LandWISE INCORPORATED

HAWKE'S BAY FUTURE FARMING
TE MATAU A MĀUI AHU WHENUA-HĪKINA TAIAO

Carbon Positive Project

Milestone Four Operational Report

Due 1 June 2023

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Milestone 4: Year 1 Completed

Date: 1 June 2023	**Milestone 4**
Milestone description	Year 1 Completed
Target Outcome	Scientific knowledge of regenerative agriculture principles and transition.
Activities undertaken	Operational Advisory Group (OAG) meeting, harvest, crop, and soil analyses completed, winter crops established, magazine article, Outreach presentations at 1 conference. Further activities as per Annual Project Plan and Annual Science Plan
Deliverables / evidence of completion / achievement of Outcome	Trial results, copies of all extension material. Photos of events (preferred but not essential) PSG and TAG meeting minutes. Deliverables as per milestones within Annual Project Plan and Annual Science Plan.
MPI Funding amount	$83,303.55
Co-Funding contribution	36,701.52
Total	**$120,005.07**

Science Plan Activities

Activity	**Target Completion Date**	**Details**	**Date Completed**
Year 1 Completed	1/06/23	Scientific knowledge of regenerative agriculture principles and transition.	11/5/2023
Crop monitoring maturity	1/04/23	Count plants silking in 5m row, 4 rows/plot	2/3/2023
Harvestable yield	15/04/23	Count cobs in 5m row, 4 rows/plot, weigh cobs	5/4/2023
Crop quality	15/04/23	Subsample 10 cobs/plot - to factory for quality testing	6/4/2023
Crop N	15/04/23	Subsample section of 5 cobs/plot to lab for N test	6/4/2023
Residue N	15/04/23	Subsample 5 plants/plot to lab for N test	6/4/2023
Measure soil N at harvest	18/04/23	8 cores per plot to 30cm, Nitrate Quick test 2 depths	19/4/2023

Activities Completed

The 2022-2023 cropping season was particularly challenging, starting with a wetter than average spring that delayed planting for most crops. The wet weather continued into the new year, with Cyclone Hale hitting in late January, and the devastating Cyclone Gabrielle hitting on 13th February.

As mentioned in the MS3 report the sweetcorn trial remained largely unimpacted, spending a short amount of time water-logged. The sweetcorn crop was harvested 11th April, and a winter cover crop planted shortly after, taking the project to the end of its first growing year.

We would like to acknowledge all of the individuals and organisations that have provided services, knowledge and advice in the first year of the project. In particular, we would like to acknowledge the skilled contracting teams that spent many hours implementing the operational plans for each treatment. This includes the groundwork, planting, fertiliser applications and harvesting. Without these patient operators it would not be possible to demonstrate the three systems using commercial scale equipment.

Year 1 Completed

For each of the three treatments a framework has been developed in order to guide management decisions. This has evolved through the first growing season and will continue to evolve as the wider advisory group continues to develop knowledge and understanding of what it means to grow an intensive vegetable crop 'regeneratively'.

With any management decision, the practices must be:

- Able to be scaled up from $0.1m^2$ trial plot to 20ha or 200ha
- Practical and sensible
- Financially justifiable (recently added to management considerations)

At the end of season Operational Advisory Group update on the 11th of May the below frameworks were discussed and generally agreed upon. In addition to Science Plan deliverables, treatment profitability has been analysed and discussed.

Conventional	Hybrid	Regenerative
Current industry BMP	'Cherry-picking' management to achieve 'lower footprint'	5 core regen principles adapted to commercial vegetable production
Full input- full output	Some conventional practices + some regen practices	'Lower Input' (AgChem/synthetic fertiliser)
Crop management packages delivered by processor agronomists	Not full system changes- easy for growers to adopt changes	Reimagining the status quo
Plans created with processors, technical advisors	Plans created with processors, growers, technical advisors	Plans created with consultants/growers
Aim to make high profit margin	Aim to reduce environmental impact while retaining high profit margin	Aim to improve soil and plant health overtime to achieve long term improved profit, environmental, crop performance outcomes

Note on Data Presentation

For clarity we have shown the key data as a series of boxplots and a statistical table showing significance. The boxplots show how much variability there is between treatments. Where data were collected at multiple points (usually four) in each plot, the boxplots show the four replicate plots in each treatment. This shows how much variation there is within treatments. An explanation of boxplot display is given in Figure 1 below. The middle value for the group of data represented by the box is the black line in the middle of the blue box. Half the values sit within the blue box, and one quarter are above and one quarter below. Points that are extremely different (outliers) show as asterisks.

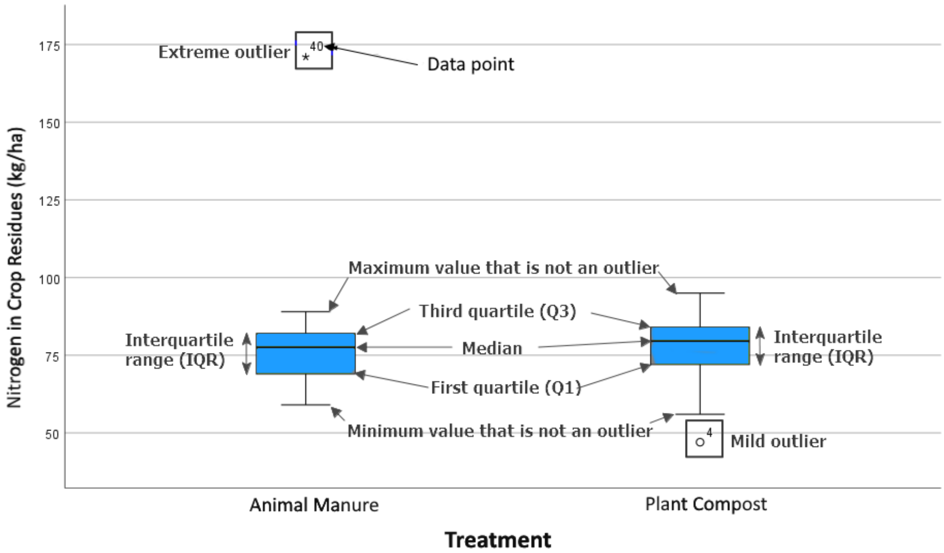


Figure 1 Example boxplot showing interpretations with median, quartiles and outliers for a mock case with two treatments.

The statistical tables show the mean values for each treatment and whether the treatment results are significantly different. We used one-way ANOVA and adopted the Tukey test to find means that are significantly different from each other. The Tukey test groups results into treatments that are the same (homogeneous subsets). Values in the same subset are not significantly different. One treatment can be in more than one column. Table 1 below shows that cobs exported from the regenerative treatment contained 40.58 kg N/ha. This is significantly less that the cobs from the conventional treatment which contained an average of 46.38 kg N/ha. The cobs from the hybrid system contained 43.51 kg N/ha, which was not significantly different to either of the other treatments.

Table 1 Mean values and homogeneous subsets of the amount of nitrogen exported in sweetcorn cobs sent for processing

Harvest N Exported (kg/ha

Tukey HSD[a]

Treatment	N	Subset for alpha = 0.05	
		1	2
Regenerative	16	40.5805	
Hybrid	16	43.5088	43.5088
Conventional	16		46.3793
Sig.		.362	.376

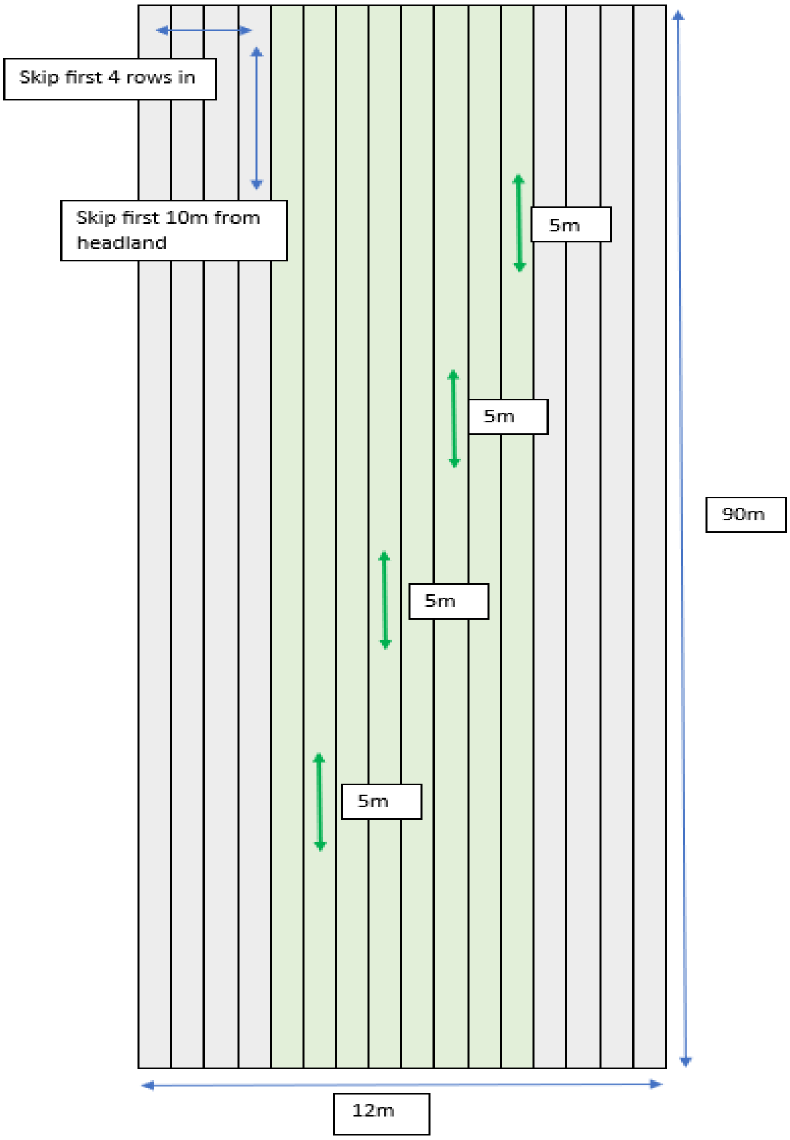
Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 16.000.

Crop Monitoring

Crop development measures have been taken throughout the season, from germination and population, to tasselling and silking, and finally harvest. Measurements have been taken in the same areas, on 5m of row, repeated 4 times through the plot, starting 10m from either end and 3m in from either edge (Figure 2).

Figure 2 Diagram of a single plot showing sampling layout and where four subsamples were collected.



Shortly after germination, five of the measured lengths of row were moved to new locations after crop damage by pükeko. This ensured the data we collected were representative of the whole plot.

Crop Development

Figure 3 Sweetcorn before canopy closure

Post emergence herbicide was applied on the 18th of January, and side dressing completed 25th January. Pükeko trapping continued through the month of January and into early February, to allow the crop to reach a size where pükeko couldn't pull them out of the ground.

The plant population per treatment showed no significant difference between treatments (Figure 4 and Table 2).

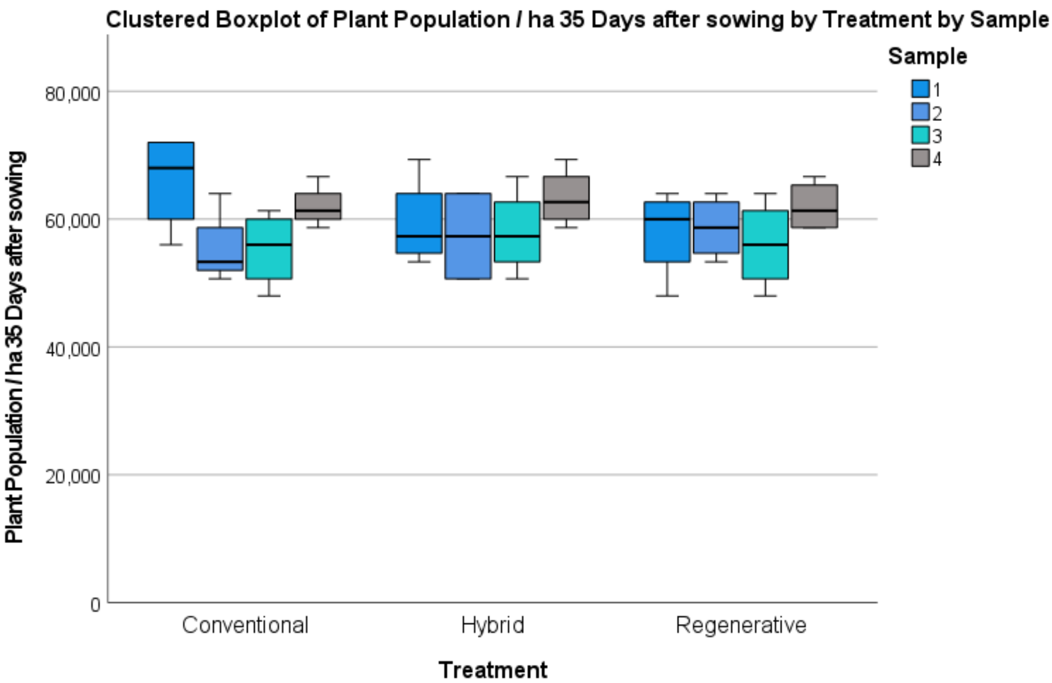


Figure 4 Clustered boxplot of plant population 35 days after sowing by treatment by sample.

Table 2 Mean values and homogeneous subsets of plant population 35 days after sowing.

PopDAS35

Tukey HSD[a]

Treatment	N	Subset for alpha = 0.05
		1
Regenerative	16	58666.69
Hybrid	16	59500.06
Conventional	16	59666.63
Sig.		.898

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 16.000.

Before canopy closure, Canopeo was used weekly to capture canopy cover in each plot. Weed cover in some plots affected results, incorrectly implying their canopies were significantly larger than others. However, after the post emerge herbicide was applied, canopy data captured became more uniform.

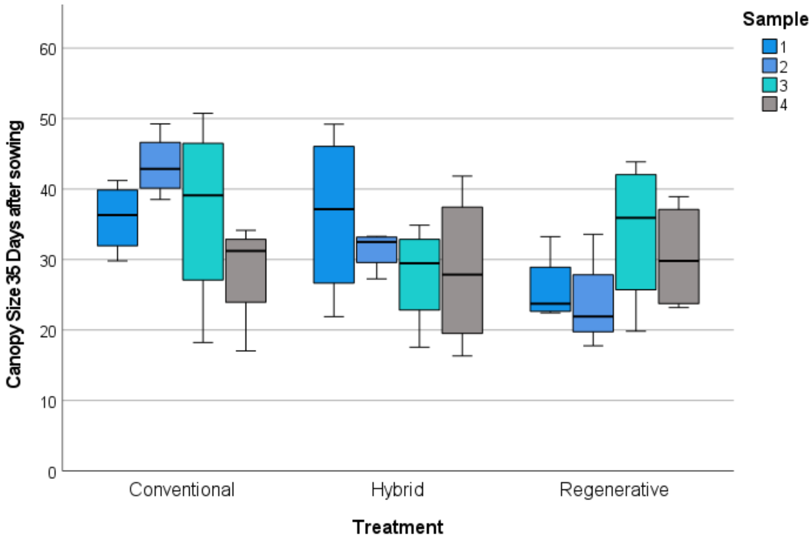


Figure 5 Clustered boxplot of canopy cover (%) 35 days after sowing by treatment by sample

There was a statistically significant difference between the conventional treatment and the regenerative treatment, however there is no significant difference between the other treatments.

Table 3 Mean values and homogeneous subsets of canopy cover (%) 35 days after sowing

Tukey HSD[a]

Treatment	N	Subset for alpha = 0.05	
		1	2
Regenerative	16	28.4756	
Hybrid	16	31.0169	31.0169
Conventional	16		36.1275
Sig.		.697	.242

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 16.000.

Pests, Disease and Weeds

The emerging crop was affected by slugs and some cutworm damage. The crop is now healthy, with no disease or insect pressure causing significant damage. We will monitor for Fall Army Worm.

There appears to be differing effectiveness in weed control with the different programs used. The crop has outgrown any significant weeds, however there may be other issues associated with weed pressure after harvest. This will be managed as appropriate.

Tasselling and silking

Tasselling and silking are key measures of crop development and plant maturity in sweetcorn. Tassels are the part of the plant were pollen is held, the pollen drops down onto the silks, fertilising the ovules, which turns into an individual kernel on the cob (Figure 6). Moisture and heat stress can impact this process. Tasselling normally begins a few days before silking. Plants were counted on the 2nd of March.

Figure 6 Left image: sweetcorn plant tasselling. Right image: sweetcorn plant silking.

Data collected show that tasselling plants were not counted early enough to capture significant differences between treatments. This was due to overlap of cyclone recovery work.

Silking was assessed when between 21% and 67% of plants counted were silking. Statistical analysis shows a significant difference between the conventional and hybrid treatments and the conventional and regenerative treatments (Figure 7). There was no significant difference between the hybrid and the regenerative treatments (Table 4).

Figure 7 Clustered boxplot of percent silking 69 days after sowing by treatment by sample

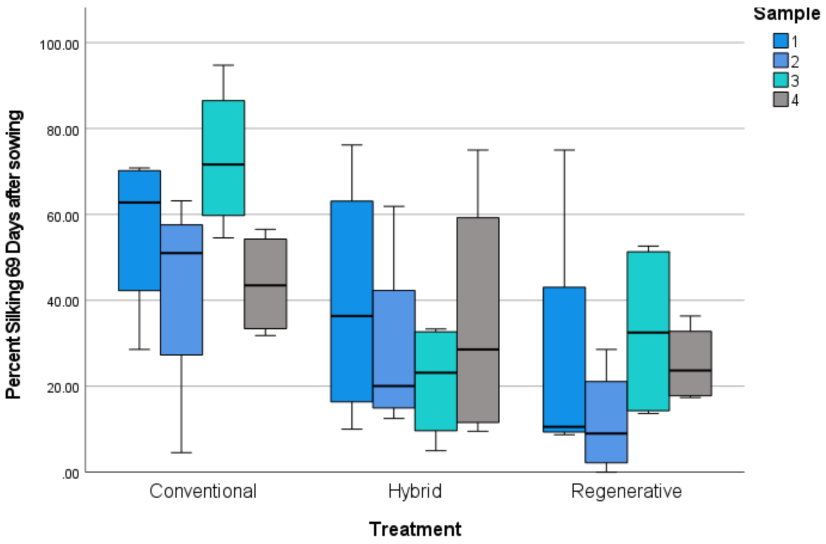


Table 4 Mean values and homogeneous subsets of percent silking 69 days after sowing

Percent Silking 69 Days after sowing

Tukey HSD[a]

Treatment	N	Subset for alpha = 0.05 1	Subset for alpha = 0.05 2
Regenerative	16	23.9838	
Hybrid	16	31.2313	
Converntional	16		53.9106
Sig.		.619	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 16.000.

Harvest

Hand harvesting was completed on 5th April. The 5m transects were measured for hand harvesting. All plants in 5m of row were cut off at ground height and removed from the plot (Figure 10).

All cobs were removed from each plant, with some plants having more than one cob. Cobs greater than 15cm were treated as 'harvestable yield' and were weighed (Figure 11). Cobs less than 15cm long were considered undersized and weighed separately.

From the 'harvestable' cobs, five were randomly selected for lab analysis for Total Carbon % and Nitrogen %. These were cut into six sections, with every second section sent off to the lab. Five cobs were also collected for kernel recovery. These cobs were weighed with the husk on, then the husk was removed prior to kernel removal.

Figure 10 Sweetcorn plants cut and removed from plot

Figure 11 Sweetcorn plants and cobs weighed

The remaining plant material (stems and leaves) was weighed. Five plants were selected at random, to be shredded (Figure 9). A subsample of the shredded plant mass was dried to calculate dry matter %. A second subsample was sent for lab analysis for Total Carbon % and Nitrogen %. The plots were then individually harvested by machine (Figure 9).

Figure 9 Sweetcorn plants being shredded prior to plant analysis

Figure 9 Sweetcorn harvester at work in trial plot

Harvestable Yield

Harvestable yield per hectare is calculated using the cob weight (cob with husk on) of 5m of row. This data is used to calculate the per hectare yield of each plot. Target yield for 'Super Sweet' corn cv. Galaxy for McCains was 22T/ha. Given the late planting of the corn, and wet, low-light summer this was not achieved in any of the treatments. This season the average yield for McCains was

Figure 12 Clustered boxplot of yield (t/ha) by Treatment by Sample

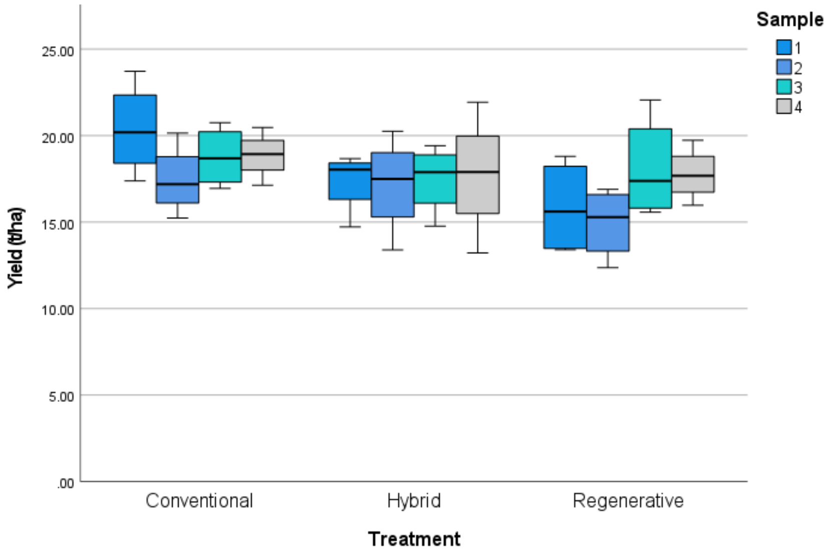


Table 5 Mean values and homogeneous subsets of Crop Yield (t/ha)

Tukey HSD[a]

Treatment	N	Subset for alpha = 0.05 1	2
Regenerative	16	16.6713	
Hybrid	16	17.4381	17.4381
Converntional	16		18.8638
Sig.		.628	.209

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 16.000.

16T/ha, so in general the Carbon Positive sweetcorn performed well, with plots producing between 15.9T/ha and 19.4T/ha (Figure 12).

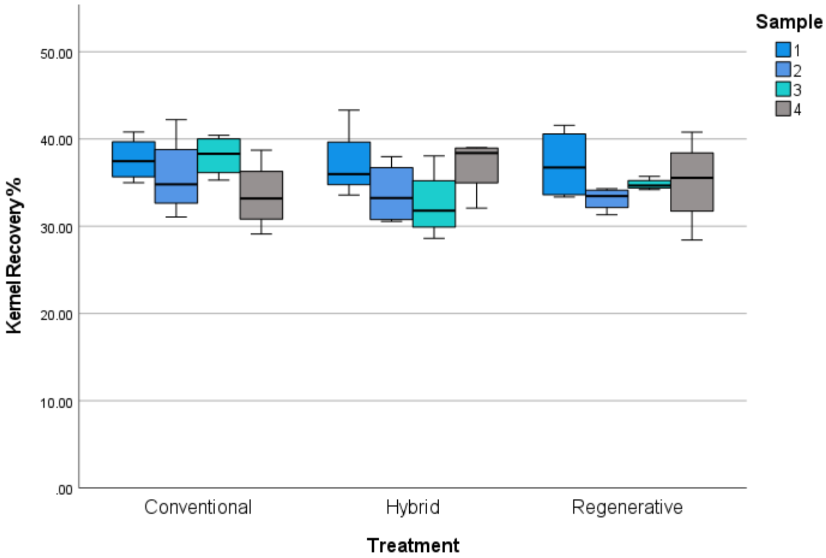
Analysis of this data shows that there was there is a significant difference between the conventional and the regenerative treatment, but there was not a significant difference between the conventional and hybrid treatments, or between the hybrid and regenerative treatments (Table 5).

Crop Quality

Kernel Recovery

Kernel recovery is a product quality measure used by McCains. It is the weight of kernels removed from the cob divided by the total cob weight (including the husk). Five cobs were selected per 5m of harvested row. Cobs were taken to McCain's factory to have kernels mechanically removed and then weighed. Target kernel recovery for McCains is 39%. Across the treatments kernel recovery was between 29-43%, perhaps reflected some under-mature cobs (Figure 13).

Figure 13 Clustered Boxplot of Kernel Recovery by Treatment by Sample



Analysis of this data showed that there was no significant difference between any of the treatments (Table 6).

Table 6 Mean values and homogeneous subsets of Kernel Recovery

Tukey HSD[a]

Treatment	N	Subset for alpha = 0.05 1
Regenerative	16	35.0344
Hybrid	16	35.1269
Converntional	16	36.2644
Sig.		.613

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 16.000.

Brix

Brix is a measure of dissolved sugar in fruits and vegetables and is another product quality measure used by McCain Foods. Sugar content is an indicator of crop maturity, alongside moisture content.

Brix levels in the sweetcorn was measured at McCains factory using a subsample of the kernels removed for kernel recovery. Kernels were pureed, a small subsample was taken and pressed through mesh to separate the juice from the solids. This juice was analysed using a digital refractometer (Brix Meter), to give a percentage Brix reading. Target range for McCains sweetcorn is 16-18% Brix.

All Brix readings taken were within this range, and there was no significant difference between any of the treatments (Table 7). The below box plot shows the spread between treatments, which appears high, however all averages were around 16.4% and showed very little variation (Figure 14).

Figure 14 Clustered Boxplot of Kernel Brix by Treatment by Sample

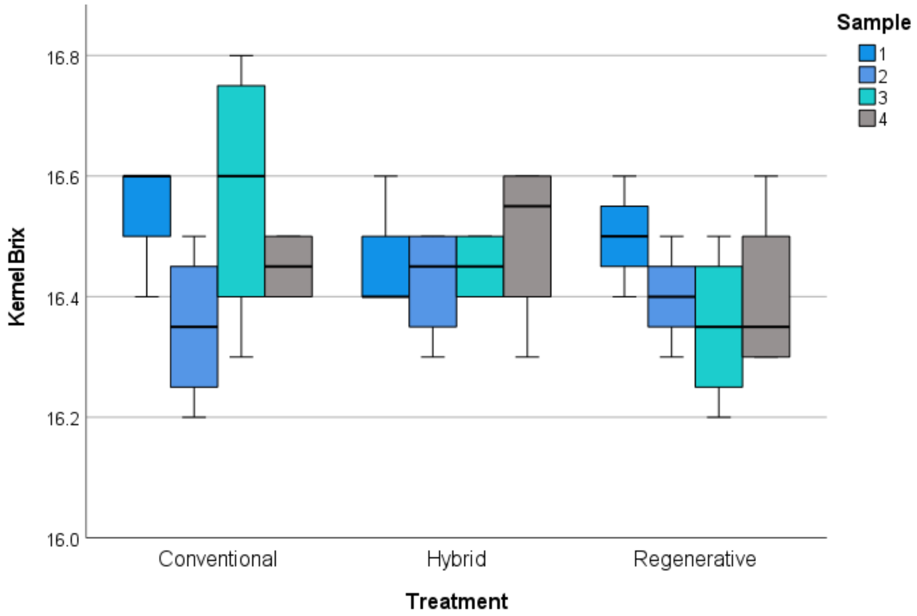


Table 7 Mean values and homogeneous subsets of Kernel Brix

Tukey HSD[a]

Treatment	N	Subset for alpha = 0.05 1
Regenerative	16	16.413
Hybrid	16	16.456
Converntional	16	16.481
Sig.		.274

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 16.000.

Moisture Content

Moisture content is another product quality indicator used by McCain Foods. As the crop matures, kernel moisture decreases. The optimum moisture content for sweetcorn will depend on the end use of the product. For McCain Foods, sweetcorn is processed and the optimum range for moisture is 73-80% (or 20-27% dry matter). This moisture level means that kernels will be easy to mechanically remove from the cob, without compromising kernel quality (taste/texture).

Figure 15 and statistical analysis (Table 8) show that there is no significant difference between the conventional and hybrid treatments, or between the hybrid and regenerative treatments but there is a significant difference between the conventional and regenerative treatments. Average kernel moisture content is within McCain Foods' target range for all treatments.

Figure 15 Clustered Boxplot of Kernel Moisture (%) by Treatment by Sample

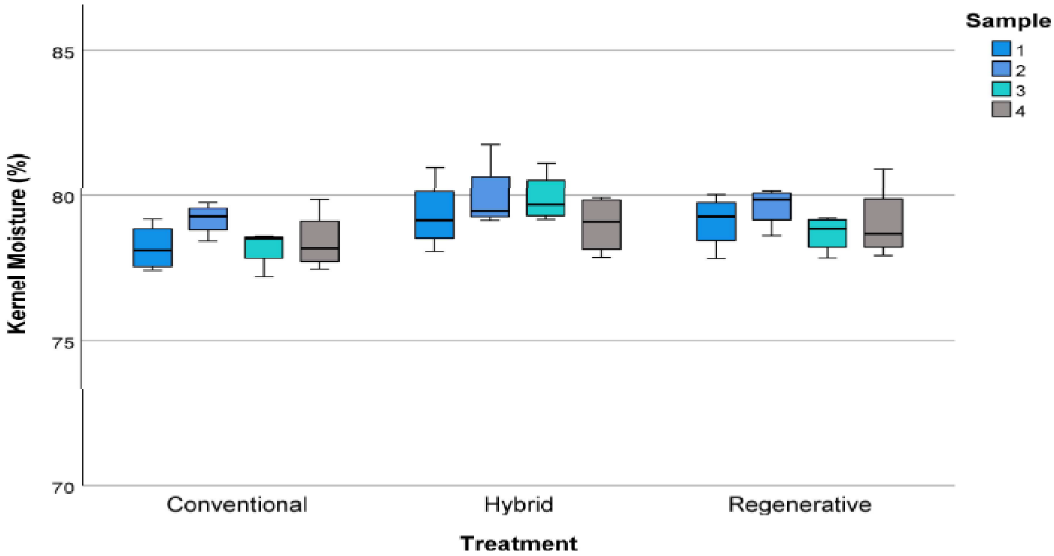


Table 8 Mean values and homogeneous subsets of Kernel Moisture (%)

Tukey HSD[a]

Treatment	N	Subset for alpha = 0.05 1	2
Conventional	16	78.4969	
Regenerative	16	79.1094	79.1094
Hybrid	16		79.5425
Sig.		.161	.393

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 16.000.

Nitrogen Balances

Crop N (Exported N)

To determine the nitrogen content of the crop exported from each plot, three 2 cm thick discs were cut from each of five cobs complete with outer husk from each sample point. The samples were analysed by Hill Laboratories, to determine the nitrogen content. This information was used to complete nitrogen budgets and post-harvest nitrogen balances.

Laboratory results are presented as Nitrogen %, which was adjusted by dry matter content to determine the amount of nitrogen removed (kg N/ha). There was little difference in nitrogen content between the samples analysed, with N% ranging from 1.5-1.8%. However once crop yield (biomass per hectare) is considered, there is difference in nitrogen exported (Figure 16).

There was no significant difference between the conventional and hybrid treatments, or between the hybrid and regenerative treatments but there was a significant difference between the conventional and regenerative treatments (Table 9). This is consistent with the lower yield in the regenerative treatment compared to the conventional treatment.

Figure 16 Clustered Boxplot of Harvest N Exported (kg/ha) by Treatment by Sample

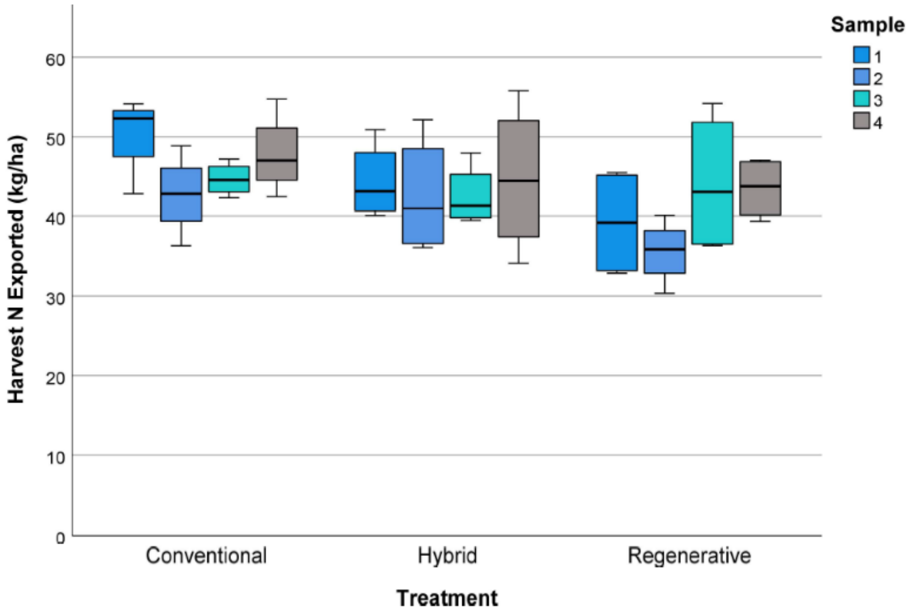


Table 9 Mean values and homogeneous subsets of Harvest N Exported (kg/ha)

Tukey HSD[a]

Treatment	N	Subset for alpha = 0.05 1	 2
Regenerative	16	40.5805	
Hybrid	16	43.5088	43.5088
Conventional	16		46.3793
Sig.		.362	.376

Means for groups in homogeneous subsets are displayed.

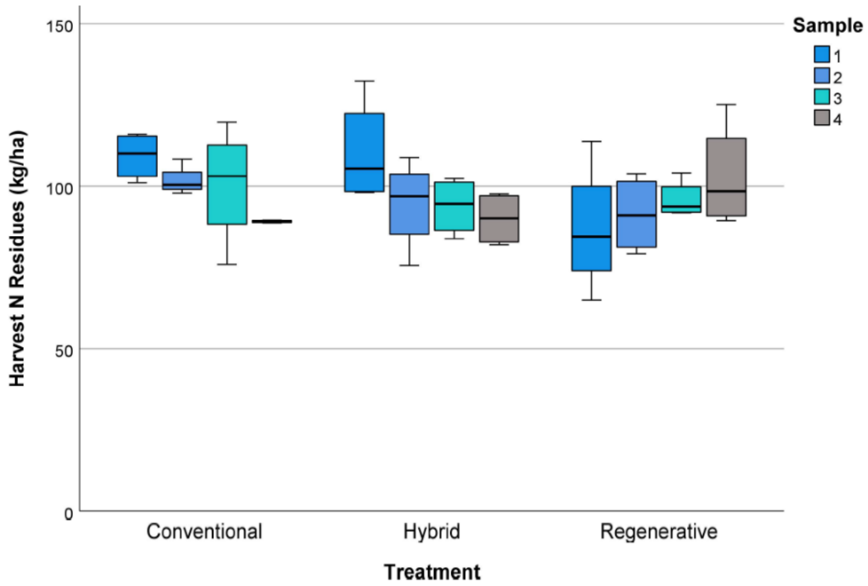
a. Uses Harmonic Mean Sample Size = 16.000.

Residue N

The nitrogen content of the crop residue (plant matter left in paddock) was determined from shredded stalk and leaf subsamples. Plant material was analysed by Hill Laboratories for percentage Nitrogen. This was adjusted by dry matter content and total fresh biomass to determine the amount of nitrogen retained in the crop residue in each plot (kg N/ha). The nitrogen retained in the plant residue will become available as the plant matter breaks down.

There was little difference in nitrogen content of the samples analysed with N% ranging from 1.3-1.7%. However once crop yield (biomass per hectare) is considered, there is difference in amount of nitrogen retained in different plots (Figure 17).

Figure 17 Clustered Boxplot of Harvest N Residues (kg/ha) by Treatment by Sample



Statistical analysis of the data shows that there is no significant difference between any of the treatments (Table 10).

Table 10 Mean values and homogeneous subsets of Harvest N Residues (kg/ha)

Tukey HSD[a]

Treatment	N	Subset for alpha = 0.05 1
Regenerative	16	94.2885
Hybrid	16	97.2212
Conventional	16	100.2410
Sig.		.424

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 16.000.

Measure Soil N at Harvest

The amount of immediately available nitrogen present in the soil post-harvest was determined using the Nitrate Quick Test. Samples were taken at two depths 0-15cm and 15-30cm. The Quick Test results were then calculated to kilograms of nitrogen per hectare using the FAR Mass Balance Calculator. This data has been combined and expressed as kilograms of nitrogen 0-30cm. As there was only one combined sample used at each depth in each plot, the data are presented as a simple box plot (Figure 18). There was no significant difference between treatments (Table 11).

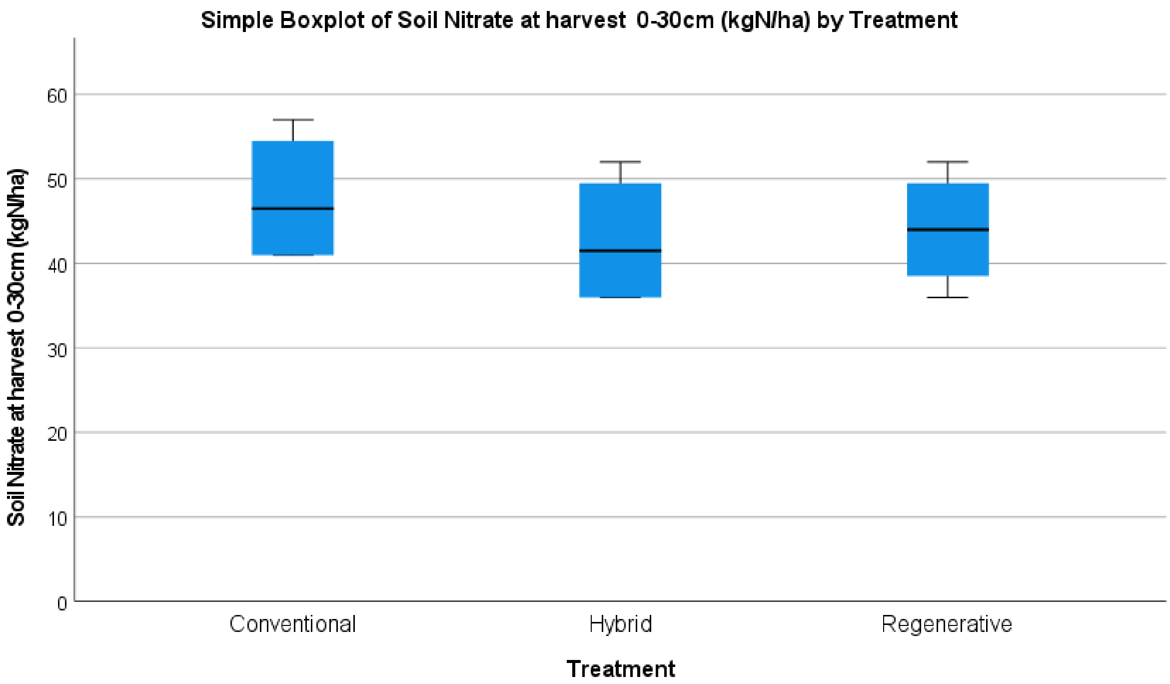


Figure 18 Simple Boxplot of Soil Nitrate at harvest 0-30cm (kgN/ha) by Treatment

Table 11 Mean values and homogeneous subsets of soil nitrate at harvest 0-30cm

Soil Nitrate at harvest 0-30cm (kgN/ha)

Tukey HSD[a]

Treatment	N	Subset for alpha = 0.05 1
Hybrid	16	42.75
Regenerative	16	44.00
Conventional	16	47.75
Sig.		.112

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 16.000.

This is an interesting result given the amount of nitrogen applied to each plot has been different, however the very wet season is likely to have resulted in leaching of excess nitrate. Additionally the conventional treatment has 'used' more nitrogen, as seen in above data on crop exported N and residue N. It is difficult to determine the impact of the compost application on the regenerative treatment. The nitrogen is unlikely to have all become available this season but may become available over a longer period of time. Literature suggests between 12 and 20% of the compost N might be released in the first year after application.

The effect of nitrogen supply on yield was assessed by comparing the cobs exported with the total available nitrogen and with the additional nitrogen applied to the crop (Figure 19). In neither case was there a significant difference demonstrated between any of the treatments (Table 12).

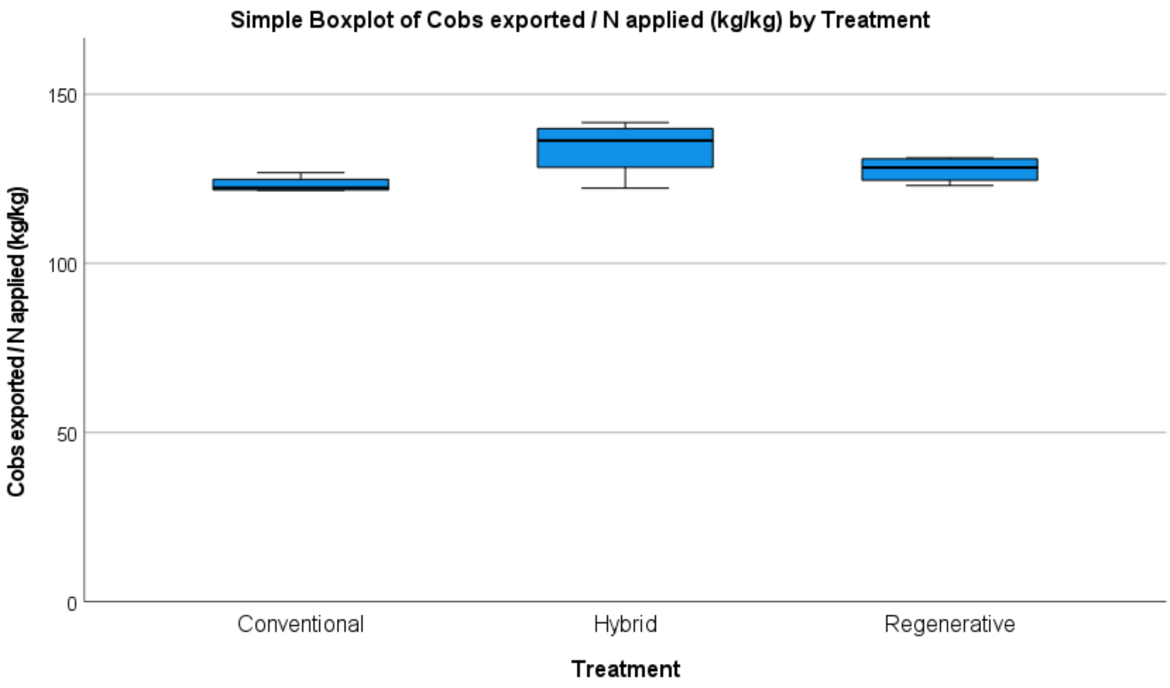


Figure 19 Simple Boxplot of Cobs exported / N applied (kg/kg) by Treatment

Table 12 Mean values and homogeneous subsets of cobs exported per unit of nitrogen applied to the crop (kg/kg)

Cobs exported / N applied (kg/kg)

Tukey HSD[a]

Treatment	N	Subset for alpha = 0.05 1
Conventional	4	123.29
Regenerative	4	127.75
Hybrid	4	134.14
Sig.		.052

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 4.000.

Profitability

The cost of growing each treatment has been calculated as part of the post season review. A summary is presented in Table 13. See Appendix 1 for full details.

Table 13 Gross margin summary of sweetcorn grown under conventional, hybrid and regenerative cropping management systems.

	Conventional	Hybrid	Regenerative
Total operational spend	$ 2,456.80	$ 2,150.88	$ 3,846.93
Total income	$ 5,393.96	$ 4,987.84	$ 4,767.62
Estimated profit	$ 2,937.16	$ 2,836.96	$ 920.69

The costs presented for each management practice are standard commercial rates or contractor provided standard per hectare estimates, rather than the cost at trial scale. This way costs are relevant in a commercial farm context.

Note that due to an uncharacteristically poor growing season, sweetcorn yields for the trial were significantly lower than target yield of 22T/ha, which affected the overall profitability of the sweetcorn for all treatments. Additionally, the gross margin analysis includes operational costs only, and does not include other farm costs such farm management, land-lease, labour, rates etc. which are specific to individual businesses.

There was a large gross margin difference between the regenerative treatment and the conventional and hybrid treatments. The cost of compost in the regenerative treatment was very high. This application has been discussed with the operational team which agreed that it was important in setting up the regenerative plots for subsequent crops, so should be viewed as an investment. In financial terms, it might therefore be accounted for over several seasons. There was considerable post-season discussion as to how compost might fit into the system in the future.

Winter Cover Crop Established

Winter cover crops were planted 30th April. Each treatment will be managed differently over the winter, as determined by wider advisory team of processors, growers and consultants. The cover crops established this year, may evolve and change over time depending on subsequent cash crops, and as the knowledge of regenerative cropping builds within the wider advisory group.

Table 14 Winter cover crop considerations and management

Treatment	Approach	Cover Crop	Management Practices	Pros	Cons
Conventional Treatment	Heretaunga Plains typical system	Annual ryegrass (Moata), grazed.	Sweetcorn stubble mulched, aerated, rotary hoed, rolled, planted with 100kg/ha DAP	Growers have a source of income in finishing lambs over the winter. Cashflow Oct-Nov Approximate operational profit is about $1000-1200 per hectare	Environmentally not BMP, risk of N loss, compaction over the winter
Hybrid Treatment	'Cherry picking" Approach	Annual ryegrass, not grazed.	Sweetcorn stubble mulched, aerated, direct drilled with 100kg/ha DAP	Grow biomass over the winter which can then either be sprayed out and direct planted into Reduced N loss Lower risk of compaction	Miss out on additional cashflow in the spring
Regenerative Treatment	Beyond status quo	Oats/vetch /blue lupins, not grazed	Sweetcorn stubble mulched, aerated, direct drilled. Lime/humates applied pre plant + inoculum sprayed on.	Grow biomass over the winter, cover crop mulched and planted into to provide weed control for next crop. Legumes= N fixation Lower risk of compaction	Miss out on additional cashflow in the spring

Looking ahead – Watties Tomatoes

Planning is underway for the next crop, which will be tomatoes grown for Heinz-Watties. The target planting date is 1st November, and target harvest date will be 135 days after planting. Target yield will be approximately 100T/ha paid yield.

Tomatoes are a high input crop and are costly to produce relative to other crops. A meeting with Watties agronomists and wider team is scheduled for mid-June to discuss operational plan for the 2023-2024 season and confirm details of the three treatments. Key considerations are planting methods, weed, pest and disease management, and nutrient management.

Heinz-Watties already uses both full- and strip-cultivation to grow tomatoes. We envisage these alternatives will be the basis of the conventional and hybrid treatment respectively. We have engaged with the live2give group in Palmerston North and arranged to test their mulch-planter prior to the season (Figure 20). It is expected this machine will enable establishment of tomato seedlings into mulched cover crop residue in the regenerative cropping treatment plots.

Figure 20 The Mulch-Tech planter being considered for establishing tomato seedlings in the regenerative treatment

Outreach

LandWISE Conference 2023- Normal Practice Revisited

LandWISE held its annual conference 24th-25th May 2023, hosting 95 delegates from across the country, including keynote speakers from the USA and Australia. Delegates included growers, consultants, scientists, sector leaders, regional council, other industry representatives and high school students.

Key sector leaders present included:

- Chris Smith, FAR
- Antony Heywood, Fresh Vegetables NZ
- Matt Thorn, Horticulture NZ
- Stuart Davis, LeaderBrand Produce Ltd
- Allen Lim, Vegetables NZ
- Daniel Sutton, Vegetables NZ

One of the three key focus areas for the conference was Regenerative Cropping. Presentations included:

- *Carbon Positive- Regenerative cropping for intensive process vegetables* presented by Alex Dickson, presenting a trial overview, project progress to date at the end of year one, some results from the first crop (sweetcorn), and a look ahead to next season.
- *Carbon Positive – Soil Health Indicators* presented by Dan Bloomer, discussing Soil Health Institute Indicators, soil carbon measurements, and baseline results for the Carbon Positive project.
- *Regenerative Cropping – A Global View Kraft-Heinz* presented by Lizzy Wicken discussing changing consumer demands, sustainable farm management practices currently used by growers internationally, and their roadmap forward, including their involvement with the Carbon Positive project.
- *Regenerative Agriculture at McCain Foods* presented by Allan Machakaire on processor strategies from a global and local perspective, work that is being done on McCain farms overseas, core principles being integrated into on farm practice.
- *Regenerative Management Systems for NZ Vegetable Production* presented by Stuart Davis from LeaderBrand on the joint SFFF project between LeaderBrand, Countdown and Plant and Food focused on regenerative vegetable production.
- *Soil organisms as indicators of soil function and fertility* presented by Syrie Hermans from AUT including information on her postdoc research on Environmental DNA in regenerative farming systems, including her involvement in the Carbon Positive project.
- *Mulch Systems in Vegetable Production* presented by Tobias Euerl on his involvement with mulch systems in organic vegetable production in New Zealand and Germany and the Mulch-Tech planter.

Conference 2023 MicroFarm Field Day

Day two of the conference included an afternoon field day at the MicroFarm where delegates were split into small groups to visit four different stations, including a session discussing the Carbon Positive cover crops in field, looking at the management decisions for this year, as well as discussions on how cover crop management might evolve over the coming years. There was also a demonstration of the Mulch-Tech planter. There was a high level of interest from many of the participants on following the trial over the coming years, as well as a desire for more field days, and the opportunity to bring operational and advisory teams to the MicroFarm to look at the project.

Figure 21 LandWISE Conference 2023 Field Day

Planning Ahead: Milestone 5 - Due 1 Oct 2023

Date: 1 Oct 23	**Milestone 5**
Milestone description	Year 2 Planning Completed
STOP / GO	MPI approval of Annual Science Plan
Target Outcome	Scientific knowledge of regenerative agriculture principles and transition.
Activities undertaken	PSG reviews progress and plans, TAG reviews science plans, Year 2 spring process crops established, soil and crop monitoring. On site Field Day. Magazine article and websites updated. Annual Project Plan Year 2 approved. Further activities as per Annual Project Plan and Annual Science Plan.
Deliverables / evidence of completion / achievement of Outcome	MPI approved Annual Science Plan (with milestones). PSG approved Annual Project Plan (with milestones) Year 2 trial site prepared. Trial results, copies of all extension material. Photos of events (preferred but not essential) PSG and TAG meeting minutes. Deliverables as per milestones within Annual Project Plan and Annual Science Plan.
MPI Funding amount	$173,469
Co-Funding contribution	$74,344
Total	$247,813.07

Key actions for Milestone 5 include:

- Planning meeting with Heinz-Watties to determine operational plan for each treatment. Site preparation to begin accordingly.
- TAG to meet and review Year 1 results, and review and deliver Year 2 Annual Science Plan.
- Trial results for Year 1 compiled and delivered.

Appendix 1

Practice	Conventional	Cost/ha	Hybrid	Cost/ha	Regenerative	Cost/ha
Ground work	Aerator	$ 205.00	Aerator	$ 205.00	Aerator	$ 205.00
	Strip Till	$ 180.00	Strip Till	$ 180.00	Strip Till	$ 180.00
	Rotary Hoe	$ 219.00		$ -		$ -
	Planting	$ 260.00	Planting	$ 260.00	Planting	$ 260.00
Seed cost	Seed	$ 600.00	Seed	$ 600.00	Seed	$ 600.00
Base Fert Cost	150kg lime/30kg SP90/10kg Boron	$ 52.80	150kg lime/30kg SP90/10kg Boron	$ 52.80	150kg lime/30kg SP90/10kg Boron	$ 52.80
Spreader Cost	Cart and spread	$ 73.00	Cart and spread	$ 73.00	Cart and spread	$ 73.00
Compost (Product)		$ -		$ -	BioRich Compost at 25m3/ha	$ 1,375.00
Spreader Cost		$ -		$ -	Cart and spread	$ 190.00
Nutrition (Starter)	200kg/ha Cropzeal 20N	$ 241.60	200kg/ha Cropzeal 20N	$ 241.60	150kg/ha Cropzeal 20N	$ 181.20
Seed amendment		$ -			200gm/ha Trichoderma	$ 12.00
Nutrition (AP 1)		$ -		$ -	BioAg Soil and Seed@ 8L/ha +	$ 84.00
					5kg/ha soluble humates	$ 28.75
		$ -		$ -	Application cost	$ 50.00
Nutrition (AP 2)		$ -		$ -	BioAg Root and Shoot 3L/ha	$ 31.50
					Calcinit 20kg/ha	$ 33.20
		$ -		$ -	Application cost	$ 50.00
Nutrition (Side dressing)	250kg Urea/ha	$ 245.00	200kg urea/ha	$ 196.00	100kg Urea/ha	$ 98.00
SD Spreader cost	Application	$ 150.00	Application	$ 150.00	Application	$ 150.00
Post Emerge Herbicide	Arietta 0.2 L/ha (Topramezone)	$ 87.48	Arietta (Topramezone) 0.2 L.ha	$ 87.48	Arietta (Topramezone) 0.2 L/ha	$ 87.48
	Atrazine 3.0L/ha	$ 37.92	Kwickin	$ 12.00	Kwickin	$ 12.00
	Kwickin	$ 12.00		$ -		$ -
Insecticide	Slugbait 10kg/ha	$ 93.00	Slugbait 10kg/ha	$ 93.00	Slugbait 10kg/ha	$ 93.00
Total Spend		$ 2,456.80		$ 2,150.88		$ 3,846.93
Yield	18.86T	$ 5,393.96	17.44T	$ 4,987.84	16.67T	$ 4,767.62
Gross Margin		**$ 2,937.16**		**$ 2,836.96**		**$ 920.69**