New crop opportunities

Alternative Crops for the Wairarapa

Project code X17-05

Duration Year 3 of 3

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Location: Wairarapa

Funding: SLMACC MPI 405290

Acknowledgements Mick and Karen Williams, Henry Reynolds (host farmers), Geoff Copps (regional consultant), Garth Gillam (Champion Mills)

Key points

- Second year pre-commercial scale demonstration durum wheat plots were sown on irrigated and non-irrigated paddocks in the Wairarapa.
- The quality of wheat from both plots continued to be of good commercial quality, with the irrigated plot (7,100 kg/ha) having double the yield of the dry land plot (3,890 kg/ha).
- Samples of durum wheat semolina processed from the 2019 harvest were supplied to pasta makers, bakers and chefs in the region. Feedback was extremely positive with further work on granule size to be carried out at the mill.

Background

The unwanted organism pea weevil (*Bruchus pisorum*) was discovered in the Wairarapa region in 2016. The response to the incursion resulted in a ban on growing peas in the region for four seasons prompting the need to assess the viability of alternative crops. This project aims to identify potential new crop opportunities for the region.

Methods

Based on previous years' developments (McDougall and Lawrie 2019), the project team decided to proceed in the third year with establishing two one-hectare pre-commercial durum wheat plots, one with irrigation and one dryland, to get an indication of the feasibility of this crop for the region.

Results and Discussion

Following dry summer conditions for the region, and with both demonstration plots receiving almost identical inputs, the dryland plot yielded 3,890 kg/ha whereas the irrigated plot yielded 7,100 kg/ha (both adjusted to moisture of 14%).

Figures 1 and 2 show the detailed ProductionWise reports on the inputs and operations for the blocks at Ahiaruhe (irrigated) and Carters Line (dryland). Both treatments used cv. Farina, bred by the New Zealand Institute for Plant & Food Research and commercialised by Kiwi Seeds, Marlborough. For the purpose of this analysis, freight costs to Christchurch for milling were excluded as it would need to be scaled up to get market rates.

Gross Margin Analysis for Wheat 2019 Paddock Irrigated durum								
Crop	Durum Wheat	Start Date	1/11/2019					
Sowing Area	1.00 ha	End Date	8/03/2020					
Income	Date Occurred	Yield	Yield Source		Price	Per ha	Area (ha)	Total
Grain Harvest	8/03/2020	7.10 t/ha	Diary		$500.00 /t	$3,550.00	1	$3,550.00
Forage Harvest		0.00 t/ha			$0.00 /t	$0.00	1	$0.00
Grazing		0.00 lwt kg/ha			$0.00 /lwt k	$0.00	1	$0.00
Operation	Date Occurred				Performed I	Cost Per h	Area (ha)	Total Cost
Sowing	1/11/2019				Contractor	$145.00	1	$145.00
Fertiliser Application	1/11/2019				Contractor	$22.00	1	$22.00
Spraying	25/11/2019				Contractor	$32.00	1	$32.00
Fertiliser Application	25/11/2019				Contractor	$22.00	1	$22.00
Irrigation	1/12/2019				Farm Emplo	$0.00	1	$0.00
Spraying	16/12/2019				Contractor	$32.00	1	$32.00
Irrigation	1/01/2020				Farm Emplo	$0.00	1	$0.00
Grain Harvest	8/03/2020				Contractor	$250.00	1	$250.00
Input	Date Occurred	Product	Rate/ha	Unit	Cost Per Un	Cost Per h	Area (ha)	Total Cost
Seed	1/11/2019	Other	339	kg/ha	$1.36	$461.04	1	$461.04
Fertiliser	1/11/2019	Cropmast	250	kg/ha	$0.87	$217.50	1	$217.50
Molluscicide	1/11/2019	Slug Out	4	kg/ha	$8.90	$35.60	1	$35.60
Adjuvant	25/11/2019	Actiwett	37.5	mL/ha	$0.02	$0.64	1	$0.64
Insecticide	25/11/2019	Transform	50	mL/ha	$0.36	$17.83	1	$17.83
Fertiliser	25/11/2019	N-Protect	180	kg/ha	$0.56	$100.26	1	$100.26
Irrigation	1/12/2019	Water	35	mm	$2.15	$75.25	1	$75.25
Adjuvant	16/12/2019	Partner	1	L/ha	$10.00	$10.00	1	$10.00
Fungicide	16/12/2019	Kestrel	1	L/ha	$61.97	$61.97	1	$61.97
Fungicide	16/12/2019	Inspire	750	mL/ha	$0.05	$40.50	1	$40.50
Herbicide	16/12/2019	Hussar	150	g/ha	$0.40	$60.00	1	$60.00
Irrigation	1/01/2020	Water	35	mm	$2.15	$75.25	1	$75.25
Total Income						$3,550.00	1	$3,550.00
Cost of Production						$1,658.83	1	$1,658.83
Gross Margin						$1,891.17	1	$1,891.17

Figure 1. ProductionWise data on the inputs and outputs associated with the irrigated, one-hectare pre-commercial durum wheat plot at Ahiaruhe in the 2019-20 season.

Gross Margin Analysis for Wheat 2019 Paddock Unirrigated durum								
Crop	Durum Wheat	Start Date	3/11/2019					
Sowing Area	1.00 ha	End Date	29/06/2020					
Income	Date Occurred	Yield	Yield Source		Price	Per ha	Area (ha)	Total
Grain Harvest	29/06/2020	4.00 t/ha	Diary		$500.00 /t	$2,000.00	1	$2,000.00
Forage Harvest		0.00 t/ha			$0.00 /t	$0.00	1	$0.00
Grazing		0.00 lwt kg/ha			$0.00 /lwt	$0.00	1	$0.00
Operation	Date Occurred				Performe	Cost Per h	Area (ha)	Total Cost
Sowing	3/11/2019				Contracto	$145.00	1	$145.00
Fertiliser Appli	3/11/2019				Contracto	$20.00	1	$20.00
Spraying	10/12/2019				Contracto	$32.00	1	$32.00
Spraying	16/12/2019				Contracto	$32.00	1	$32.00
Fertiliser Appli	17/12/2019				Contracto	$22.00	1	$22.00
Grain Harvest	29/06/2020				Contracto	$250.00	1	$250.00
Input	Date Occurred	Product	Rate/ha	Unit	Cost Per U	Cost Per h	Area (ha)	Total Cost
Seed	3/11/2019	Other	300	kg/ha	$1.36	$408.00	1	$408.00
Fertiliser	3/11/2019	Yara Mila	200	kg/ha	$1.02	$204.00	1	$204.00
Fertiliser	3/11/2019	YaraVera	140	kg/ha	$0.66	$92.40	1	$92.40
Molluscicide	3/11/2019	Slug Out	5	kg/ha	$8.90	$44.50	1	$44.50
Insecticide	10/12/2019	Sparta	20	mL/ha	$0.22	$4.44	1	$4.44
Fungicide	16/12/2019	Phoenix	1	L/ha	$24.48	$24.48	1	$24.48
Fungicide	16/12/2019	Proline	500	mL/ha	$0.10	$48.95	1	$48.95
Fungicide	16/12/2019	Acanto	300	mL/ha	$0.09	$28.23	1	$28.23
Herbicide	16/12/2019	Bromotril	750	mL/ha	$0.04	$26.55	1	$26.55
Herbicide	16/12/2019	Glean	20	g/ha	$0.60	$12.08	1	$12.08
Fertiliser	17/12/2019	YaraVera	100	kg/ha	$0.66	$66.00	1	$66.00
Total Income						$2,000.00	1	$2,000.00
Cost of Production						$1,460.63	1	$1,460.63
Gross Margin						$539.37	1	$539.37

Figure 2. ProductionWise data on the inputs and outputs associated with the dryland, one-hectare pre-commercial durum wheat plot at Carters Line in the 2019-20 season.

A total of 11 tonnes of grain were sent to storage in Christchurch to be processed at Champion Mills in July 2020. Quality tests (Table 1) for both the irrigated and unirrigated block were of acceptable standards, on a par with 2019 results.

Table 1. Quality test results for durum wheat cv. Farina produced under irrigation or as a dryland crop in the Wairarapa in the 2019-2020 season.

		Screen (% 2.0mm)	TGW (g)	Test Weight (kg/hl)	Protein (%)	Falling No. (s)
Durum	Irrigated	3.8	40.4	71.9	12.5	398
Durum	Dryland	1.85	41.8	75	14	438

Summary

As the push to grow more domestic milling wheat in New Zealand grows, so do the opportunities for specialty grains and products from the regions. Durum wheat semolina has a wide range of uses from pasta making to pizza and specialty breads. Internationally, durum meeting the appropriate quality specifications will attract a 15-20 % premium over high grade milling wheat. For the purpose of this project, the estimated price for durum (as the market does not currently exist) was set at $500 per tonne, against a current contract price for premium 1 milling wheat of $450. This was a conservative estimate as currently in Canada (the world's largest producer of durum wheat) the price was USD 308.60/tonne in May, 2020, compared to USD 238.00/tonne for bread milling wheat.

In order to meet the profitability expectations of local growers (comparable to peas) gross margins of at least $1800 per hectare need to be obtained consistently. Two consecutive years of field-scale plots indicate that it would be unlikely for this crop to be viable without irrigation in the Wairarapa region.

The demonstration plots have provided a platform for growers to think more broadly about which crops can be successfully grown in the area and how to engage with the milling and baking sectors on developing new products with a known local origin.

References

McDougall, S, and Lawrie, L (2019). Wairarapa alternative crops. *FAR Annual Research Report 2018-19* pp 137-139. https://www.far.org.nz/files/display/8152/annual-research-results-18-19.pdf NZX

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Food Products for the Future

Project code X18-38

Duration Year 2 of 3

Authors Ivan Lawrie, Sam McDougall, Matilda Gunnarsson (FAR), Keith Gundry (Pure Oil NZ)

Location Canterbury and Manawatu

Funding MPI Sustainable Farming Fund

Acknowledgements Roger Lasham (Pure Oil NZ), Paul Mackintosh (trial host)

Key points

- Three new imported high oleic sunflower hybrids have comparable yields to 'Idillic' in demonstration trials.
- Bird damage continues to be the most significant challenge for commercial sunflower crops.
- The commercial area in high oleic sunflower continues to increase, but yields need to be consistently above 2.8 tonnes/ha to make it sustainable.

Background

The aim of this MPI Sustainable Farming Fund project was to explore new crop options for added value food products, starting with a wide range of crops and narrowing the options to those with realistic commercial applications.

FAR and Pure Oil NZ identified an opportunity to diversify oilseed production with high oleic sunflower hybrids as there is increasing consumer demand domestically for a high-quality product with health benefits.

Internationally, sunflower grows well in temperate regions where wheat, barley and maize are grown. Hybrids suitable for New Zealand conditions were selected and imported from France by Pure Oil NZ.

Methods

Following the results from the 2019-20 season, demonstration plots were established to assess new high oleic sunflower hybrids to compare with the standard currently in use (Idillic). Both demonstrations were established on farmers' properties, one in the Manawatu and one in Canterbury. Cereal grain options were limited to small scale demonstration plots at FAR's Chertsey Arable Site in Canterbury with the primary purpose of display at FAR's ARIA event on Wednesday 4th December, 2019.

High Oleic Sunflower Hybrid Evaluation – Chertsey (South Island)

Location: Chertsey (Turley's)
Sowing date: 12 December, 2019
Previous crop: Process Peas (August Planted, Harvested first week December)
Sowing rate: 69,500 seeds/ha
Fertiliser: None
Herbicides: Interrow sprayed - 15 January, 2020
Desiccation: Aerial Application 2L/ha Reglone® – 10 April 2020
Harvested: 26-27 April, 2020

High Oleic Sunflower Hybrid evaluation - Whanganui (North Island)

Three numbered pre-commercial sunflower hybrids were established in demonstration plots, 12 km West of Whanganui in December, 2019. Seed was drilled into a cultivated seed bed. The first planting was damaged by birds and/or rabbits, and a second planting was made in 12 December, 2019. Plots were weeded and netted to exclude birds on 24 January, 2020.

Harvest was undertaken on 5 June after being delayed due to Covid-19. Birds (12-15 sparrows) had managed to get through the net and remove some of the seed. A 5 m length from the centre row of each plot was harvested and returned to the lab for moisture assessment. Measurements of bird damage were made for each head. These data were used to correct yields for bird damage.

Results and Discussion

High Oleic Sunflower Hybrid Evaluation - Chertsey (South Island)

Tables 1 shows the adjusted-seed yield and seed quality results for the high oleic sunflower hybrids grown at Chertsey in 2019-20, which on average was 2.9 t/ha. All hybrids met the international standards required for fat, while both Idillic and SF 78 002 meet the quality standards required for oleic acid (Table 2).

Table 1. Plant population**,** adjusted-seed yield and other plant measurements for high oleic sunflower hybrids grown at Chertsey in 2019-20.

Hybrid	Plant Population (plants/ha)	Average Yield (t/ha)	Average bird damage (%)	No. plants harvested (total) (4 plots x 3m^2)	Average diameter of head (cm)	No. plants harvested (total) (4 plots x 3m^2)	Weight per head (g)
78-001	71667	2.8	3.2	86	138	86	39.07
78-002	70000	3.1	0.5	84	137	84	44.29
78-003	72500	3	1.9	87	141	87	41.38
Idillic	61667	2.7	8	74	141	74	43.78
Average		**2.9**					

Table 2. Oil quality results (summarised from AsureQuality analysis results) for high oleic sunflower hybrids grown at Chertsey in 2019-20.

Hybrid	Fat (%)*	Oleic acid (%)*	Linoleic acid (%)
Idillic	42.00	80.76	10.47
SF 78 001	45.30	75.97	14.98
SF 78 002	45.40	84.50	7.12
SF 78 003	44.70	76.60	14.71

*Total fat content required to meet international standards is above 42 %, minimum oleic acid required is 80 %. Yellow indicates hybrids that met the oleic acid standards.

Figure 1 shows sunflower heads of different hybrids produced in the demonstration trial at Chertsey.

High Oleic Sunflower Hybrid evaluation - Whanganui (MacIntosh)

Table 2 shows the adjusted-seed yield for the high oleic sunflower hybrids grown at Whanganui, Manawatu in 2019-20, which on average was also 2.9 t/ha.

Table 3. Plant populations and seed yields for a sunflower, hybrid Idillic, crop grown in Whanganui, Manawatu in 2019-20.

Hybrids	Population (plants/ha)	*Seed yield (t/ha)	*Estimated seed yield corrected for bird damage* (t/ha)
78-001	64,000	2.78	3.7
78-002	31,000	2.57	2.57
78-003	52,000	1.71	2.37

*adjusted to 9% moisture

North-East End					
ES Idillic			SFR78-003	SFR78-002	SFR78-001
Rows 12,11,10	Rows 9,8,7	Rows 6,5,4	Rows 3,2,1		

South-West End

Figure 1. Sunflower heads of different hybrids produced in the demonstration trial at Chertsey, Canterbury in 2019-20.

Summary

All work in these trials was conducted as demonstration plots and, as such, the work lacks the replication to reach statistically validated results. Nevertheless, having adjusted for bird damage, the demonstration trials showed that yields in the Southern North Island are comparable to those in Canterbury and both are potentially viable for arable farmers. The lack of processing capacity in the Manawatu region, however, would mean freight to Canterbury, with an impact of $70-100 per tonne extra cost. The only installed capacity for processing currently exists at Rolleston. In Canterbury, grower interest and demand for high oleic sunflower contracts is steady with 17 growers and 259 ha in 2019-20, up from 9 growers and 112 ha the previous season.

Bird damage continues to be the most significant risk to the commercial success of this crop. The project team has indicated that a major focus on bird control on sunflower is a priority for next year. Activities are planned on a 7-ha commercial sunflower plot on the FAR Kowhai Research Farm in Lincoln for the 2020-2021 season, evaluating a range of bird scaring devices.

The effect of sowing date on the production of two imported high oleic hybrids of sunflower

Project code X18-38

Duration Year 1 of 1

Authors Matilda Gunnarsson and Phil Rolston (FAR)

Location FAR Kowhai Arable site, Lincoln (GPS: -43.638079 S, 172.470354 E)

Funding FAR

Acknowledgements PureOil New Zealand

Key points

- There was no significant difference in seed yield (average 3.88 t/ha) between three sowing dates (26 October to 22 November 2017), but a large decrease in yield (of 1.7-1.8 t/ha) for a later sowing date (6 December).
- There was no cultivar or time-of-sowing (TOS) effect on flower head diameter
- There was no difference in the harvest index (HI) for the first three TOS with an average HI of 40%.

Background

High oleic sunflower is seen as a potential new crop as the markets for food grade oil exist and the oil extraction process can be integrated into existing oil seed rape extraction facilities. This trial was undertaken to evaluate sowing dates for two hybrids imported from France. Both hybrids were monounsaturated and high in oleic acid. High oleic is usually defined as having a minimum of 80% oleic acid.

Methods

The trial was undertaken at the Kowhai FAR Research at Lincoln, on a Wakanui silt loam. The trial compared two hybrids with a high oleic content, 'Baltic' and 'Idillic', sown with a 4-row air seed drill and row spacing of 45 cm at four different timings. The first sowing was on the 26 October, 2017, followed by 8 November, 22 November and 6 December. Urea at 100 kg/ha (46 kg nitrogen (N)/ha) was applied on December 18. A soil test on September 6 indicated that the potentially available N was 87 kg/ha. Each cultivar and time of sowing was harvested at an average of 17% seed moisture content. No desiccant was applied.

The trial area was irrigated during the period between 31 October 2017 and 2 February, 2018 and the site had 183 mm of rain. The plots were 10 m long and 1.35 m wide with 4 replicates in a randomized block design. 1.75 L/ha Trifluralin (480 g/L trifluralin) was applied pre-sowing and cultivated into the soil straight after application. At harvest, 2 metres by 2 rows were sampled from each plot at two different locations (1.8 m^2 harvested per plot). Stems were cut at ground level and the number of nodes and stem lengths were measured. Head diameter was also recorded for each flower.

The plot area was bird-netted, however, all the plots had moderate to severe bird damage. For each harvest, each sunflower head was given a bird damage score between 0-100%; with 0 being no damage at all and 100 being totally destroyed. The heads were dried hanging in a hessian bag until the whole trial had been harvested. They were then put into a stationary combine at the New Zealand Institute for Plant & Food Research, Lincoln. The yields were corrected for bird damage.

Results and Discussion

There was no cultivar x time-of-sowing (TOS) interaction. The average seed yield for hybrid 'Idillic' was 3.74 t/ha (Table 1). The second TOS on 8 November achieved the highest yield of 4.59 t/ha (Table 1). For Baltic, the average yield was 3.16 t/ha with the highest yields sown between 26 October and 22 November (Table 1). For both hybrids, sowing in early December resulted in the lowest seed yield. In 2017-18, the last frost was 13 September. In other years, a 26 October could be too early considering the potential for late frosts and the susceptibility of sunflower.

Table 1. Seed yield for high oleic sunflower hybrids Baltic and Idillic sown at one of four different dates at FAR Kowhai Arable site, Lincoln in the 2017-18 growing season.

Treatment	Time of sowing	Seed yield (t/ha)	
		Baltic	**Idillic**
1	26 October 2017	3.59	4.01
2	8 November 2017	3.65	4.59
3	22 November 2017	3.49	3.93
4	6 December 2017	1.91	2.42
	mean	**3.16**	**3.74**
	Cultivar LSD (p=0.05)	**0.55**	
	F. prob value	**0.003**	

Note: Yellow indicates the treatment was amongst the treatments showing the seed yields.

Plant height, which averaged 129 cm, was similar for the cultivars sown in November. Leaf number, measured by leaf scars, averaged 19 per plant. Again, there was no cultivar or TOS effect on the number of leaves. Seed head diameter averaged 14.9 cm per plant and there was no cultivar or TOS effect.

There was a significant difference in bird damage for the different TOS, with the later sowings generally having more bird damage than the earlier TOSs (Table 2). The last sowing date also resulted in a significantly lower harvest index (HI) (28.1 %) when compared with the other TOSs, which had an average HI of 40 % (Table 2).

Table 2. The effect of time-of-sowing (TOS) on bird damage and the combined Harvest Index for two high oleic sunflower hybrids Baltic and Idillic grown at the FAR Kowhai Arable site, Lincoln in the 2017-18 growing season.

TOS	Bird damage (%)		Harvest Index (%)
	Baltic	**Idillic**	
1	22.7	3.8	41.0
2	16.1	3.9	38.7
3	27.9	22.7	40.0
4	64.6	57.4	28.1
LSD (p=0.05)	16.5		5.9
P value	0.001		0.009

Note: Yellow indicates the treatment was amongst the treatments showing the lowest bird damage and greatest harvest index.

Summary

The effect of TOS on the yield of two high oleic acid cultivars was compared. There was no difference in yield with sowing dates between 26 October and 22 November (average yield 3.88 t/ha), but a later sowing on the 6 December averaged only 2.17 t/ha). Although the trial was netted, there was bird damage that increased with the later sowing dates. For commercial crops, bird management will clearly be one of the main challenges to producing a successful crop. Future work will also need to consider the oil content in crops sown at different times.