PFR SPTS No. 21191

SFFF 20071 Feasibility of growing Hi-Oleic peanuts in Northland: final report

Trolove S, van der Weyden J, Graham D, Punter M, Sorensen P, Searle B, Amponsah N, Weir B, Black D, Hall G, Johnstone J

June 2021

Confidential report for:

Picot Productions Limited
SFF 20071

PUBLICATION DATA

Trolove S, van der Weyden J, Graham D, Punter M, Sorensen P, Searle B, Amponsah N, Weir B, Black D, Hall G, Johnstone J. June 2021. SFFF 20071 Feasibility of growing Hi-Oleic peanuts in Northland: final report. A Plant & Food Research report prepared for Picot Productions Limited. Milestone No. 88855. Contract No. 38648. Job code: P/441022/01. PFR SPTS No. 21191.

Report prepared by:

Stephen Trolove
Scientist/Researcher, Soil Function and Health
June 2021

Report approved by:

Paul Johnstone
Science Group Leader, Cropping Systems & Environment
June 2021

Contents

Executive summary

SFFF 20071 Feasibility of growing Hi-Oleic peanuts in Northland: final report

Trolove S[1], van der Weyden J[1], Graham D[2], Punter M[3,4], Sorensen P[4], Searle B[1], Amponsah N[1], Weir B[5], Black D[6], Hall G[4], Johnstone J[4]
Plant & Food Research: [1]Hawke's Bay, [2]Auckland, [6]Kerikeri; [3]Northland Inc.; [4]Farmlands Co-operative Society Limited; [5]Manaaki Whenua – LandCare Research

June 2021

Picot Productions Limited (manufacturers of Pic's Really Good Peanut Butter) currently imports all its peanuts from Australia, but has a focus on employment for New Zealanders and a desire to reduce its carbon footprint. Previous peanut trials conducted in the 1980s reported average yields of 1–2 t/ha, which is considerably lower than the 2.5 t/ha average yield for non-irrigated crops in New South Wales or 4 t/ha yields in Queensland. Other issues given for the lack of a peanut industry developing in Northland included the lack of industry infrastructure and problems with weed control. With climate change, new cultivars and sprays, and with commercial demand, there is interest in reviewing the commercial feasibility of growing peanuts in the region. The purpose of this project is to establish the feasibility of growing Hi-Oleic peanuts through local field trials.

Two trial sites were established (as per the project brief) on sandy soils, which are ideal for peanuts – Kai Iwi Lakes and Te Kopuru. The Kai Iwi Lakes site was on Te Roroa Trust Māori land. Two additional trials were also established on heavier soils. One of these sites was at Ruawai, where kūmara are also grown, since there is interest amongst the kūmara growers to learn whether peanuts will perform well in their growing system as a rotational crop. A second site was at Plant & Food Research in Kerikeri. Four cultivars of peanuts were planted per site, except Kerikeri where three were grown. These were Hi-Oleic cultivars, and seed was supplied by Picot Productions Ltd from Canon Garth in Zambia. Irrigation was applied at Te Kopuru, Kai Iwi Lakes and Kerikeri, and used at planting at Ruawai. Emergence was most even at Te Kopuru, and least even at Ruawai, where it was found that the tractor-based irrigation system used for kūmara was not particularly suitable for use at planting. There were differences in emergence among the cultivars at all sites.

Nodules were found on peanut roots at all sites. These were pink when cut open, indicating that they were actively fixing nitrogen. Samples were sent to Manaaki Whenua – Landcare Research for *Rhizobium* species identification, and found to be a white clover type.

The Te Kopuru site was relatively free of pests and diseases throughout thse trial, although mites caused damage to cultivars M15-0703 and WT11-0009 just prior to harvest. Caterpillars were the main insect pest observed at Kai Iwi Lakes, with turkeys and rabbits also causing damage. This site was destroyed by bulls just prior to harvest. A fungal infection was observed at Ruawai, which was controlled by fungicide. Weeds were the main problem at the Rauwai site, and scarifying (the form of control used in a kūmara system) was not an effective means of control in peanuts.

Peanut yields were poor at Ruawai (<1 t/ha) because of poor establishment and weed control. Peanut yields at Kerikeri, where the crop was sown late, were 3.7, 2.7 and 0.6 t/ha for cultivars 'Akawa', 'Wamusanga' and M15-0703, respectively. Yields at Te Kopuru ranged from 2.1 to 3.7 t/ha at the 1 m spacing using in the trial. If scaled to a row spacing of 70 cm, which may be used in commercial practice, it is estimated that yields of 2.9 to 5.3 t/ha could be achieved. These yields are promising, and compare well with average yields in Australia. There were significant differences among cultivars, with WT11-0009 and 'Wamusanga' yielding more than M15-0703.

A gross margin estimated that growers may make a return of around $NZ3,900/ha, assuming a yield of 5 t/ha, as it appears that we should be able to achieve similar yields to the average yields in Australia for irrigated peanuts, and a payout similar to what Australian growers receive of $NZ1400/t for first grade, shelled, dried peanuts. Costs were estimated to be around $3,000/ha, but these would vary, particularly depending on the irrigation and fertiliser requirements, and drying costs. These figures look promising, and further research is proposed to continue to investigate the possibility of peanuts on a more commercial scale.

In terms of an economic benefit to Northland, Picot Productions Ltd currently import approximately 2,500 t of peanuts per year, and this amount is growing rapidly. If all peanuts imported by Picot Productions Ltd were grown in New Zealand, at a current price of $A1300/t ($NZ1400), this alone represents $3.5 million. In 2012, New Zealand imported approximately 12,000 t of shelled peanuts and other peanut products, which at $1400/t equates to almost $17 million. The development of a peanut industry in Northland could have many potential benefits to Northland, including improved financial returns, income diversification and the learning of new skills. There is considerable interest from Māori land-owners.

Current challenges to immediate implementation of a peanut industry in Northland are thought to be around access to registered agrichemicals, the difficulties of drying peanuts naturally in the field, the need for infrastructure and equipment such as threshers and driers, and access to water for irrigation may also be a challenge in some areas.

For further information, please contact:

Stephen Trolove
Plant & Food Research Hawke's Bay
Private Bag 1401
Havelock North 4157
NEW ZEALAND

Tel: +64 6 975 8880
DDI: +64 6 975 8917

Email: Stephen.Trolove@plantandfood.co.nz

1 Introduction

Picot Productions Limited is New Zealand's leading peanut butter manufacturer and exports 50% of its annual production. Picot Productions Ltd have used Australian Hi-Oleic peanuts – but has a focus on growing employment opportunities for New Zealanders and a reduced carbon footprint, so is interested to explore the opportunity to grow peanuts locally. Other reasons include increasing yearly demand for Pic's Peanut Butter and the effects of global warming on Australian peanut production. Picot Productions Ltd currently uses approximately 2,500 tonnes and has a strong growth strategy that could see its demand for nuts double over the short to medium term. In 2012, New Zealand imported approximately 12,000 tonnes of shelled peanuts and other peanut products. Based on Australian farmer returns, a yield of 4 tonnes per ha could have a gross income of around $5,000 per ha, although it is possible that there could also be a grower premium associated with New Zealand-grown peanuts. Growing areas in traditional production countries, including Australia, are becoming marginalised as a result of climate change; and the per tonne price is expected to increase over time. In addition, local production of peanuts provides the opportunity for new locally produced, processed foods. For example, the cultivars selected for evaluation in Northland as part of this project are "Spanish Peanuts", the type most widely used in confectionary, snacks – as well as peanut butter production. Spanish peanuts, which are defined by their smaller kernels and reddish brown skins, have a high oil content, which makes them ideal for the crushing market.

One of the regions identified as being suitable for peanut production is Kaipara (Fedaeff et al. 2020). Kaipara’s economy is based on its primary industries, particularly dairy, forestry and horticulture. Almost all the nation’s kūmara crop is grown in the Kaipara District and a new leguminous cash crop like peanuts – which adds nitrogen to the soil, could be highly complementary to kūmara production, and kūmara growers are keen to trial peanuts in their growing system. Importantly, this project aligns with Northland Inc.'s Kaipara Kai project, which includes a goal to ignite new opportunities in food, create new related jobs and work towards a 20% lift in land value.

Small-scale peanut evaluation trials were last conducted in the region during the 1980s. Average yields reported by Anderson & Piggot (1981) were around 1–2 t/ha, which is considerably lower than the 2.5 t/ha average yield for non-irrigated crops in New South Wales or 4 t/ha yields in Queensland (Wright et al. 2017). Other issues given for the lack of a peanut industry developing in Northland included the lack of industry infrastructure and problems with weed control, although by 2003 this was thought to be less of a problem (Griffiths at al. 2003). With climate change, new cultivars and commercial demand, there is interest in reviewing the commercial feasibility of growing peanuts in Northland.

2 Methodology

2.1 Site selection

In mid-September 2020, a number of sites in the Kaipara region were visited and assessed for their suitability for peanut production. This assessment covered a range of factors, including climate and soil type, as outlined by Fedaeff et al. (2020), but also took into account access to irrigation, distance from the Northland Inc. office in Ruawai (to service the trials), the desire for Māori involvement, and the desire for kūmara growers to trial peanuts using their growing systems.

2.2 Trial design

Soil tests were conducted at each site approximately 1 month prior to planting. Soil test results were compared with Australian recommendations for peanuts (GRDC 2017), or New Zealand recommendations for peas (Reid & Morton 2019), and fertiliser was applied accordingly. Kai Iwi Lakes, Te Kopuru and Ruawai received nitrogen at 40 kg/ha at planting. A soil nitrate Quick Test and mass balance (Mathers et al. 2020) at flowering indicated that no further nitrogen fertiliser was necessary at any site, particularly since plants all sites had nodules that were actively fixing nitrogen.

Temperature and soil moisture probes were installed at each site.

Seed was supplied by Canon Garth from Zambia. Four different cultivars of Hi-Oleic peanut were planted at each site, except for Kerikeri, where three were sown. Two cultivars 'Akawa' and 'Wamusanga' were more upright and earlier maturing than the more prostrate cultivars M15-0703 and WT11-0009. At each of the trial sites, additional zero nitrogen plots were established to investigate whether there were resident *Rhizobium* populations that would form nodules on the roots and fix nitrogen.

Peanuts were planted by hand at 5 cm depth. Emergence counts were carried out at each site, and the trials were monitored weekly for the presence of pests and diseases, and appropriate control measures taken as required. After harvest, peanuts were air-dried for two weeks outdoors in mesh trays that were protected from rain. This was to simulate wind-rowing. Dried weights were then recorded as the yield.

3 Description of the trial sites

3.1 Kai Iwi Lakes

3.1.1 Site description and planting

The Kai Iwi Lakes site is located on a sandy soil, which is ideal for peanuts (Fedaeff et al. 2020). The site was previously in permanent pasture and used for grazing bulls. The farm is in Māori ownership. The site is free draining, with a few soil cores showing evidence of some iron nodule formation.

The site was sprayed out with glyphosate on 15 October 2020, then deep ripped to 60 cm and power-harrowed four days later. Strada® was sprayed as a pre-emergent herbicide. This may have had limited effectiveness, since there was 6 mm of rainfall accompanying the application, rather than the recommended 10 mm. Soil test values were low (Table 1), so the following nutrients were broadcast on the soil surface: potassium at 210 kg/ha, phosphorus at 67 kg/ha, calcium and sulphur as gypsum at 600 kg/ha, and boron at 0.5 kg/ha.

Table 1. Pre-plant soil test values for Kai Iwi Lakes.

pH	Olsen P	P retention	CEC	Ca	Mg	K	Na
in water	mg/L	%	me/100 g	me/100 g	me/100 g	me/100 g	me/100 g
6.1	4	77	13	5.0	1.3	0.2	0.2

Peanuts were planted by hand at 5 cm depth on 20 October 2020. Rows were spaced 1 m apart for the purposes of this trial, to enable monitoring of canopy development. There were four replicates of each treatment, plus a replicate that received zero nitrogen. The seedbed was “fluffy” and contained a great deal of trash. Nitrogen, at the rate of 40 kg/ha as Crop Zeal® 20, was banded next to the seed rows at planting. Temperature and soil moisture probes were installed at 7.5, 20 and 40 cm depth. A pre-emergence spray was applied for weed control and a molluscicide to control slugs and snails.

3.1.2 Establishment and crop development

Peanuts began to emerge 9 d after planting. Establishment was poor at Kai Iwi Lakes, ranging from 35 to 49% (Figures 1 and 2). Typical establishment rates in Australia are close to 80% (GRDC 2017). Establishment at this site was lower than that at Te Kopuru, which may be because there was a great deal of residue on the surface at this site. This site had a heavy mat of kikuyu grass, so in future, sites in kikuyu may need to be ploughed earlier to allow more time for the residue to break down.

Peak flowering occurred between the 16 December 2020 and 19 January 2021 visits. By 20 January, 76% of ‘Wamusanga’ plants were pegging, and >95% of plants from the other three cultivars.

The crop was irrigated regularly, although there were some issues with the amount of water available at this site, which may have had a small effect on yields.

Figure 1. Peanut trial at Kai Iwi Lakes, 36 days after planting.

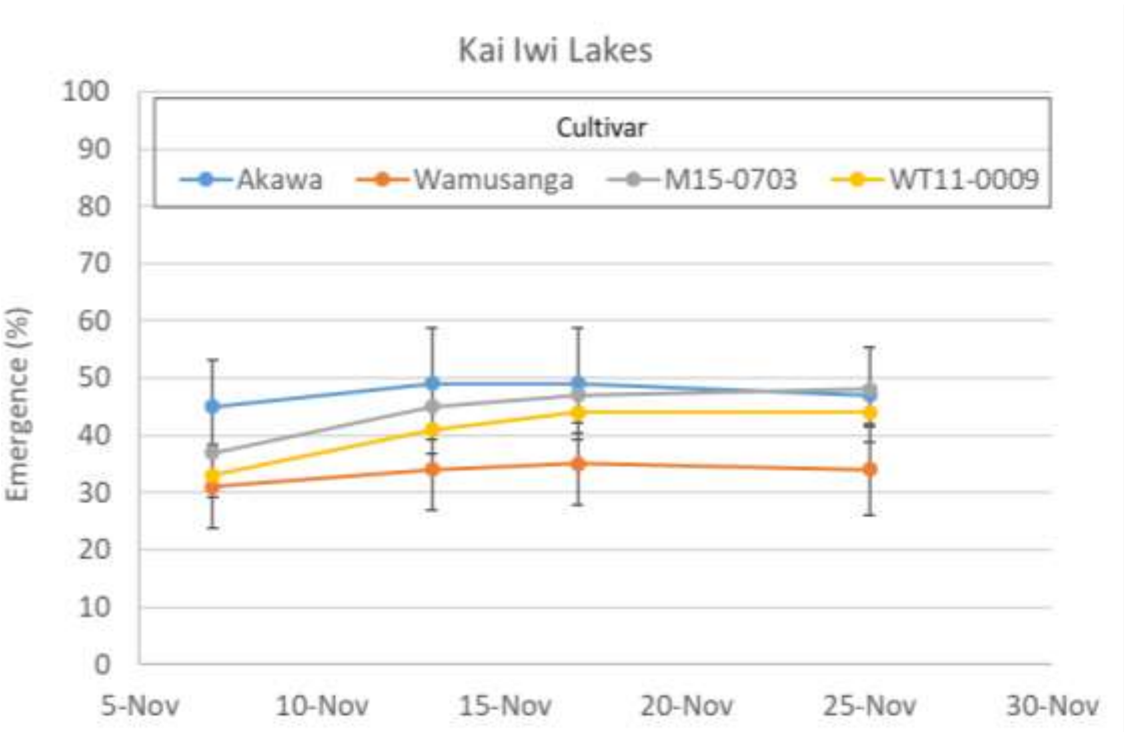

Figure 2. Percentage emergence data for the four peanut cultivars grown at Kai Iwi Lakes. The bars are the standard errors of the means.

3.1.3 Pests, diseases and nodulation

Caterpillars were the main problem at this site. Shield beetles were also observed. Cyper insecticide was applied in late January. No fungal leaf spot symptoms were observed at this site, but an application of Barrachlor® 720 was applied on 30 December 2020 as a precautionary measure since suspected Early Leaf Blight symptoms had appeared at Ruawai (see Appendix 1), which was thought to have been seed-bourne. Turkeys and rabbits were also an issue here. Turkeys were culled in early December, but re-emerged as a problem in February. Leguminous weeds, particularly *Lotus pedunculatus*, were beginning to become a problem, so regular weeding was carried out at this site from mid-December to early March. Nodules were identified on the peanut roots. These were pink when cut in half, indicating that they were actively fixing nitrogen

3.1.4 Harvest

The site was to be harvested on 29 March 2021, but upon arrival it was discovered that bulls had broken the fence and eaten the entire crop. The pods had been pulled up and consumed, so there was nothing to harvest. It appears that the power supply to the electric fence had been cut somehow. The bulls appeared to be fine, so peanuts may be suitable as a stock food for cattle.

3.2 Te Kopuru

3.2.1 Site description and planting

The Te Kopuru site was also on a free-draining sandy soil, on land that was used for dairy farming (Figure 3). The soil test results (Table 2) indicated that nutrient concentrations were suitable for growing peanuts. Plots were 3 rows wide by 5 m long. There were four replicates of each treatment plus a replicate that received zero nitrogen. Rows were spaced 1 m apart for the purposes of this trial, to enable monitoring of canopy development. Peanuts were planted on 20 October 2020, at 5 cm depth. Nitrogen, at the rate of 40 kg/ha as Cropzeal 16N, was banded next to the seed rows at planting. Temperature and soil moisture probes were installed at 7.5, 20 and 40 cm depths within the trial area. A pre-emergence spray was applied for weed control and a molluscicide to control slugs and snails. A drip tape irrigation system was installed (Figures 3 and 4).

Table 2. Pre-plant soil test results for Te Kopuru.

pH	Olsen P	P retention	CEC	Ca	Mg	K	Na
in water	mg/L	%	me/100 g	me/100 g	me/100 g	me/100 g	me/100 g
7.0	63	28	25	21.1	1.9	1.0	0.2

3.2.2 Establishment and crop development

The establishment of peanuts was most even at this site (Figures 4 and 5). Average percentage establishment of peanuts ranged from 58 to 87% depending on the cultivar (Figure 5). 'Akawa' had the highest rate of establishment, which was 87% (Figure 5). The establishment rate of 'Akawa' compares favourably with Australian data, where 80% is considered good (GRDC 2017).

Flowering was observed on 16 December, with approximately 50% of 'Akawa' and 'Wamusanga' plants flowering, but just over 10% of the prostrate cultivars M15-0703 and WT11-0009 flowering. By 20 January 2021 all plants had flowers and over 90% were pegging.

The crop was irrigated as necessary throughout the growing season using the drip tape system.

Figure 3. Location of the trial site at Te Kopuru.

Figure 4. Peanut establishment at Te Kopuru, 36 days after planting.

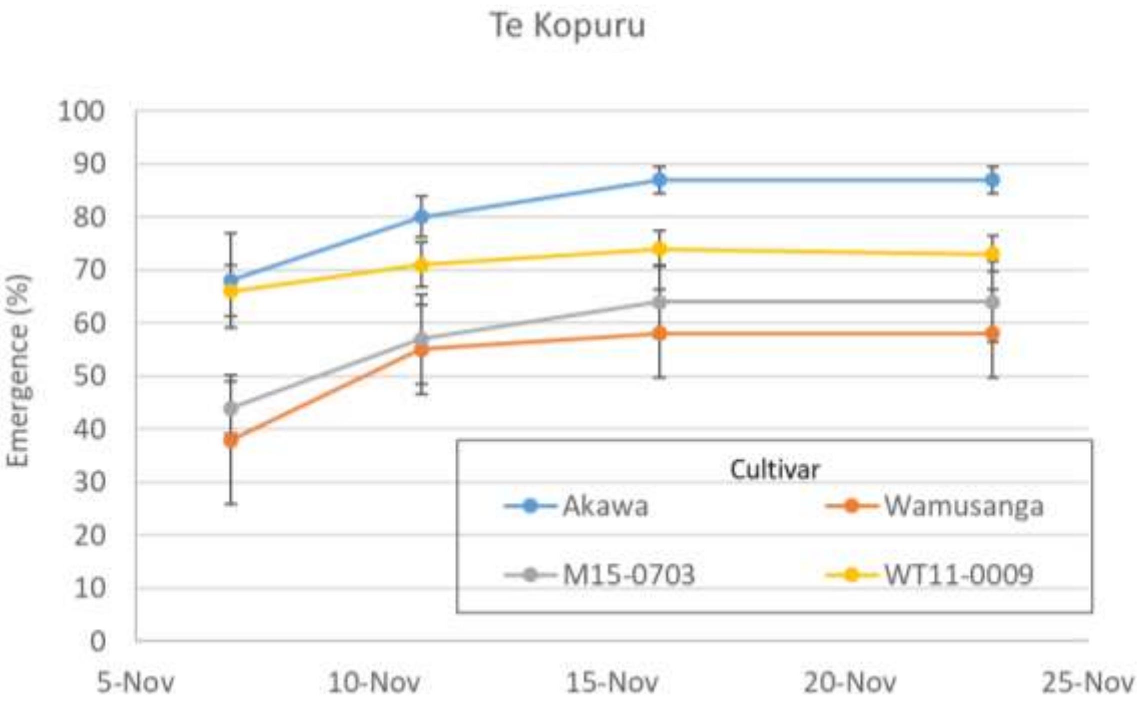

Figure 5. Percentage emergence data for the four peanut cultivars grown at Te Kopuru. The bars are the standard error of the mean.

3.2.3 Pests, diseases and nodulation

Sequence® selective herbicide was applied to control grass weeds on 30 November. Hand weeding was done from mid-December to early March to control any remaining weeds. There were low numbers of insect pests at Te Kopuru for the majority of the growing period. Mite numbers increased rapidly towards the end of the growing period on cultivars M15-0703 and WT11-0009. No fungal leaf spot was observed, but, as for the other trial sites, an application of Barrachlor® 720 was applied on 30 December 2020 as a precautionary measure since suspected Early Leaf Blight symptoms had appeared at Ruawai (see Appendix 1), which was thought to have been seed-bourne. Nodules were identified on the peanut roots. These were pink when cut in half, indicating that they were actively fixing nitrogen.

3.2.4 Yield

The Te Kopuru field trial was harvested on 9 April 2021 (Figure 6), 1740 growing degree days[1] after planting. Note that the cultivars M15-0703 and WT11-0009 were slightly immature at harvest, but it was decided to harvest them anyway because the growing season had nearly ended, with temperatures dropping, and there was high mite pressure. The highest yields of all sites were recorded at Te Kopuru (WT11-0009 was the highest yielding cultivar, yielding significantly more than M15-0703 and 'Akawa'. Good yields were also achieved by 'Wamusanga', which yielded significantly more than M15-0703, Table 3). Actual per hectare yields measured at the 1 m spacing in these trials ranged from 2.1 to 3.7 t/ha. However, commercial yields are likely to be higher than this, given that a closer row spacing is commonly used. A closer row spacing means plants capture more light, which

[1] Growing degree days were calculated as (maximum temperature + minimum temperature)/2 – 9 (GRDC 2017)

would drive more yield, provided that crops were irrigated and well-fertilised, so that water and nutrients were not limiting. The more prostrate cultivars almost reached canopy closure by harvest, but there was approximately 30 cm of bare soil between rows for the more upright cultivars (Figure 6). It is possible that a 70 cm row spacing would have given yields ranging from 2.9 to 5.3 t/ha (Table 3). These yields are promising, given that average peanut yields of non-irrigated crops are 2.5 t/ha in New South Wales and 4 t/ha in Queensland, or 5 t/ha with irrigation (Wright et al. 2017). In some countries, a row spacing of 45–50 cm is used (Emmanuel Chakwizira, pers. comm.), but it is not known if this would result in greater increases in yield, given that canopy closure should be reached. Further trials of 1 ha are planned (Section 8), which should give a better indication of yields that may be achieved using a closer row spacing and other commercial practices.

There were significant differences in yield among the cultivars (Table 3). WT11-0009 was the highest yielding cultivar, yielding significantly more than M15-0703 and ‘Akawa’. Good yields were also achieved by ‘Wamusanga’, which yielded significantly more than M15-0703.

Table 3. Yields of dried peanuts at Te Kopuru. Yields at 1 m spacing are those observed in the trial, whereas the scaled yield at 0.7 m spacing are an estimate of what might be achieved in commercial practice. A P value <0.05 indicates there are significant differences among treatments. LSD = least significant difference.

Cultivar	Yield at 1 m spacing (t/ha)	Estimated yield assuming 0.7 m spacing (t/ha)
‘Akawa’	2.6	3.6
‘Wamusanga’	3.2	4.6
M15-0703	2.1	2.9
WT11-0009	3.7	5.3
P	0.002	
LSD	0.7	

Figure 6. Harvesting peanuts at the Te Kopuru site.

3.3 Ruawai

3.3.1 Site description and planting

The Ruawai site was situated in part of a paddock used for kūmara production (Figure 7). The soil was a mix of peat and clay, which is a much heavier texture than at the other two sites, so was potentially less suitable for peanut production. The kūmara growers were interested to know whether they can grow peanuts as part of their kūmara rotation, so the techniques of growing peanuts here involved planting peanuts on mounds (which should improve the soil drainage on this heavier soil), and using the equipment that the kūmara growers use. The soil test results (Table 4) indicated that nutrient concentrations were sufficient for growing peanuts, except that the pH was low, so lime was applied at 1.5 t/ha.

There were only three replicates of each cultivar rate, because of the limited area of land set aside for this trial site. Of these, one replicate received no nitrogen fertiliser. Rows were spaced 76 cm apart.

Peanuts were planted on 21 October 2020.

Temperature and soil moisture probes were installed at 5, 15, 30 and 45 cm depths within the trial area.

Figure 7. Peanut seedlings growing next to kūmara (top right of picture) in a kūmara bed system at Ruawai, 15 days after planting.

Table 4. Pre-plant soil test for Ruawai.

pH	Olsen P	P retention	CEC	Ca	Mg	K	Na
in water	mg/L	%	me/100 g	me/100 g	me/100 g	me/100 g	me/100 g
5.4	60	53	31	15.3	5.0	1.5	0.4

3.3.2 Establishment

Establishment of the peanuts was poorer and less even at this site (Figure 8) than at other sites. This appeared to be linked to irrigation practices. Specifically, the tractor-based equipment used to normally irrigate kūmara applied water at a high flow rate, and this caused some of the peanut seed to become exposed.

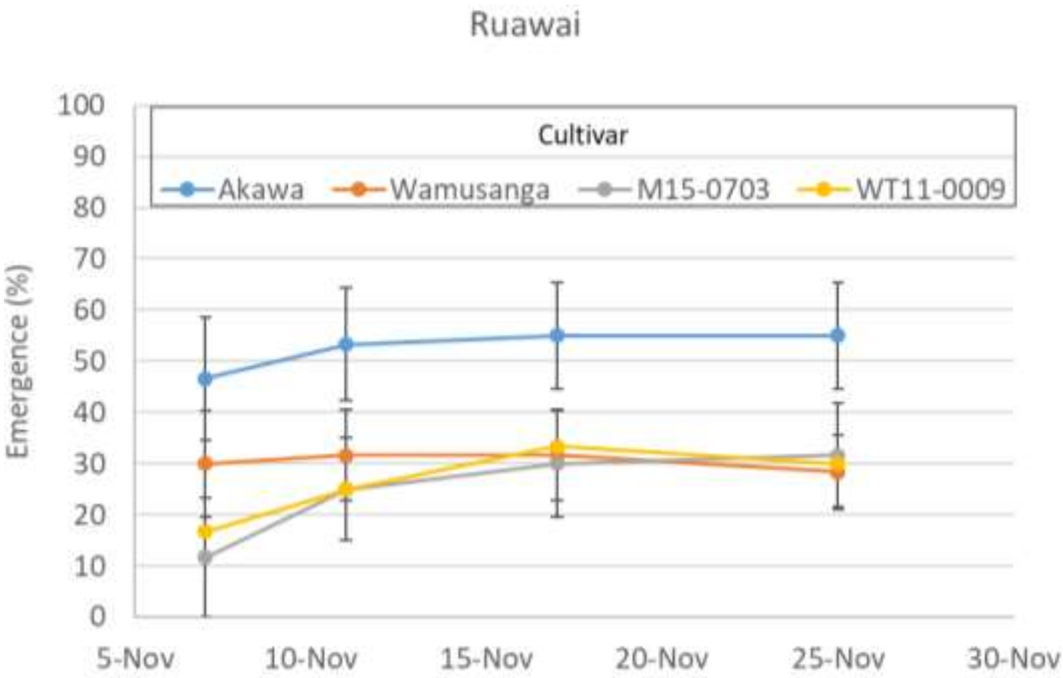

Figure 8. Percentage emergence data for the four peanut cultivars grown at Ruawai. The bars are the standard error of the mean.

3.3.3 Pests, disease and nodulation

Weeds were a major issue at the Ruawai site. An attempt was made to control these by scarifying, but this was largely ineffective.

Figure 9. Leaf spots identified on peanut leaves at Ruawai.

Brown spots surrounded by a yellow ring were identified on peanut leaves at Ruawai (Figure 9). These symptoms resembled Early Leaf Spot, which is a fungal disease that is thought not to be in New Zealand. The Ministry for Primary Industries was notified. Leaf samples were taken and six different fungal colonies were isolated from a representative infected leaf by Nicholas Amponsah of Plant & Food Research. DNA was extracted from these isolates and sent to Macrogen DNA in South Korea for analysis. None of the fungi were identified as *Passalora arachidicola* (previously known as *Cercospora arachidicola*), the fungus that causes Early Leaf Spot. The report (Appendix **Error! Reference source not found.**) was sent to MPI.

The disease was controlled by an application of Barrachlor 720 on 31 December, followed by an application of Hornet® 430 on 18 January.

Nodules were identified on the peanut roots. These were pink when cut in half, indicating that they were actively fixing nitrogen. Samples were sent to Manaaki Whenua – Landcare Research to identify the *Rhizobium* species (see Section 8).

3.3.4 Yield

Peanuts were harvested on 8 April 2021, 1720 growing degree days[2] after planting. Yields were low at Ruawai (Table 5). This was largely the result of poor establishment and the ineffectiveness of scarifying (the means of weed control in kūmara) for controlling weeds in peanuts.

Table 5. Yields of dried peanuts at Ruawai.

Cultivar	Yield (t/ha)
'Akawa'	0.32
'Wamusanga'	0.01
M15-0703	0.14
WT11-0009	0.65

3.4 Kerikeri

3.4.1 Site description and planting

A limited amount of seed remained after the other three trials, so an additional trial of three cultivars of peanuts was established at the Plant & Food Research site in Kerikeri. Peanuts were grown on a mound where avocados had previously been grown. The soil type was a loam. Peanuts were sown on 23 November 2020 in three rows, 50 cm apart. There was no replication at this site.

3.4.2 Establishment

Peanut establishment was estimated to be 95% for 'Wamusanga' (Figure 10) and 'Akawa', but approximately 60% for M15-0703.

The crop received sprinkler irrigation as necessary, and two light rates of YaraMila® complex fertiliser were applied.

3.4.3 Pests and diseases

Pest and disease pressure was low at Kerikeri, and no agrichemicals were applied. However, weekly weeding was undertaken from late December through to early April.

3.4.4 Yield

The cultivars 'Akawa' and 'Wamusanga' were harvested on 8 April 2021, and M15-0703 on 7 May 2021. Yields at Kerikeri (Table 6) were lower than at Te Kopuru. One reason for this lower yield is the shorter growing season. Yield for M15-0703 was particularly low, owing to poor pod numbers. M15-0703 is slower maturing than 'Akawa' and 'Wamusanga', and the planting date at this site was later than at Te Kopuru.

[2] Growing degree days were calculated as (maximum temperature + minimum temperature)/2 – 9 (GRDC 2017)

Figure 10. Peanut establishment on a mound at Kerikeri.

Peanuts appeared to have no problems pegging in this heavier soil.

Table 6. Yields of dried peanuts at Kerikeri. Note that the row spacing used was 50 cm.

Cultivar	Yield (t/ha)
'Akawa'	3.7
'Wamusanga'	2.7
M15-0703	0.6

4 Gross margin for peanut production

An estimated gross margin for peanut production suggests returns for a good crop would be approximately $3,900/ha (Table 7). The price is based on what an Australian grower would receive per tonne of dried, shelled peanuts (converted to $NZ), and was supplied to us by Picot Productions Ltd. Key drivers for grower returns are the yields, and, to a lesser extent, large cost items such as fertiliser, irrigation and drying. The gross margin used a yield of 5 t/ha, as the Te Kopuru data suggest that Kaipara should be able to achieve similar yields to the average yield of 5 t/ha achieved in Australia for irrigated peanuts (Wright et al. 2017). Lower yields were recorded at other sites for various reasons. Larger plantings of 1 ha are planned for this coming season (see Section 8), which should supply more accurate yield data for commercial production in Northland.

Total costs came to almost $3,000/ha, which is just slightly more than costs of A$2,500/ha ($NZ2,690) for Australian growers (Picot Productions Ltd, pers. comm.). The main difference between the Australian and New Zealand gross margins is likely to be that our gross margin assumed higher drying costs than in Australia, where field drying is likely to be an option. Drying costs will vary greatly depending on whether the peanuts can be naturally dried in the field, or need to go for commercial drying at a high moisture content. It will also depend on transport distance and accessibility to a drier. Fertiliser costs will also vary with site. Large applications of fertiliser and gypsum were required at the low fertility Kai Iwi Lakes site (at a cost of $836/ha), whereas the smaller rate used at Te Kopuru would cost $209/ha. Irrigation costs will vary with season.

Table 7. An estimated gross margin for producing peanuts in Northland. Peanut price was supplied by Picot Productions Ltd, and is based on the price Australian growers receive for shelled, dried peanuts. Yields were assumed to be graded as for Australian peanuts (AgMargins 2021). Most operational costs are from the Lincoln Financial Budget Manual (Lincoln University 2020). Product costs were supplied by Farmlands Co-operative.

INCOME		Yield	Price	$/ha
Yield of first grade peanuts		3.8	$1,400	5,320
Yield of second grade peanuts		0.8	$1,200	960
Yield of third grade peanuts		0.4	$1,100	440
Reduction in N use for following crop#			Urea is $669/t	109
COSTS				
Operation				
Spray out with glyphosate x2				50
Disc and powerharrow				120
Cart and spread base fertiliser				25
Pre-emergent herbicide				25
Planting				50
Slug bait application				18
Weed control (x2 sprays)				50
Fungicide (x3 sprays)				75
Insecticide sprays (x6 sprays)				150
Cart and broadcast gypsum				26
Irrigation		280 mm	$2.15/mm	602
Dig peanuts†				25
Thresh†				40
Drying†			$60/t	300
Freight			$10/t	50
Products applied	**Product**	**Rate/ha**	**# applications**	**$/ha**
Peanut seed				335
Glyphosate	Orion Glyphosate 360	6 L	2	72
Pre-emergent	Strada®	1.25 L	1	35
Fertiliser (base dressing)	Various‡		1	435
Slug bait	SlugOut®	15 kg	1	133
Post emergent	Sequence®	250 mL	1	35
Insecticide	Cyper	250 mL	6*	77
Fungicide	Barrachlor® 720	1.4 L	2	58
Fungicide	Hornet® 430SC	145 mL	1	14
Gypsum	Gypsum	600 kg	1	159
Total income				**6,829**
Cost of production				**2,959**
Gross margin				**3,870**

#Assume peanuts provide 75 kg N/ha for the following crop through nitrogen fixation (GRDC 2017)
†Estimate
‡CropZeal 20N @ 222 kg/ha, muriate of potash at 200 kg/ha and triple super @ 200 kg/ha
*In commercial practice, a range of insecticides would be used.

5 Benefits of the project

It is too early to report wider regional benefits following the pilot trials of summer 2020/21. But the potential benefits are presented in the follow sections.

5.1 Economic

Peanuts have the potential to offer good financial returns to growers, with an estimated gross margin of $3,870 (Table 7) being slightly higher than the $3,569 for a 12.5 t/ha crop of maize (Lincoln University 2020), and also higher than dairy and sheep and beef (Lincoln University 2020). There are some capital costs that may be incurred for peanuts, such as the cost of an irrigation system, and a thresher. There are also some infrastructure costs that may be required in some regions, such as a drying facility (see Section 6). A peanut crop would also have the advantage of diversifying the grower's income, with present options being largely pastoral agriculture, maize, kūmara or avocados.

In terms of an economic benefit to Northland, Picot Productions Ltd currently import approximately 2,500 t of peanuts per year, and this amount is growing rapidly. If all peanuts imported by Picot Productions Ltd were grown in New Zealand, at a current price of $A1,300/t ($NZ1,400) this alone represents $3.5 million. In 2012, New Zealand imported approximately 12,000 t of shelled peanuts and other peanut products, which at $1,400/t equates to almost $17 million. This benefit would not be to growers alone. A peanut industry would create more opportunities for agricultural contractors for cultivating, sowing and harvesting, drying facilities and freight. This may mean more work for existing contractors, plus potentially more employment. There would also be the opportunity for gourmet food products made from New Zealand peanuts.

5.2 Environmental

Peanuts are legumes and will fix nitrogen (N). This is advantageous in organic systems where chemical N fertiliser cannot be used. Australian literature suggests that peanuts will provide between 60 and 90 kg N/ha (GRDC 2017). This N is slow-release, so can help to reduce the risk of N leaching if it substitutes for a single application of 60–90 kg/ha of soluble N fertiliser to the following crop.

New Zealand-grown peanuts may also have a lower carbon footprint than imports from Australia and Brazil. This has not yet been quantified.

On the cautionary side, care may need to be taken to minimise wind erosion on the light sandy soils that are suited to peanut production. This may involve trialling direct drilling or minimum tillage to ensure some plant residue remains on the soil surface. No obvious wind erosion was noted at any of the sites in the current trials.

5.3 Social and cultural

A peanut industry in Northland would provide for the diversification of income streams and bring more financial security into the region. It would also bring in new skills and expertise. There is also considerable interest from iwi. One of the reasons for interest from Māori was that peanuts were apparently one of the early crops grown by their ancestors soon after the arrival of the early European settlers. A report commissioned by MPI (PWC 2014) found that in Northland there are over 26,5983 ha of Māori freehold land that is categorised as Land Use Classes 1–4, which are potentially suitable for cropping. Of these, the lighter textured and well-drained soil types are likely to be suited to peanut production, provided irrigation water is available.

There has been considerable interest from local farmers, the community and government agencies in this project and the potential for an expanded project. A number of media outlets have presented positive and informative stories over the past 9 months:

- Rural Delivery Television show
- TV One Network News
- TV3 Network News
- Radio NZ Checkpoint
- Newstalk ZB
- Northern Advocate Newspaper
- NZ Herald website
- Newshub website
- Stuff website
- Scoop website
- Rural News Group website
- Sarah’s Country LIVE TV - Farmers Weekly’s
- Plant & Food Research podcast series
- MBIE’s Provincial Development Unit’s website.
- NZ Grower magazine

The project also features in MPI’s new promotional flyer for SFF Futures.

6 Current challenges to immediate implementation of commercial-scale peanut production

One of the challenges is that there are currently no agrichemicals registered for peanuts in New Zealand. This is because there is no peanut industry yet. Growers can, however, use any New Zealand-registered pesticide, provided residues are below the stated New Zealand minimum residue levels (or if none is listed, below the New Zealand default limit of 0.1 mg/kg). Therefore, the proposed follow-on project will collect samples of peanuts for residue analysis.

A supply of seed for New Zealand would also need to be secured, preferably disease-free.

The weather in Northland makes it unlikely that there will be a period of 10 days or so to dry peanuts down to the recommended 8% moisture for safe storage. This means that commercial drying will be required. Drying facilities are scarce in Northland, which may potentially be an issue in some areas and may need to be built. Drying options such as shipping containers or grain trailers with false floors and a forced-air supply are commonplace in the peanut industry. The purchase of these would be a relatively low-cost investment and be fully transportable to the harvest site.

Threshing machinery would also need to be purchased from overseas, which would considerably add to costs.

Access to irrigation water is also important for high yields. This may be a challenge for a number of sites in Northland. Peanuts are relatively deep rooting, but prefer growing in sandy soils, which have a lower water-holding capacity. Soils in Northland can typically have around 35–45 days of soil moisture deficit, and another 10–15 days in autumn (Griffiths et al. 2003). New South Wales data suggest that average yields from irrigated fields are approximately double those of unirrigated fields.

7 Next steps for the project

The project team is currently developing a larger project which will involve larger commercial-scale blocks (one hectare each) in the Far North and Kaipara districts. The proposed project will have four Workstreams:

1. Commercialisation
    a. Determine actual costs across the entire production process
    b. Use machinery to plant and harvest peanuts
    c. Test yields across a variety of sites that have varying soils and climatic conditions
2. *Rhizobium* – testing and de-newing
    a. Undertake further testing to determine whether suitable *Rhizobium* spp. for peanuts are already present in New Zealand
    b. If prior outcome is negative, begin application process for de-newing the organisms legally (see Section 9, below).
3. Business case
    a. Use costs and yields from Workstream 1 to build a basic business case that focuses on the potential for commercialisation of peanuts and provides some estimations around the potential size of market, and such factors
    b. Better understand the size of the market in New Zealand and explore alternative uses for peanuts
    c. Use findings from Workstream 1 to identify potential structures for an industry
4. Social licence
    a. Use outcomes from smaller trial sites to build case studies that other land-users, e.g. dairy farmers, beef farmers, can relate to and see themselves in, to drive conversations about alternative land use
    b. Improve local understanding and capability in peanut cultivation/production.

The project has significant support from Northland Inc. and Picot Productions. An application will be made to MPI for financial support for via the SFFF programme.

8 Peanut rhizobia in New Zealand

Peanut roots (like all legume roots) are “infected” by soil organisms that are in a group of bacteria known as ‘rhizobia’. Rhizobia are capable of converting inert nitrogen gas from the atmosphere into a soluble form (e.g. nitrates) that are a natural nitrogen fertiliser for legume plants. The rhizobia make the precise amount of nitrogen needed for the plant, thus eliminating the need for chemical fertilisers, which may have a higher risk of nitrate leaching than leguminous nitrogen.

Dr Bevan Weir, Research Leader, Mycology & Bacteriology Systematics, has completed sequencing 85 of the most likely candidate rhizobia cultures in the Manaaki Whenua – Landcare rhizobia collection to see whether any matched rhizobia strains commonly used for inoculating peanuts overseas – e.g. *Bradyrhizobium yuanmingense* strain NC92. The sequencing undertaken showed most strains were *Bradyrhizobium* but some turned out to be *Mesorhizobium* (near the bottom).

- Dr Weir did not find a match of any New Zealand-isolated strain with that of *Bradyrhizobium yuanmingense* strain NC92, nor any other known peanut-nodulating strain.
- The ICMP peanut strains (isolated overseas) fell into two groups, *Bradyrhizobium zhanjiangense* and an undescribed species from Argentina that Dr Weir referred to as APN
- New Zealand has a high diversity of *Bradyrhizobium* strains.

Dr Weir has also searched archived DSIR and HortResearch documents related to peanut trials. These reports go into great detail about the agrichemicals that were used, but provide no details concerning the Rhizobium strains. However, there is a report from 1969 about a Dargaville trial that mentioned: “Seed on sites 1 and 3 and part 2 were inoculated with a culture prepared by Plant Diseases Division”. At that time the only appropriate culture available at that time was ICMP 1330, which was sent from the USA to the collection in June 1964.

ICMP 1330 in the tree it is *Bradyrhizobium zhanjiangense,* which is very close to *Bradyrhizobium yuanmingense*. *B. zhanjiangense* was described only last year (2019), so it is likely that it would have been called *B. yuanmingense* in the past.

As a result of this initial investigation, Dr Weir travelled to the current field trials and also to a field near Helensville where peanuts have been grown for 40+ years, to sample, isolate and sequence rhizobia. The results were:

- Isolated rhizobia from the 2020 trial:
  - *Rhizobium leguminosarum* (clover rhizobia)
  - *Phyllobacterium*
- Helensville field
  - One cultivar had no effective nodules
  - One with *Rhizobium taibaishanense.*

None of these rhizobia were related to the target peanut *Bradyrhizobium* spp.

9 Acknowledgements

This research was funded by the Sustainable Food and Fibres Futures fund (SFFF 20071). Additional contributions of finance and advice were provided by Picot Productions Ltd and Northland Inc. Considerable in-kind contributions were made by Northland Inc. (via Kaipara Kai), and Farmlands Co-operative Society Ltd, helping with organising the project, finding trial sites, checking trial sites, spraying, weeding and harvesting etc. Farmlands also provided the agrichemicals. We would also like to thank the farmers and managers – Snow Tane, Te Roroa Trust, Kai Iwi Lakes; Allister and Maree McCahon, Te Kopuru; and Warwick Simpson, Ruawai, for their in-kind assistance in site preparation, fencing etc., and the use of their land. We are also grateful to Codie McIntyre, Business Analyst for Northland Inc., for her comments on the potential benefits of this project.

10 References

AgMargins 2021. Peanut reports (Irrigated). Queensland Government https://agmargins.net.au/Reports/Index# Accessed 2 July 2021.

Anderson JAD, Piggot GJ 1981 Peanuts – a possible crop for warm northern areas of New Zealand. Proc Agron Soc NZ 11: 73-75.

Fedaeff N, Macara G, Paul V, Pearce P, Sood A, Zammit C, Wadhwa S, Paulik R, FitzHerbert S, McLeod M, Carrick S, Ward R, Funnell K, Clothier B 2020. Current and future crop suitability in the Kaipara District. Report for the Kaipara District Council. NIWA, Manaaki Whenua – Landcare Research, Plant & Food Research. pp. 56.

GRDC 2017. Peanuts. Grow Notes™. Grains Research and Development Corporation.

Griffiths G, Tait A, Wratt D, Jessen M, McLeod M, Reid J, Anderson J, Porter N, Halloy S, Richardson A 2003. Use of Climate, Soil, and Crop Information for Identifying Potential Land Use Change in the Hokianga and Western Kaipara Region. NIWA Client Report AKL2003 037.

Lincoln University 2020. Financial Budget Manual Gross Margins 2020. Lincoln University Press

Mathers D, Norris M, Hunt A, Dellow S, Liu J, Trolove S. 2020. The Nitrate Quick Test mass balance tool. Foundation for Arable Research and Plant & Food Research. https://www.far.org.nz/assets/files/blog/files//e63bd985-409d-5947-8fad-3c090c674061.pdf Accessed 1 July 2021.

PWC 2014. Growing the productive base of Māori freehold land – further evidence and analysis. Price Waterhouse Coopers. https://www.mpi.govt.nz/dmsdocument/4957/direct Accessed 24 June 2021.

Reid J, Morton J 2019. Nutrient management for vegetable crops in New Zealand.

Wright G, Wieck L, O'Connor D 2017. Peanut production guide. Peanut Company of Australia.

A smart green future. Together.