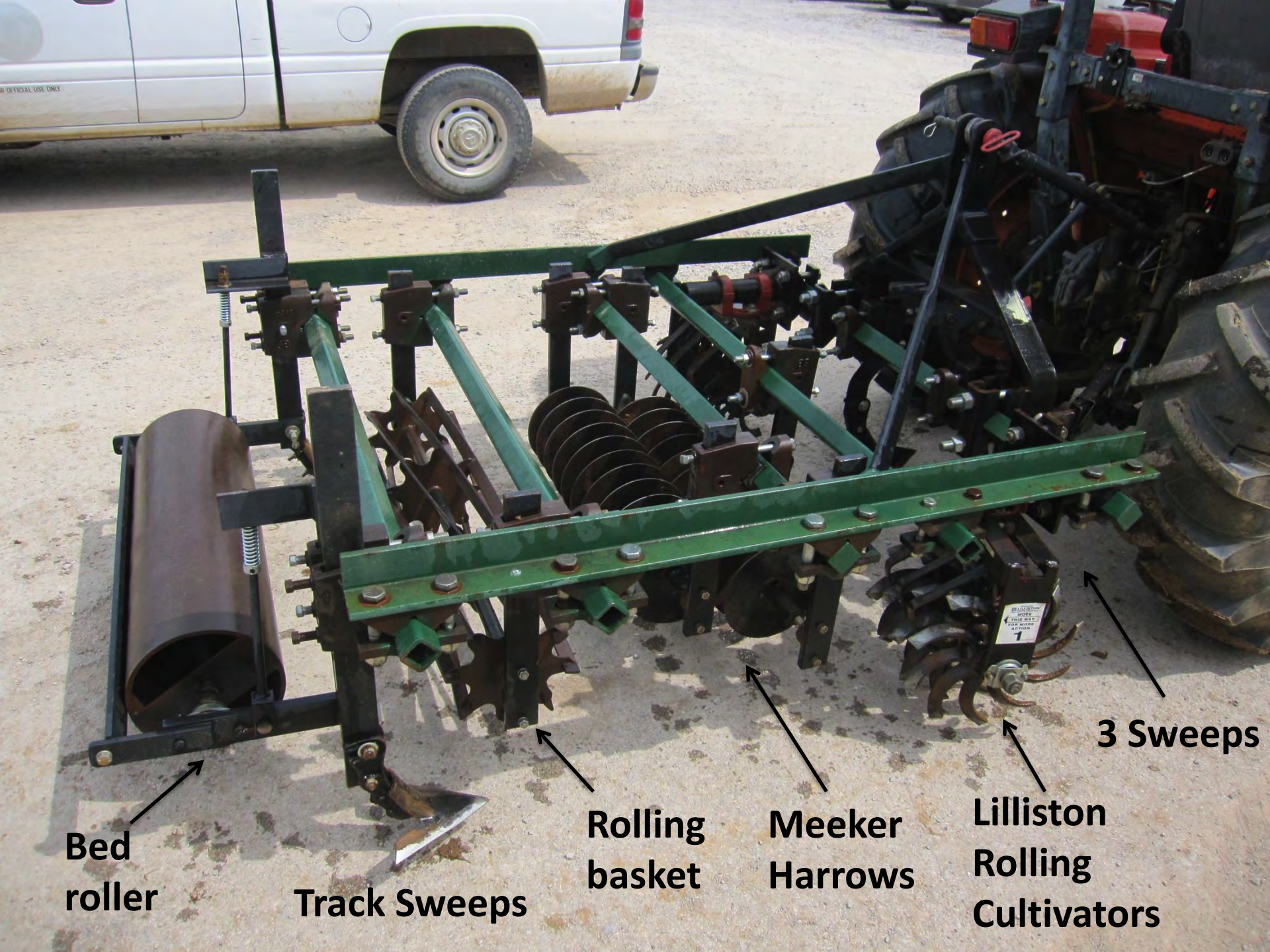
Dr Charles N Merfield

The BHU Future Farming Centre

Permanent Agriculture and Horticulture Science and Extension

www.bhu.org.nz/future-farming-centre


Stale Seedbed Cultivator


Bed roller
Track Sweeps
Rolling basket
Meeker Harrows
Lilliston Rolling Cultivators
3 Sweeps

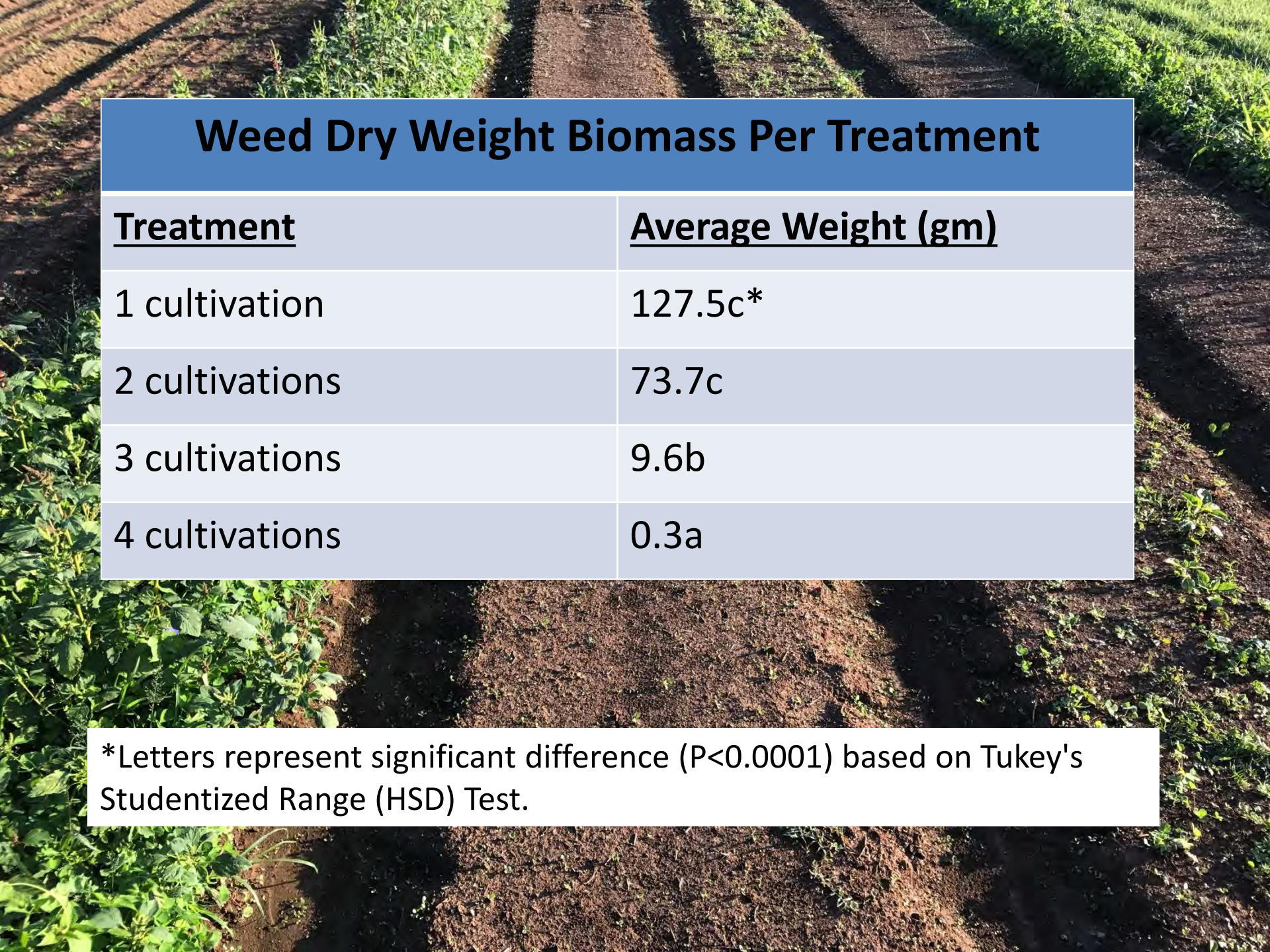

KUBOTA


STANLEY

Stale Seedbed Cultivation Field Experiment - Summer 2017

Stale Seedbed Cultivation Field Experiment - Summer 2017

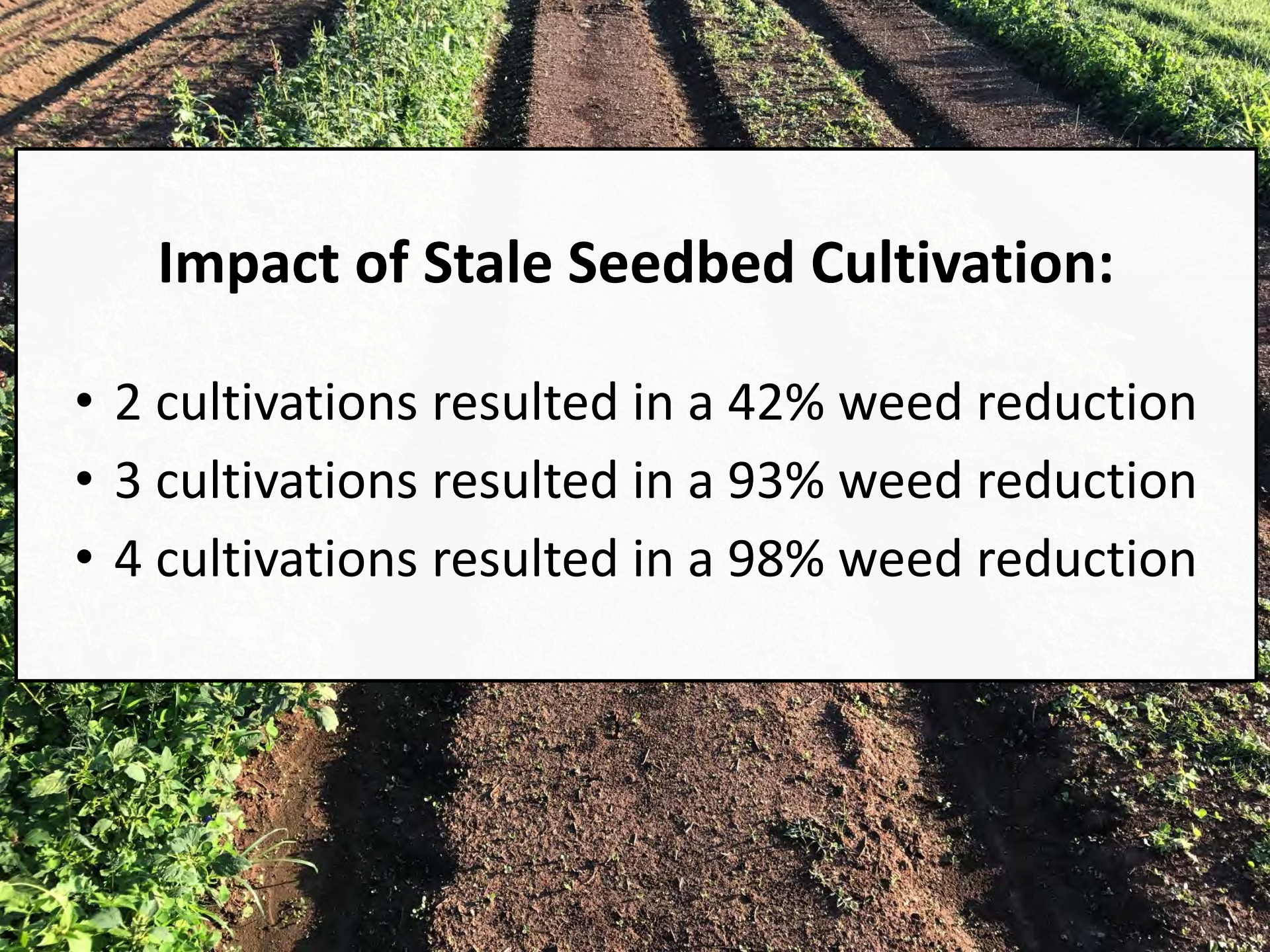
- Four treatments: 1, 2, 3, or 4 cultivation events, each separated by 10 days
- Individual plot size: 52” x 40’; 4 replications arranged in a completely randomized design
- Weed data collected 10 days after final cultivation: dry weight biomass, species identification and abundance



Weed Dry Weight Biomass Per Treatment

Treatment	Average Weight (gm)
1 cultivation	127.5c*
2 cultivations	73.7c
3 cultivations	9.6b
4 cultivations	0.3a

*Letters represent significant difference ($P<0.0001$) based on Tukey's Studentized Range (HSD) Test.



Impact of Stale Seedbed Cultivation:

- 2 cultivations resulted in a 42% weed reduction
- 3 cultivations resulted in a 93% weed reduction
- 4 cultivations resulted in a 98% weed reduction


Food Bank Farm, Hadley, MA


Capay Organic, Capay Valley, CA.

The Steketee Seedbed combination implement

BED RECONDITIONER

Post-harvest or pre-plant raised bed maintenance

Pyroweeder by Farmer's Friend

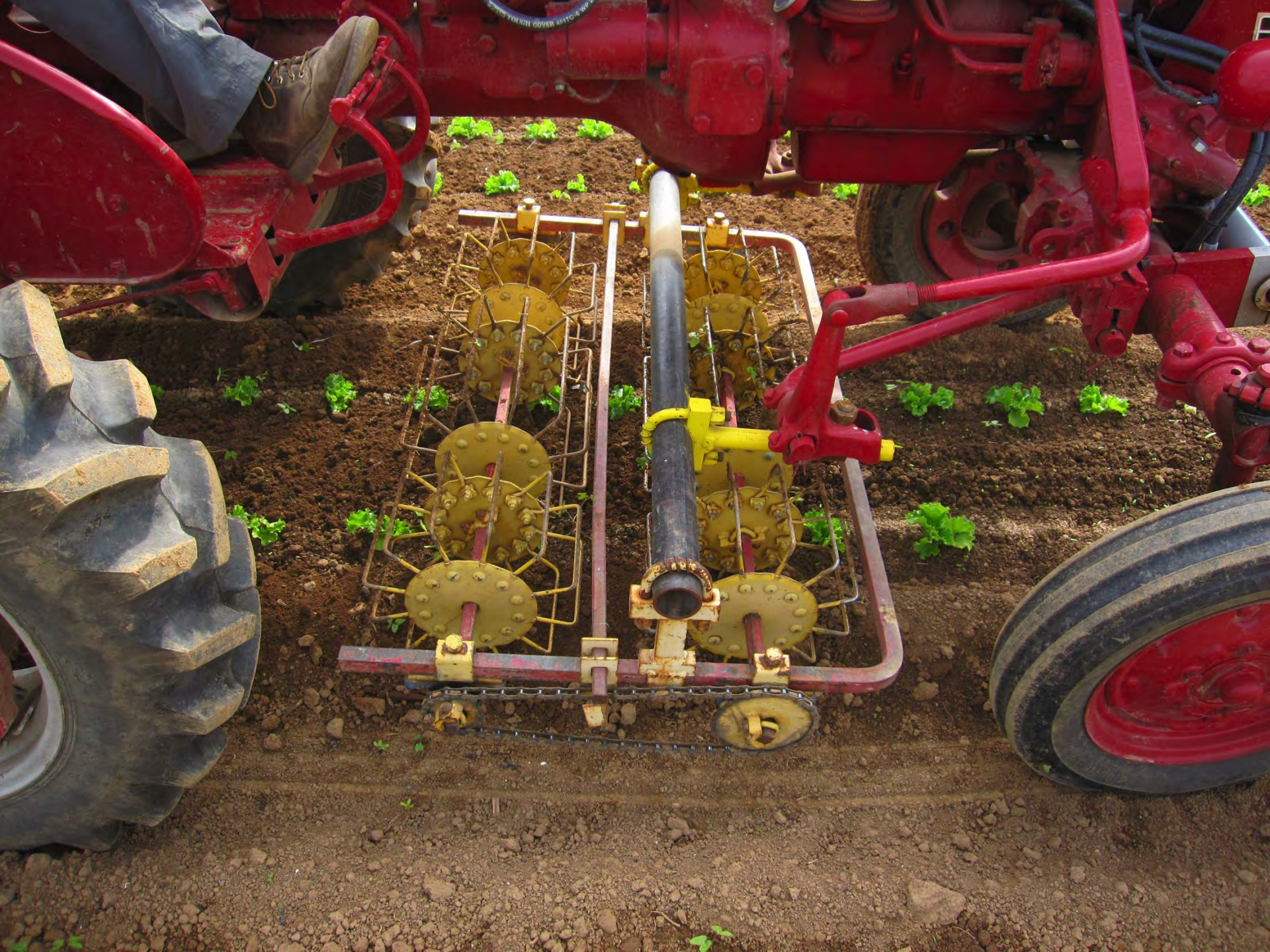
- $895


Mechanical Transplanter with fertilizer hopper


Matermacc vacuum seeder
with fertilizer hoppers


Between row cultivation with a Buddingh Basket weeder and custom power steering
INTERNATIONAL
FARMALL
140


INTERNATIONAL
FARMALL
140



Kress Finger Weeder


K.U.L.T.


K.U.L.T.
www.kress-landtechnik.de
$7,600

Critical Components of an Integrated System

- Allelopathic cover crops
- Mulches (living and dead)
- Subsurface drip irrigation
- Stale seedbed cultivation
- Restricted fertilizer placement
- Timely and effective between row cultivation
- Effective in-row cultivation