NorthlandInc
Growing Northland's Economy
Kia tupu ai te ōhanga o Te Tai Tokerau

# Kaipara Water Demonstration Sites

## 2021/2022 End of Season Report

For Kaipara District Council

Contents

# 1 Executive Summary

This report covers the 2021 to 2022 summer growing season from 1 October 2021 to April 2022. The lead up to the start of the season was unusually wet across the entire region. Rain delayed multiple attempts to start site preparations from mid-September 2021. Part of the agreement with landowners is soil structure must be protected at all times. With the unusually wet conditions getting contractors into either spray out the sites and or apply fertilizer was not an option as this would have compromised the soil structure. At site one this was evident by the tire marks left in the middle of the site as the truck almost got stuck.

Planting finally got underway late November once the grounds had dried out enough to spray, fertilize and then cultivate for planting. In an ideal environment a second spray out would have taken place prior to planting to kill any residual weeds and their seeds that had been brought to the surface with cultivation.

Initial germination across both sites of all the crops was positive. Irrigation equipment issues including teething problems, equipment breakdowns and equipment not supplied caused some delays, reducing the application of water at both sites in the first couple of critical months. These issues were mostly resolved by the end of January 2022. However, some issues remain with the pivot irrigator not holding its primed water pressurization when not in use resulting in the programmed times not applying water.

**Site one** had stock encroachment in late February causing damage to the irrigation lines and some of the crops. Two out of the four crops at this site were successful, however the yields were not as high as expected which is down to site preparation, weeds, and water issues.

Te Roroa volunteers have been amazing in both assisting in planting and the irrigation installation at site one. They also did a crop harvest of watermelon and Kamokamo, distributing these amongst their community.

**Site two** resulted in three of the four crops being successful however the yields were not as high as expected due to compressed timelines in site preparation, weed and water issues. Issues with the pivot irrigator remote connectivity, water pressurization, and GPS issues took some time to work though and resolve. Pressurization issue remains and we are looking for a fix to be in place before the next seasons.

**Key learning** from this season is both sites are prepared in the autumn for optimal weed control in the spring/summer. Planting at key times (weather/climatic conditions dependent) is important and irrigation systems need to be fully commissioned without equipment supply delays at time of planting. Equipment tested, serviced and in full working order prior to planting of crops. Plant one crop across each site not four as this was problematic with each requiring different spray programs and harvesting times

Site one system relies heavily on a labour force to install and uninstall the irrigation. Investigate an alternative less labour-intensive irrigation delivery system.

**Harvested** produce was donated to the community through the Dargaville Food Bank and local Iwi.

# 2 Project Background Context

Council has implemented a project to deliver a proof-of-concept pilot models to demonstrate practical working examples of irrigating high value horticultural crops in the Kaipara. This will inform landowners, external investors and early adopters about high value land and water use, application of innovative technologies and provide confidence to make a commitment to transforming land (horticultural developments) in Kaipara.

Proving the feasibility of different crops is complementary to work with the Northland Regional Council (NRC) on water user demand and is a critical foundation to support future landowner uptake of water from a future community-based water storage scheme (Northland Water Storage & Use Project being delivered by the Te Tai Tokerau Water Trust).

The key outcome of this project, linked to the strategic outcomes of the Kaipara Kai project, is a practical working demonstration model to provide confidence and commitment to land transformation to benefit the community and interested parties by:

- Providing a practical working example of irrigating high value horticulture crops in Kaipara.
- Demonstrating the value of water and ways in which it can be used through infrastructure and technology.
- Creation of interest, and a conversation starter for the Kaipara community and in particular Te Kopuru where the large-scale water storage scheme will be located.
- Providing information and education to landowners with a view to give them confidence in water, crop, and irrigation solutions.
- Providing landowners with an insight into the business case for growing high value crops.
- Sharing site development progress and crop growth progress and types through time lapse video that is available to the public digitally.
- Providing opportunities by arrangement between Council and Licensor for members of the public to visit the Demonstration Sites.
- Providing iwi specific facilitation and support in kai development for iwi to build capacity and capability about horticultural opportunities and site development.
- Establishing Site activities that support the cluster development focus of the Kai Hub.
- Establishing Site activities that support the goals of large water storage project, e.g. demonstrating and proving value of water.
- Sharing information and data with Te Tai Tokerau Water Trust (TTTWT) as useful information the TTTWT project can share with landowners in the proposed Kaipara water storage location.
- Providing annual project analysis, that includes cost/benefit analysis, cropping and market projections, to allow landowners the opportunity to make informed business decisions in the future.

# 3 Project Services

Northland Inc (NI) is providing the necessary personnel, expertise, oversight, and management for the delivery of Kaipara District Council's two Kai Water Demonstration Sites:

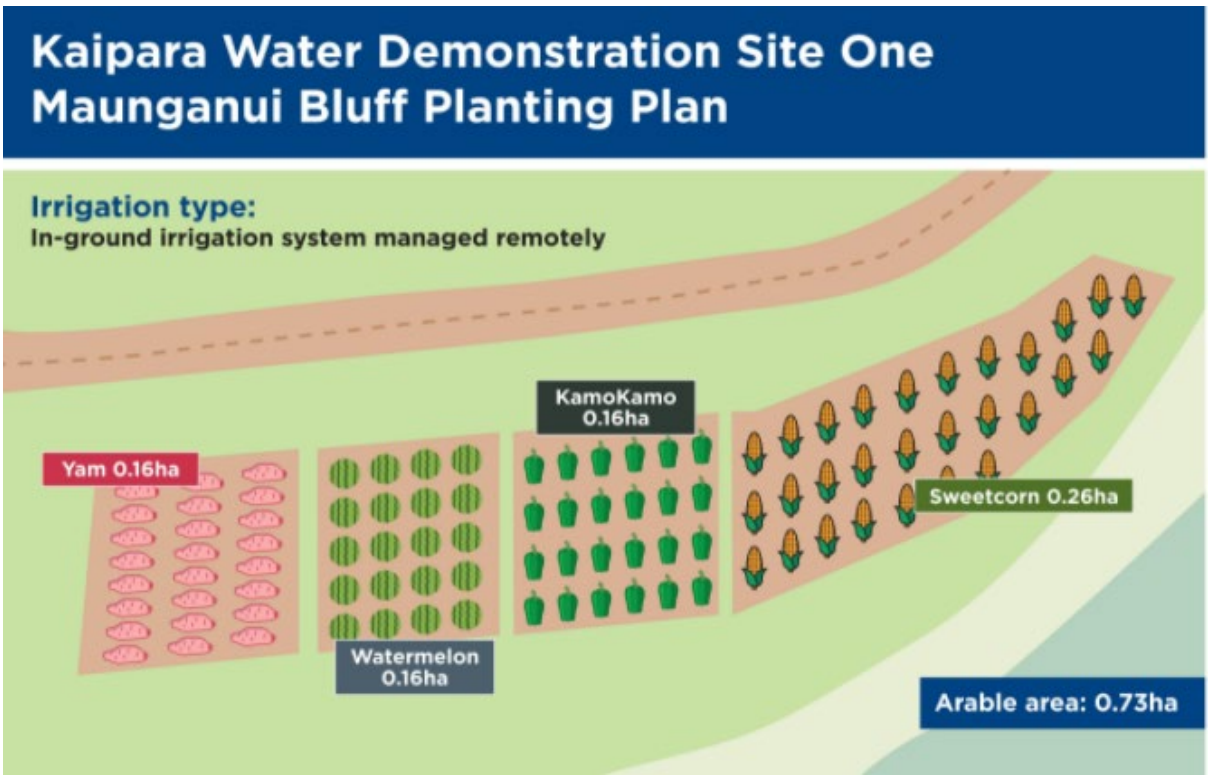
- Site 1 – Maunganui Bluff (Te Roroa property)
- Site 2 – Te Kopuru (Rope property)

# 4 Site 1 – Maunganui Bluff (Te Roroa property)

Property located at Aranga Coast Road, Maunganui Bluff

GPS: -35.76943902530477, 173.60145336879313

Site arable area 0.73ha




## 4.1 Season Overview

The start of the season was unusually wet this year, causing delays for site preparation, cultivation, and planting. These activities were delayed until conditions were suitable to ensure the best chance of crops survival whilst preserving soil structure and minimizing damage to the land *(photo 1)*

At cultivation it was discovered there is a natural spring in the middle of the site. *(photo 2)* The area was too wet to be cultivated through the horizontal center, therefore reducing the area that was able to be planted. Once the land had dried out the soil was like concrete.

*photo 1 – wheel gouges*

*photo 2 – natural spring*

Planting day was delayed from the planned 1 November until 26 November 2021. Each of the 4 crops were planted by hand with support from 29 volunteers from Te Roroa *(photo's 3 & 4*). Planting was completed within a couple of hours.

*photo 3 - planting yams*

*photo 4 - finished planting 4 crops.*

Germination was looking good before the temperatures started to increase and the lack of rain fall as the irrigation system was not commissioned.

## 4.2 Crops

| Crop | Plant | Duration in days | Harvest |
|---|---|---|---|
| Watermelon | 26 November 2021 | 85 | Mid February 2022 |
| Kamokamo | 26 November 2021 | 119 | Mid March 2022 |
| Sweetcorn | 26 October 2021 | 110 | Mid March 2022 |
| Yam | 26 October 2021 | 140 | Mid April 2022 |

### 4.2.1 Watermelon *Citrullus lanatus* (Sea breeze)

Watermelon seed was planted by hand. Watermelon performed well across the site even though at the lowest part of the site irrigation was not commissioned until end of January.

30 Watermelon harvested 3 March. Water volume 176m$^3$ with a 2 day frequency.

**Learnings:** Initial fruit were unevenly shaped which can be caused by poor pollination or poor irrigation. The shape of fruit seem to improve as the season progressed possibly due to improved irrigation and reduced pollen competition.
Watermelon are pollinated by insects. Beehives were observed in a paddock of Manuka *Leptospernum scoparium* to the west of site. Manuka pollen maybe more desirable to bees than watermelon and this affected the pollination and therefore the shape of the fruit.

There was no observable pest pressure, so no agrichemicals were applied to the plants. This reduces the inputs into the crop.

There are very few herbicides registered for use over watermelon so effective pre-emergent weed control is important at the beginning of the season to reduce the weed pressure throughout.

Some commercial growers do use polythene mulch to warm soil and suppress weeds and while this would have improved yield it is cost prohibitive for this project at around $10k for the machinery.

Plants were still flowering into late March and there was still fruit development.

Regular harvesting, every couple of days, is required as this prevents fruit lose to rot and splitting. Unfortunately, there was not the labour available to do this during this project.

Fruit harvested had good water content, texture, and flavour. Average size about 3kg.

Weed pressure caused by Black Nightshade *Solanum nigrum*, and Inkweed *Phytolacca octandra*.

### *4.2.2* Yam *(Oxalis tuberosa)*

Yams were planted by hand. Yams very slow to start off after planting partly due to planting delays of 4 weeks which is at the end of optimum planting window, having the yam tubers in stock for an earlier planting, commissioning of the irrigation system and application of water. Weed suppression was a major issue with additional spraying taking place. The yams appeared to be doing OK in January and February even though the growth was somewhat slow. Early March the entire crop had failed and on review of the soil probes the soil temperatures peaking at 33.5 degrees and an exposed site have all contributed.

**Learning:** Soil temperatures this season were at the higher end of recommendations for optimum yam growth along with a delayed planting seasons and irrigation installation. Sourcing varieties regularly grown in the Hawkes Bay may mitigate this as they may be more resilient to these higher soil temperatures. Or grow as an understory crop or in a cooler microclimate within the region.
Limited growing information available in New Zealand and no spray programs available for weed control even after reaching out to Agronomists.

### 4.2.3 Sweetcorn *Zea mays* (Buffalo)

Planting was a combination of a manual single row planter and hand planting. The later produced varying results due to depth and spacing by the volunteers. The corn was performing well for the first couple of months. The crop became infested by Tropical Army Worm in February which destroyed the crop. (photo right) The only way to treat Tropical Army Worm in corn is aerial spray (plane or helicopter). Another contributing factor was the lack of water due to commissioning of the t-tape in this section on 1 February. At least 3 weeks later than initially planned.

**Learning:** Install Irrigation straight after planting. Not suitable to small scale as aerial spraying required to combat pests once plants are established and too high.
Greatest requirement for water for Sweetcorn is in January.

Discussion with Agronomists, contractors and growers indicated that the season had been particularly challenging in terms of weed and pest pressure. Pest control in sweetcorn/maize once they become established is applied via helicopter. Budget did not allow for this.

It could not have been applied by manual means as the target area is at face height and presented a significant Health and Safety risk.

Inkweed is a host to armyworm and there was a significant quantity of inkweed on site last year which was not sprayed out just dug in therefore easily re-established itself this year despite pre-emergent weed-control.

Bio-control could have been applied but due to unavailability of contractors we missed the window to apply.

Cob development is dependent on good pollination so when examining the cobs there were a significant number of unpollinated or badly pollinated cobs. Each individual kernel must be pollinated. Kernels that don't receive pollen will not fill out. Pollen from the male tassels must reach the female silks. There are several reasons this may not happen. But the reasons that directly effect this crop are, hot weather and high winds during pollination. Flowering began on or around the 20th January. Targeted Sweetcorn irrigation was not available until the 26th January. Plants would have been under stress at flowering.

### 4.2.4 Kamokamo *Cucurbita pepo*

Kamokamo was planted by hand. This crop has performed the best with great results.

Mature fruit stores well. First fruit harvested 20 January, a strip harvest 3 March with last 23 March, although there were still flowers on the plants. Growth type helped smother weeds initially.
Pollinated well by honeybees, bumble bees and other insects.

An initial protectant insecticide with residual properties was applied shortly after planting, but no further insecticides were required.

Powdery mildew showed up after humid weather mid-February, but plants grew through this and continued to grow so no fungicide was applied.

**Learnings:** A successful crop.
Several products can be harvested, flowers, growing tips, small fruit, and mature fruit. These can all be harvested and eaten.

## 4.3 Irrigation System

1 December 2021 planned installation of the drip tape across the site didn't go according to plan as it was discovered fittings to connect the t-tape to the system, staples to secure to the ground were not supplied in the container on site and the controller unit was faulty. The fittings had to be ordered from Australia and a new controller unit ordered causing further delays.

The controller unit had to have a solar panel fitted to it as the batteries kept going flat. The unit was not communicating remotely and turning the water on as programmed, the solar panel was fitted in mid-January 2022.

Equipment was not supplied (jenny) to enable easy rollout of the t-tape rolls across the site. A small section, one water outlet (hydrant) was manually installed, this took 2 people 3 hours. Estimate based on this would take upwards of 3 days to install. This was just prior to Christmas making it impossible to hire in labour, or volunteers.

To save the planted crops from drying out and complete crop failure, the site was flood irrigated. Flooding the site used approximately 1,500,000$m^3$ of water, not the best utilization of water for cropping.

Over 3 days volunteers from Te Roroa installed the t-tape, using a jenny (t-tape roll fitted on and spun) supplied by Think Water. The irrigation system was commissioned 28 January 2022 and working as intended apart from one section being the Kamokamo which was doing well. Each hydrant was programmed to apply water as required.

This type of irrigation is very labour intensive to
a) install
b) uninstall

Installation took 120 hours of labour. Labour hire rates equates to $3,240 +gst. Estimated to be the same cost to uninstall making this system expensive at over $6,000 in labour for landowners per season. Unless there is machinery to remove the high labour inputs to make it more cost effective.

## 4.4 Pest control

Sites were monitored weekly with a thorough walk through and a hands-on examination of plants. This became more difficult as the weed pressure increased but was still conducted. There were no pests observed or required controlling on the Watermelon and Kamokamo. Lepidoptera spp. were observed on the sweetcorn but unfortunately due to timing and availability of appropriate spray equipment they were unable to be controlled by chemical means. There also seems to be a lack of natural predators.

Lavron a broad-spectrum insecticide with residual properties was applied to the Yams, Kamokamo and Sweetcorn shortly after the seeds were sown.

This was at times hindered by the weed pressure as shown in the Beetroot and Soy

## 4.5 Weed control

This season had unusually wet conditions in the lead up, the site did not have the desired spray out in autumn prior to the winter grass being planted prior to Northland Inc taking over the site management, which exacerbated the weed issues seen this season. Even after pre-emergent spray applied after planting. Care must be taken in chemical selection for weed control for each crop and needs to be on-label as crops are donated as food.

| Date | Application | Chemical and rates | Crops |
|---|---|---|---|
| 4 Nov 2021 | Weed Control/Site preparation | Glyphosate 5L/ha<br>Oil 1L/ha<br>Water Rate 200L/ha | |
| 30 Nov 2021 | Pre-emergent | Corral 7L/ha<br>Water Rate 300L/ha | Yams<br>Kamokamo<br>Sweetcorn |
| 30 Nov 2021 | Insecticide | Larvon 40ml/ha<br>Oil 1L/Ha<br>Water Rate 400l/Ha | Yams<br>Kamokamo<br>Sweetcorn |
| 14 Jan 2022 | Herbicide | Cletho 1L/ha<br>Oil 1L/ha<br>Water Rate 400L/ha | Watermelon<br>Kamokamo |
| 14 Jan 2022 | Herbicide | Clout 3L/Ha<br>Oil 1L/Ha<br>Water Rate 400L/ha | Yams |
| 14 Jan 2022 | Herbicide | Lavron 40ml/ha<br>Oil 1L/Ha<br>Water Rate 400l/Ha | Sweetcorn |

## 4.6 Fertilizer management

Base fertilizer as below was applied to the site prior to planting.

Base fertilizer : superten =4.5 tonne/ha

| Crop | Product | Application time/Rate | Comments |
|---|---|---|---|
| 1. Yam Oxalis | 8-11-20 – Banded at planting/ mix it in soil /Seed bed | 200kg/hac<br>Plot size 0.16ha | Not enough data on it so treating as Kumara but at a lower rate of fertilizer requirements |
| | CAN – 100kg/hac | Only if req (tuber formation) | *Not applied as tubers never formed* |
| | | | |

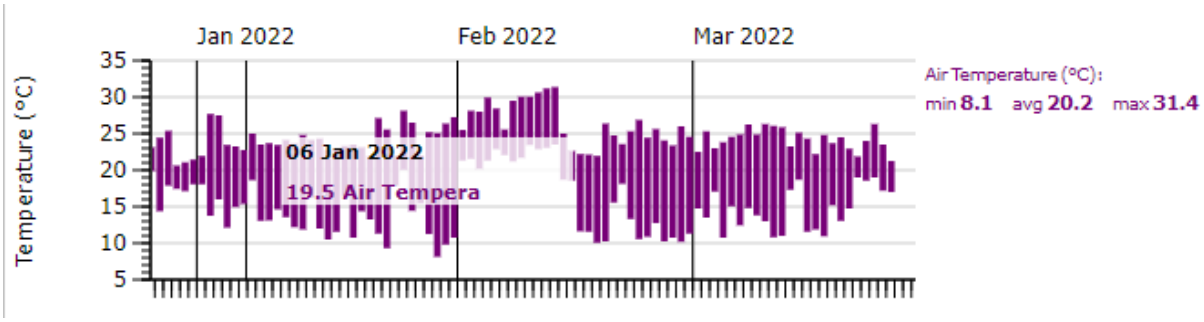
| Crop | Product | Application time/Rate | Comments |
|---|---|---|---|
| 2. Watermelon | Complex or equivalent | 800kg/hac – Banded and Planting<br>Plot size 0.16ha | Foliar sprays for trace-elements only if required *Not required.* |
| | | | |
| | | | |

| Crop | Product | Application time/Rate | Comments |
|---|---|---|---|
| 3. Kamokamo | Complex or equivalent | 600kg/hac – Banded and Planting<br>Plot size 0.16ha | Treating it as Squash crop |
| | | | |
| | | | |

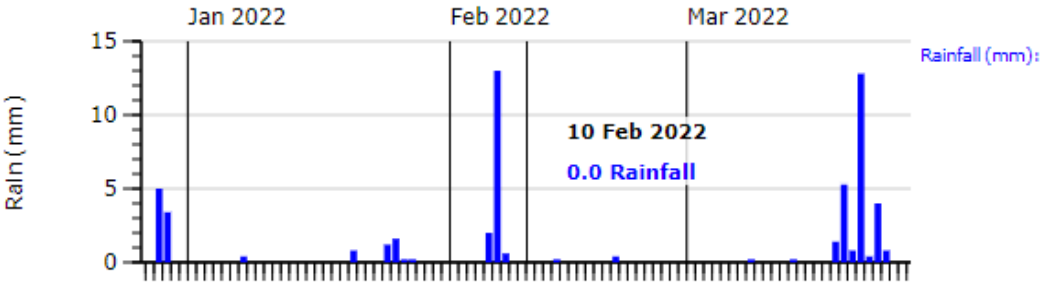
| Crop | Product | Application time/Rate | Comments |
|---|---|---|---|
| 4. Sweet Corn/Māori corn | MOP+Kieserite | 500kg/hac as Base dressing<br>Plot size 0.5ha | Treating Sweet corn and Māori Corn as same, not enough information on Mauri Corn |
| | DAP | 250kg/ha – banded at planting | |
| | Sustain or equivalent | 200kg/hac – side dressing | |

## 4.7 Monitoring System – Harvest

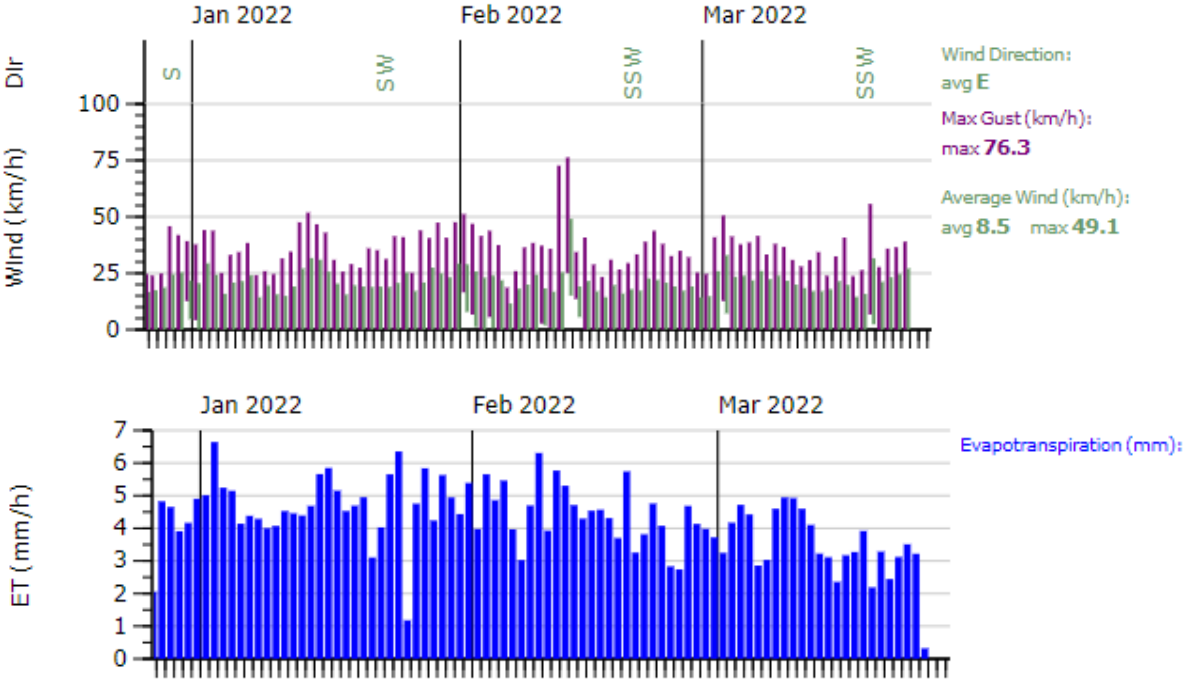
The site has a Harvest monitoring station attached to the top of the container and soil probes across the site. This measures air temperature, Rain, Wind, ET (evapotranspiration), soil moisture and soil temperature

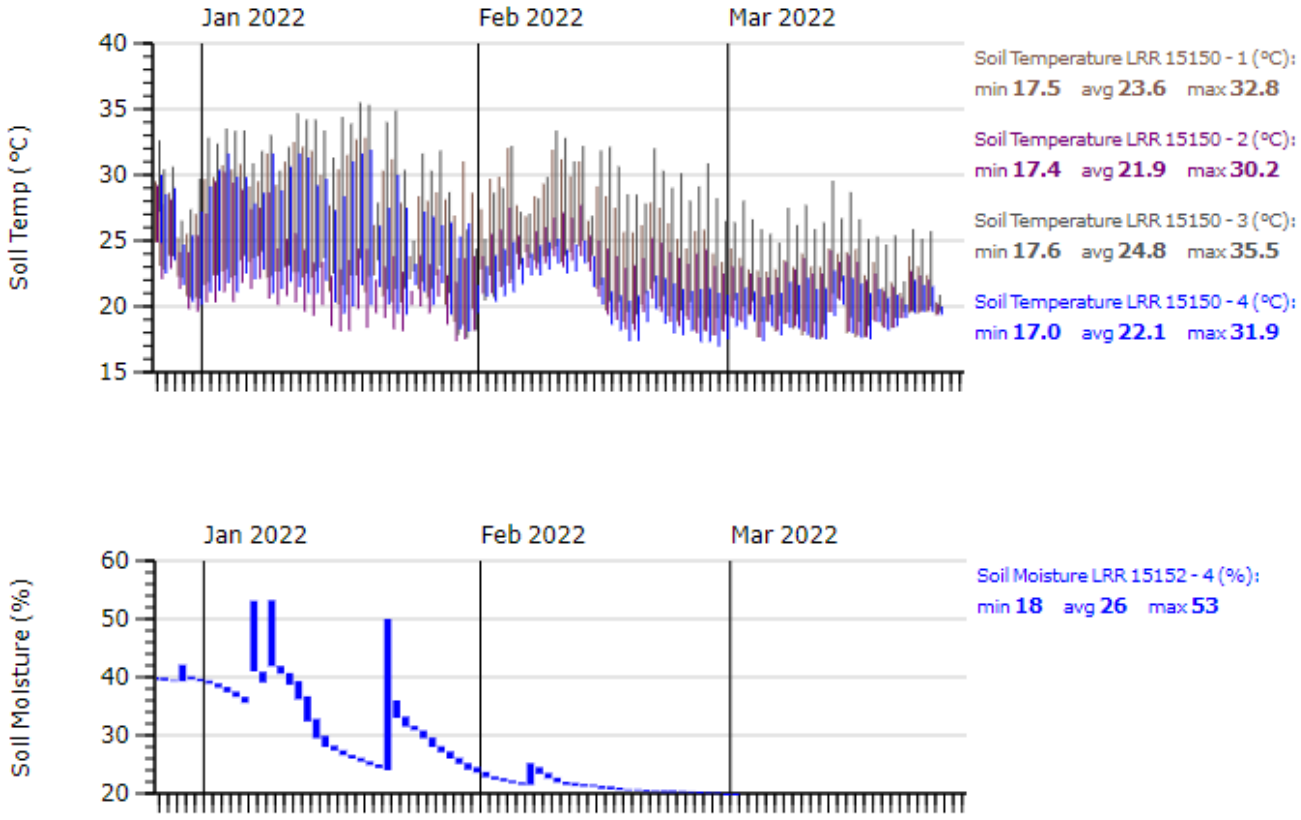



Above graph is the minimum and maximum air temperature recorded each day




Above graph shows rainfall over 3 months. Very little rain at this site over the summer






Above graph shows the results of flood irrigation applied in January.

## 4.8 Irrigation management

Regular monitoring using remote monitoring equipment and site visits to determine application of irrigation. The irrigation system and plant not being fully operational until late January 2022.

376m$^3$ of water was applied across the site in February. Highlighted numbers indicated water leaks in the t-tape and after cattle had been in the site in late February this was also shown in the high volume of water used as they had pulled some connectors apart.

Records of water application from 1 February 2022

| Date | Yam | Watermelon | Kamokamo | Corn | Grand Total |
|---|---|---|---|---|---|
| 1/02/2022 | 0.0 | | | | 0.0 |
| 10/02/2022 | | 19.2 | | 13.4 | 32.6 |
| 11/02/2022 | | | 3.5 | 0.0 | 3.5 |
| 12/02/2022 | | 32.4 | | | 32.4 |
| 13/02/2022 | 9.4 | | | 13.5 | 22.9 |
| 14/02/2022 | | 8.7 | 0.0 | 8.1 | 16.8 |
| 15/02/2022 | 9.2 | | | | 9.2 |
| 16/02/2022 | | 32.3 | | 13.5 | 45.9 |
| 17/02/2022 | 0.1 | | 2.1 | 2.1 | 4.3 |
| 19/02/2022 | 9.5 | | | | 9.5 |
| 20/02/2022 | | 14.7 | 6.9 | 14.8 | 36.4 |
| 21/02/2022 | 9.4 | | | | 9.4 |
| 22/02/2022 | | 32.2 | | 13.6 | 45.8 |
| 23/02/2022 | 0.0 | | 2.1 | 2.1 | 4.2 |
| 24/02/2022 | | 13.9 | | | 13.9 |
| 25/02/2022 | 9.5 | | | 13.6 | 23.1 |
| 26/02/2022 | | 14.3 | 5.5 | 14.3 | 34.1 |
| 27/02/2022 | 9.2 | | | | 9.2 |
| 28/02/2022 | | 9.0 | | 13.9 | 22.9 |
| 1/03/2022 | 16.0 | | 17.6 | 2.1 | 35.8 |
| 2/03/2022 | | 46.0 | | | 46.0 |
| 4/03/2022 | | | 2.6 | | 2.6 |
| 6/03/2022 | | 2.9 | | | 2.9 |
| 8/03/2022 | | | 2.8 | | 2.8 |
| 10/03/2022 | | 2.6 | | | 2.6 |
| **Grand Total** | **72.265** | **228.171** | **43.124** | **125.079** | **468.639** |

Table above shows volume of water used in cubic meters per crop. $1m^3$ = 1,000 liters

## 4.9 Crop Learnings

The season had an extremely wet lead in. Ground conditions were that contractors were unable to access sites to spray out and cultivate. Each time ground conditions allowed another wet front came across the region again delaying progress. The climatic conditions delayed site preparations and planting by 6 weeks pushing planting to late November 2021. Below are some of the issues that contribution so some of the crops not performing as expected.

- Unusual weed pressure and pest pressure has affected farmers and growers throughout the region this season.
- Delay in planting due to wet weather and inability to get machinery onto the sites.
- Difficulty in establishing appropriate seedbeds because of the wet soils and the contractual obligation not to damage the land-owners soil.
- Lack of information available as to the irrigation system supplied at Site 1.
- Supplier of Irrigator for Site 2 being based in the Hawkes Bay meant that they were unable to visit site during Covid lockdowns.
- Difficulty in accessing both irrigation systems remotely.
- Delay in establishing reliable irrigation system due to parts not being supplied and having to be sourced from overseas in the immediate lead up to the Christmas break and the delays in freighting due to Covid-19.
- Inability to source appropriate machinery to sow beetroot seed. Delayed the sowing.
- Difficulty accessing technical advice from Rural Suppliers and reluctance from advisors to advise any off-label options.
- planting 4 crops at each site meant chemical management for sprays was difficult due to registration of products across different crops.
- Isolation of site 1 some crop stolen reducing yield by an unknown amount.
- Yams site selection.

- Delay in planting yam tubers resulted in deterioration of tubers.
- Site preparation
- Time taken to install irrigation at Site 1.

## 4.10 Site Learnings:

Plant one crop per site that can be planted by machinery and being able to treat with on-label chemical management.

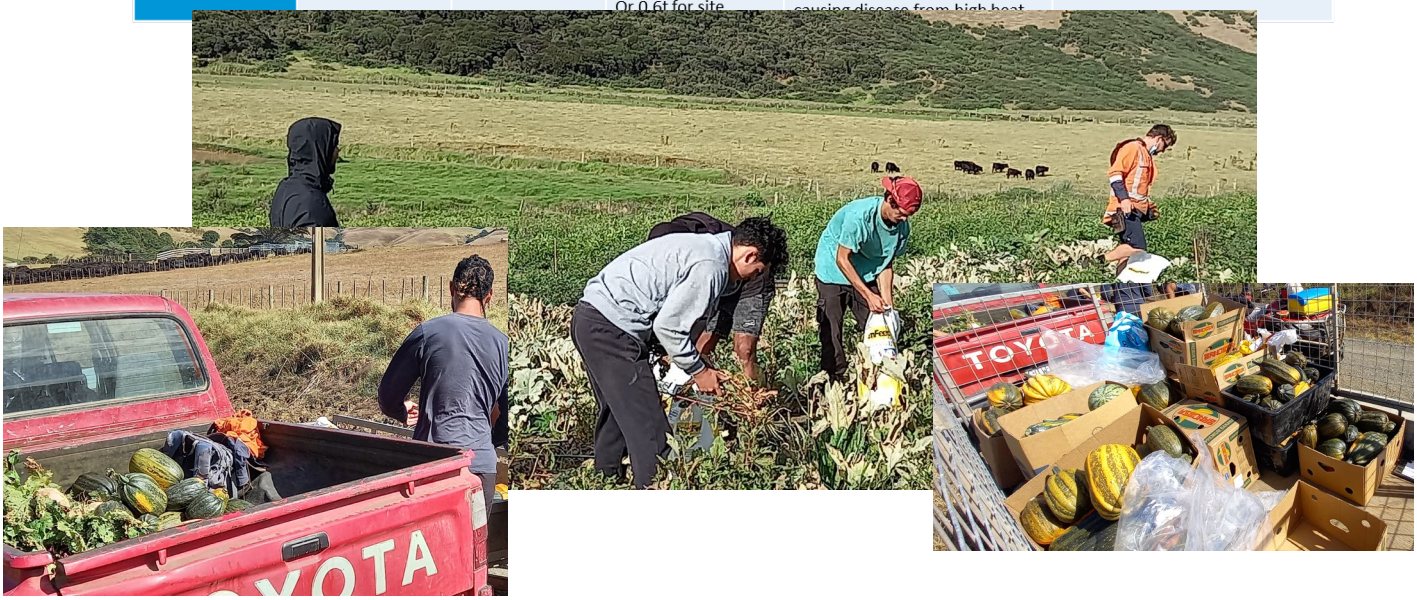
Prepare each site starting in Autumn with a winter cover crop. Have a second crop plan in case there is another delayed season.

Have a control area per crop that is not irrigated for enhanced data collection and comparisons.

## 4.11 Harvest

Volunteers from Te Roroa did one final harvest of the site. Table below shows yields achieved for the season compared to expected documented yields

| Crop | Plot size | Forecasted & Actual Yield | Expected Yield | Comment | Harvest period |
|---|---|---|---|---|---|
| Watermelon | 0.16ha | 1.03t/ha<br><br>0.165t harvested | 15 t/ha<br><br>Or 2.4t for site | May have been higher if season conditions had allowed and less theft | March |
| Kamokamo | 0.14ha | 7.2t/ha<br><br>1.01t harvested | 15 t/ha<br><br>Or 1.5t for site | May have been higher if season conditions had allowed and less theft | Feb-March |
| Sweetcorn | 0.23ha | 0 | 12 t/ha<br><br>Or 2.8t for site | Initial establishment good, armyworm in cobs & lack of pollination contributed to failure | March |
| Yam | 0.12ha | 0 | 5 t/ha<br><br>Or 0.6t for site | Weed control with limited options, to hot for variety causing disease from high heat | Late March – early April |

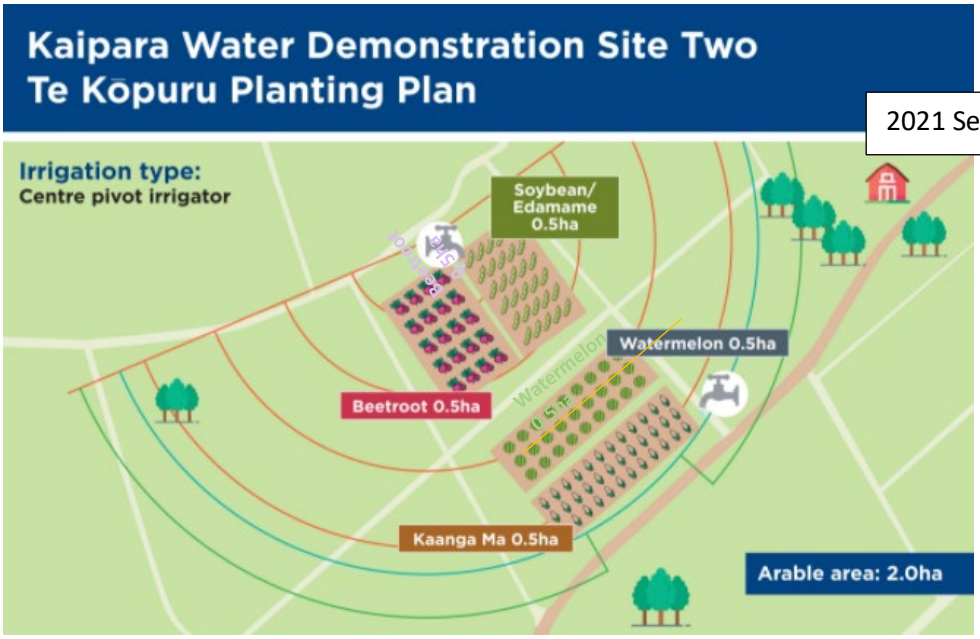


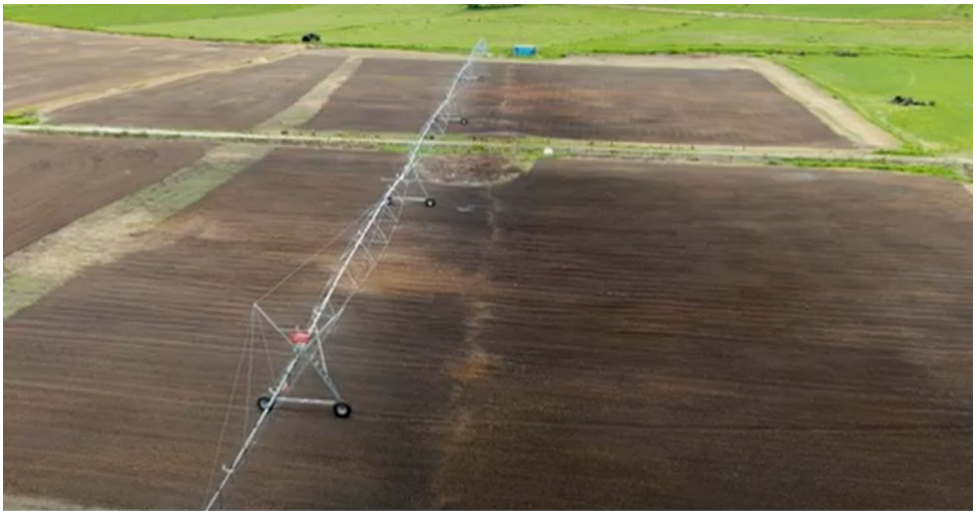
# 5 Site 2 – Te Kopuru (Rope property)

Property located at Turkey Flat Road, Te Kopuru

GPS: -36.040156370622654, 173.91661625881736

Site arable area 2.0 ha



## 5.1 Season Overview

The start of the season was unusually wet this year, causing delays for site preparation, cultivation, and planting. These activities were delayed until conditions were suitable to ensure the best chance of crops survival.

Site preparations was limited form when Northland Inc took over the contract for the site. This hindered the usual site preparation that would normally have started on Autumn with spraying out and planting a cover crop to reduce weeds in the spring.

The site came fresh out of pasture with one spray then cultivation. A base dressing was applied based on recommendations from soil sampling tests conducted earlier.

Soy, Watermelon and Kaanga Ma were planted using a maize drill which also applied a starter fertilizer through the tubes with the seeds. One row of Kaanga Ma seedlings were planted by hand as the field day was cancelled due to C-19.

Beetroot being a very small seed was planted in two methods. First was using a single row manual planter and the second was broadcasting. Broadcasting is where you throw/spread it on the ground by hand. The later method did not work on this site.

The pivot irrigator was problematic to begin with. Not maintaining its pressurization, multiple alignment faults, jamming against one of the hard barriers and falling into a small drain (the last one) that was not covered when the initial drain works were done.

## 5.2 Crops

| Crop | Plant | Duration in days | Harvest |
|---|---|---|---|
| Soybean/Edamame | 24 November 2021 | 75 | Early February 2022 |
| Beetroot | 24 November 2021 | 70 | Early February 2022 |
| Watermelon | 24 November 2021 | 85 | Mid February 2022 |
| Kaanga Ma | 24 November 2021 | 110 | Mid March 2022 |

### 5.2.1 Soybean/Edamame *Glycine max* (Sonya)

Weed control vital for the success of the crop.

High pest pressure. When speaking to an entomologist at Plant and Food Research he commented that in trials they had done in Tapora soybean had the highest pest pressure from Green Vegetable Bug *Nezara viridula* and both mature and juvenile forms were still present in numbers at the end of March

Crop description indicated height of plant 60-75cm. The plants on site 2 did not reach this height only achieving about 40-50cm. There was good pod production on plants, averaging about 10 pods per plant, and 3-4 seeds per pod. Unfortunately, many of the plants succumbed to the weed pressure

There was no indication of disease pressure but obvious signs of GVB.

The most important times for soy to have adequate irrigation are at pod development and at pod fill. These are the stages when water stress can lead to a significant decrease in yield. Irrigation also may be required prior to these stages on sandy soils (insufficient water-holding capacity) or during very low rainfall years on medium- and fine-textured soils. However, if water is applied during flowering, it is important to follow with adequate water during seed fill. Irrigation at flowering typically increases the number of seeds produced per plant, but any subsequent water stress will reduce the size of those seeds such that the yield response to an irrigation at flowering may be no more or even less than not irrigating at flowering. Due to the issues experienced with the irrigator at critical times this had an impact on yield.

The second area we planted was not successful at all. This was only planted due to running out of watermelon seed and having an excess of soybean seeds.

**Learnings:** Earlier seed bed preparation. Irrigation is applied at critical times. A robust spray program to protect the crop from the high pest pressures faced this season. Soil type is important to the success of soy which failed completely in a second area that was planted

### 5.2.2 Beetroot *Beta vulgaris* Libero

No machinery in the region suitable for sowing the seed mechanically.

The contractor applied the side dressing on fertiliser on the site, so this created ‘sowing lines’ A manual seeder was used to sow following these lines for 1/3 of the site. This was successful. The second sowing a week later was sown using a Solo fertiliser/ seed spreader. This broadcast the seed over the rest of the site until we ran out of seed.

Germination was successful and plants grew well but again weed pressure was extensive in this site kikuyu *Pennisetum clandestinum* was a significant competitor and smothered the plants reducing yield. Black Nightshade *Solanum nigrum* and other dicotyledonous plants did not affect crop yield as much although there would have been competition for nutrients and water, they seemed to shade the plants and reduce sun stress.

There was damage from caterpillars on the crop although none were seen it was probably armyworm *Spodoptera litura*. Scale was also seen on some of the roots when harvested. The size of the roots was good with the ability to pick ‘baby beets and larger.

Weed control would have made harvesting easier and increased yield.

A local grower who had grown beetroot on land further down the Pouto peninsula commented on the importance of contract growing to ensure there is a buyer before

growing the crop. It is a crop that is easy to grow and as a result does not command a high price.

**Learnings:** Earlier seed bed preparation with weed and pest controls at the right times. Not a high return crop. A contract with a processor is important to ensure there is a buyer for the crop at harvest. Still grew well under Black Nightshade but could not compete with Kikuyu. Can be sold as fresh vegetable or as a processor crop.

No appropriate machinery to sow beetroot in the area, was planted using a manual seeder. For planted rows, a 'Kumara Top chopper' could have been used to reduce weed foliage, allowing for easier manual harvest.

Inkweed is a host to armyworm and there was a significant quantity of inkweed on site which fed on the root (bulb) of the beetroot.

### 5.2.3 Watermelon *Citrullus lanatus* (Sea breeze)

Germination was good and plants established themselves well. There was no observable pest pressure, so no chemicals were applied to the plants.

There are very few herbicides registered for use over watermelon so effective pre-emergent weed control is required at the beginning of the season to reduce the weed pressure throughout.

Some commercial growers use polythene mulch, but this is cost prohibitive for this project at around $10k for the machinery alone not including the mulch film.

There seemed to be variation in the soil structure over the area used for the watermelon and this had an impact on the number of watermelons produced.

Plants were still flowering into late March and there was still fruit development although this had slowed.

Regular harvesting, every couple of days is required to prevent fruit splitting then rotting. Unfortunately, the labour was not available to do this during this project.

Weed control was an issue and potentially reduced crop harvest by competing for nutrition and water. Harvest was improved by using a weed eater to top the weeds over crop. This made it much easier to locate fruit and prevented them being damaged by being stood on.

Fruit shape was better than Site 1. Had good water content. Texture and flavour. Average size 3kg.

Final large harvest 28 March 2022

**Learnings:** Earlier seed bed preparation at the beginning of the season. Irrigation system working as intended. If watermelon were to be considered as a crop for next year, beehives on site or close by would enhance pollination. Low input crop as no insect or disease control was required however weed control is important.

### 5.2.4 Kaanga (Māori corn) (*Zea mays*)

Initial establishment post germination was good.

100 seeds were germinated in pots and hand planted beside in a row beside the seeds. There was no long-term advantage. The seeds were planted in pots for the public planting but as cancelled due to C-19 lockdowns, the team just planted them.

No signs of fungal issues. Slugs were controlled with slug bait applied at germination. Unable to spray for armyworm as the target area was at face height.

Cob development is dependent on good pollination, when examining the cobs there were a significant number of unpollinated or badly pollinated cobs. Each individual kernel must be pollinated so kernels that don't receive pollen will not fill out. Pollen from the male tassels must reach the female silks. There are several reasons this may not happen. But the reasons that directly effect this crop were;

- Hot weather and
- high winds during pollination.

Greatest requirement for water for Sweetcorn is in January. Insufficient soil moisture to keep corn evenly moist. Corn is shallow rooted so would not have been able to access the water table when we were unable to irrigate.

Flowering began on or around the 20 January 2022. There only appeared to be one cob per plant reducing expected yield.

**Learnings:** Earlier seed bed preparation would have allowed better weed suppression. Larger site area would have reduced the wind damage that occurred at the end of cob formation.
Discussion with Agronomists, contractors and growers indicated that the season had been particularly challenging in terms of weed and pest pressure. Pest control in sweetcorn/maize once they become established is applied via helicopter.

Inkweed is a host to armyworm and there was a significant quantity of inkweed on site. Armyworm spp. and Vegetable Bug were both present. No signs of fungal issues. Slugs were controlled with slug bait applied at germination.

## 5.3 Irrigation Systems

The pivot irrigation system has a span of 242 meters which is programmed and controlled remotely. The season experienced some technical issues which did delay application of water on occasion through December and January. Each time the issues happened did required a site visit to manually reset the system. Once the irrigation company replaced some components in January this resolved the main issue of the system loosing it's GPS positioning. Another issue that required site visit to reset was the system not maintaining its water pressure when it was shut down. A fix is due to be installed prior to the next season.

## 5.4 Pest Control

Sites were monitored weekly with a thorough walk through and a hands-on examination of plants. This became more difficult as the weed pressure increased but was still conducted. There were no pests observed or required controlling on the Watermelon

## 5.5 Weed Control

This season had unusually wet conditions in the lead up, the site did not have the desired spray out in autumn prior to the winter grass being planted prior to Northland Inc taking over the site management, which exacerbated the weed issues seen this season. Even after pre-emergent spray applied after planting. Care must be taken in chemical selection for weed control for each crop and needs to be on-label as crops are donated as food.

Weed control applied using an approved licensed contractor and or manual hand weeding.



## 5.6 Fertilizer management

Initial soil tests were conducted on site and the results sent to Fertilizer company Agronomist for analysis and a fertilizer application. This was followed as per recommendations.

Lime 2 tonne/hac
Base Fert: Superten 10k = 1.2tonnes/ha

| Crop | Product | Application time/Rate | Comments |
|---|---|---|---|
| 1.Soybean/Edamame | Complex | 800kg/hac- Seedbed/mix in soil Plot size 0.5ha | |
| | CAN | 250kg/hac- side dressing | |
| | CAN | 150kg/hac – side dressing only if req | |

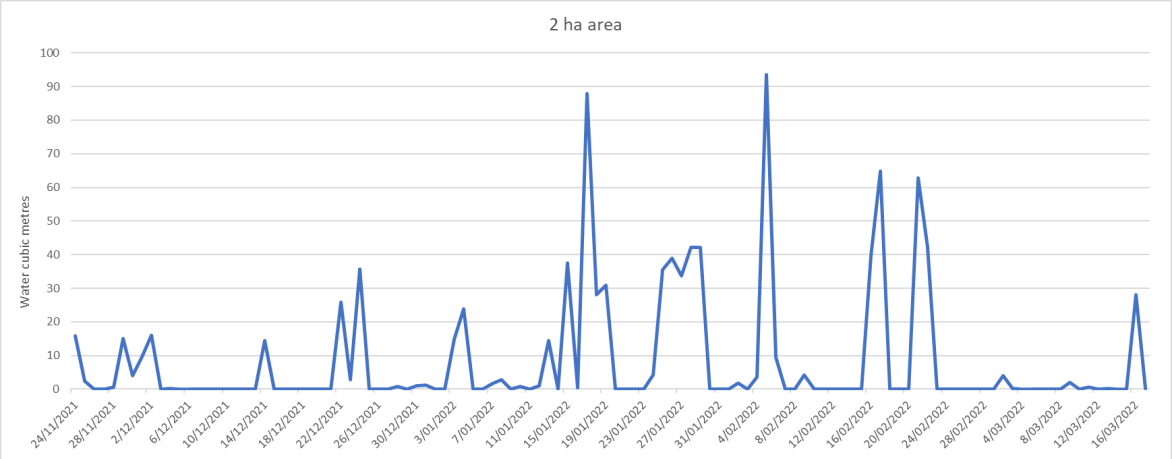
| Crop | Product | Application time/Rate | Comments |
|---|---|---|---|
| 2.Beetroot | Complex | 500kg/hac- Seedbed/mix in soil Plot Size 0.5ha | |
| | CAN | 250kg/hac- side dressing | 2 leaf stage |
| | CAN | 250kg/hac – side dressing only if req | 4 leaf stage Not required |

| Crop | Product | Application time/Rate | Comments |
|---|---|---|---|
| 3.Sweet Corn/Māori corn | MOP+Kieserite | 500kg/hac as Base dressing Plot size 0.5ha | Treating Sweet corn and Māori Corn as same, not enough information on Mauri Corn |
| | DAP | 250kg/ha – banded at planting | |
| | Sustain or equivalent | 200kg/hac – side dressing | |

| Crop | Product | Application time/Rate | Comments |
|---|---|---|---|
| 4.Watermelon | Complex or equivalent | 800kg/hac – Banded and Planting Plot size 0.16ha | Foliar sprays for trace-elements only if required. Not required |

## 5.7 Irrigation management

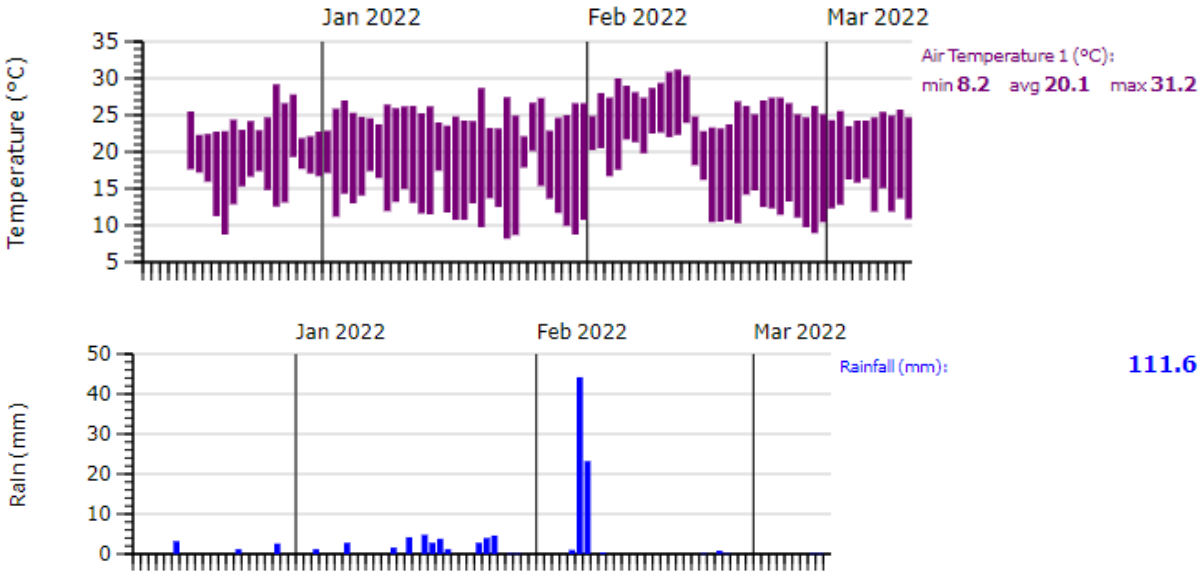
Regular monitoring using remote monitoring equipment and site visits to determine application of irrigation.

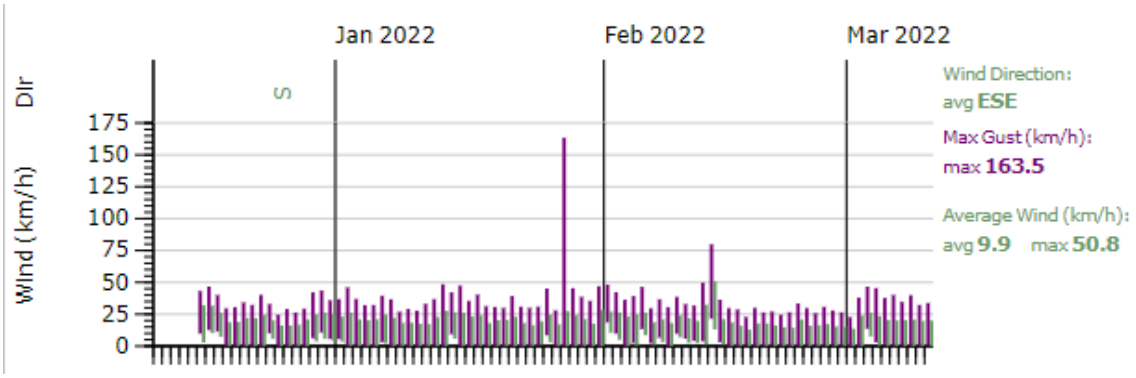


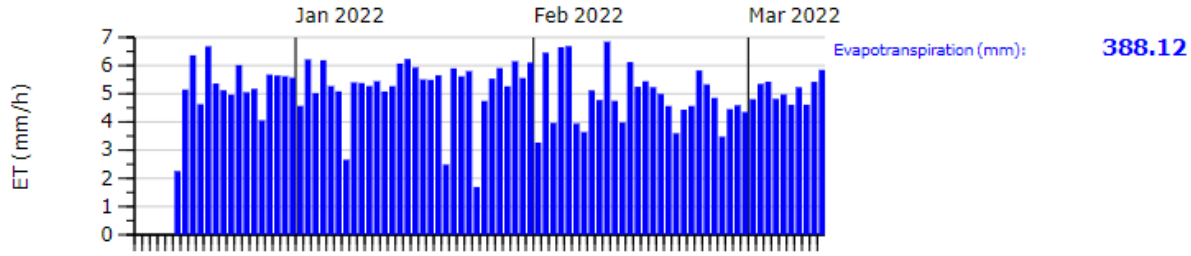

*Above graph is calculated by irrigator maximum throughput by running time not application*

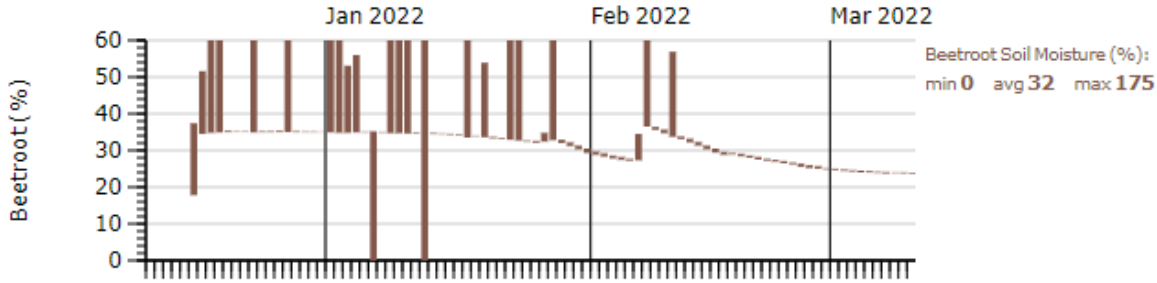
## 5.8 Monitoring System - Harvest

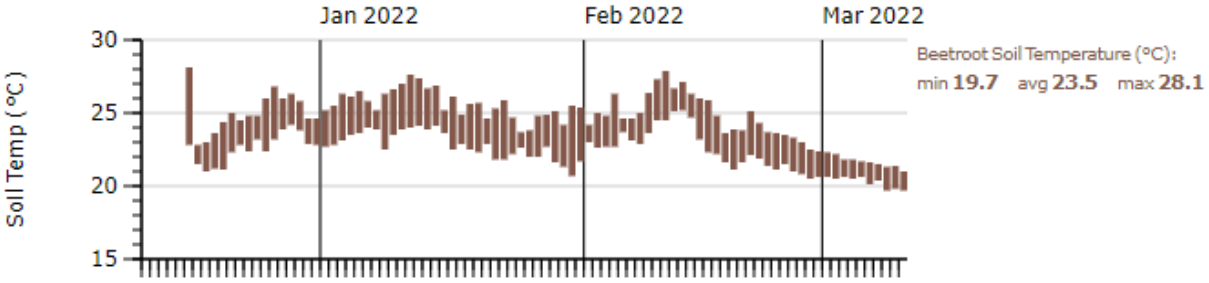
The site had a Harvest monitoring station attached to the top of the container and soil probes across the site installed mid-December 2021. This measures air temperature, Rain, Wind, ET (evapotranspiration), soil moisture and soil temperature

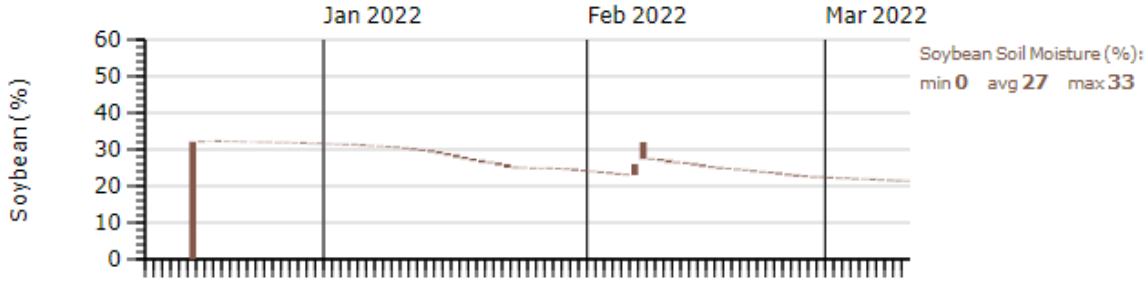


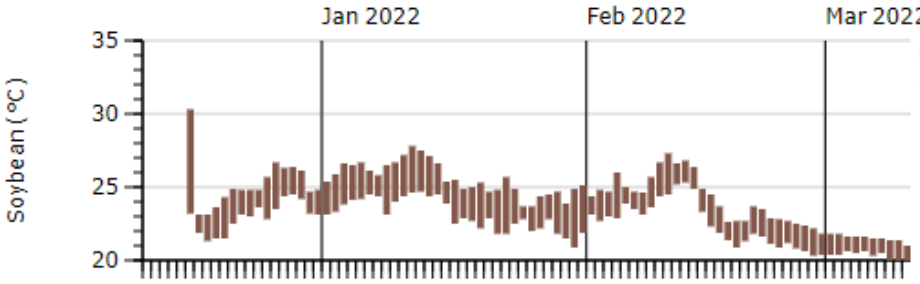

Jan 2022
Feb 2022
Mar 2022
Dir
S
Wind (km/h)
175
150
125
100
75
50
25
0
Wind Direction:
avg ESE
Max Gust (km/h):
max 163.5
Average Wind (km/h):
avg 9.9 max 50.8


Jan 2022
Feb 2022
Mar 2022
ET (mm/h)
7
6
5
4
3
2
1
0
Evapotranspiration (mm):
388.12

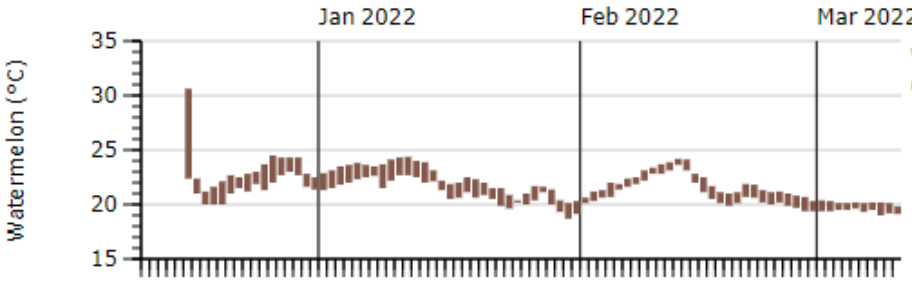

Jan 2022
Feb 2022
Mar 2022
Beetroot (%)
60
50
40
30
20
10
0
Beetroot Soil Moisture (%):
min 0 avg 32 max 175


Jan 2022
Feb 2022
Mar 2022
Soil Temp (°C)
30
25
20
15
Beetroot Soil Temperature (°C):
min 19.7 avg 23.5 max 28.1

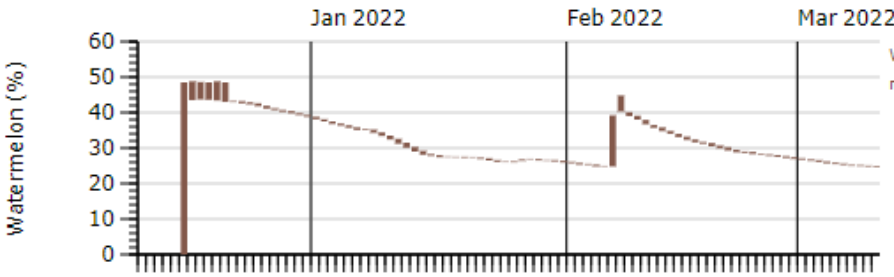

Jan 2022
Feb 2022
Mar 2022
Soybean (%)
60
50
40
30
20
10
0
Soybean Soil Moisture (%):
min 0 avg 27 max 33



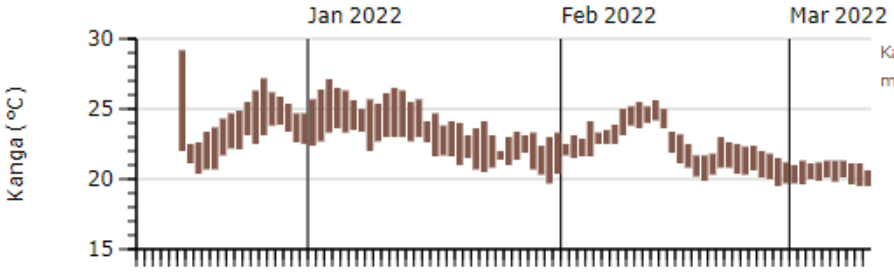

Soybean Soil Temperature (°C):
min **20.0** avg **23.5** max **30.3**




Watermelon Soil Temperature (°C):
min **18.7** avg **21.5** max **30.6**

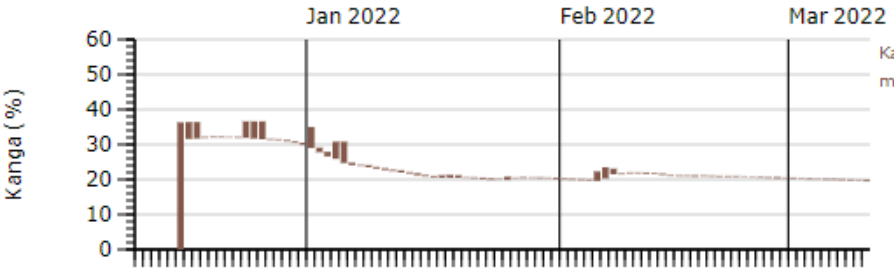



Watermelon Soil Moisture (%):
min **0** avg **32** max **49**




Kanga Soil Temperature (°C):
min **19.5** avg **22.6** max **29.2**

**20.6**




Kanga Soil Moisture (%):
min **0** avg **23** max **37**

## 5.9 Water take management

Water take was monitored to ensure compliance associated to resource consent for the property. Water take flows were above the minimum take level of 19 liters per second throughout the season when the irrigator was in use.

## 5.10 Crop Learnings

The season had an extremely wet lead in. Ground conditions were that contractors were unable to access sites to spray out and cultivate. Each time ground conditions allowed another wet front came across the region again delaying progress. The climatic conditions delayed site preparations and planting by 6 weeks pushing planting to late November 2021. Below are some of the issues that contribution so some of the crops not performing as expected.

- Sufficient lead in time for site preparation (Autumn start)
- Climatic conditions prior to site preparation and planting – unable to control.
- Paddocks fresh out of pasture into horticulture takes couple of seasons to bed in
- Constant weed issues. More water = more weeds.
- Have great engaged contractors on board
- Don't rely of contractors stating all equipment supplied (prior to N Inc)
- Pivot irrigator unforeseen equipment issues with GPS, pump pressure and programming
- Reduce number of crops per site (different pressures and spray programs)
- New equipment will have teething problems, need time to bed these in.

## 5.11 Site Learnings:

Plant one crop per site that can be planted by machinery and being able to treat with on-label chemical management.

Prepare each site starting in Autumn with a winter cover crop. Have a second crop plan in case there is another delayed season.

Have a control area per crop that is not irrigated for enhanced data collection and comparisons.

Have company service and ensure irrigator is in full working order

## 5.12 Harvest

Multiple harvests were done by the project team throughout February and March of the Watermelon and Beetroot with the products donated to the Dargaville Food Bank.

Volunteers from Māuri Orā harvested the remaining watermelon and distributed through their communities

| Crop | Plot size | Yield for plot size & Actual | Expected Yield | Comment | Harvest period |
|---|---|---|---|---|---|
| Soy/Edamame | 0.5 ha | 1 t/ha<br><br>0.002t harvested | 6 t/ha<br><br>Or 3t for site | High pest pressures on this crop. Weed/grass pressures and irrigator issues inhibited the crop. Good pod numbers on surviving plants. Only grew to half of expected height. | Late Feb to Early March<br><br>Small amount harvested now finished |
| Beetroot | 0.28 ha | 11t/ha<br><br>0.04t harvested | 25t/ha<br><br>Or 7t for site | Army worm damage along with weed/grass pressures affected yield. Scale also noted on roots | Late Feb – Late March |
| Watermelon | 0.405 ha | 16 t/ha<br><br>4t harvested | 15 t/ha<br><br>Or 6t for site | few herbicides registered for watermelon. Variation in soil structure across the site impacted production | Late Feb – Mid March |
| Kaanga Ma | .015 ha | 9.8t/ha estimated<br><br>None harvested | 12 t/ha<br><br>Or 1.8t for site | Hot weather and high winds during pollination crop failed to mature fully | March |

Beetroot

Soy/Edamame

Watermelon