COGGO

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CORRIGIN
Farm Improvement Group

Growing More Profitable Crops on Chemical Fallow – 2013 and 2014

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Introduction

In these trials Corrigin Farm Improvement Group aimed to test the benefits of growing crops on chemical fallowed soil. The trials specifically compared which crop species were most profitable under a chemical fallowing regime. In season 2013 barley was most profitable and in 2014 albus lupins were the most profitable crop grown on chemical fallow.
This was a COGGO funded project run over two seasons, 2013 and 2014.

Background to the project.

Previous research by CFIG has shown that crops grown on chemical fallow can increase returns on medium and heavier textured soils in the Corrigin district. Chemical fallow is the process of non-crop, chemical control of weeds in year one with the aim to reduce the weed population, store soil moisture and nutrients and subsequently produce higher crop yields in year two. Corrigin Farm Improvement Group trials have shown that crops grown on chemical fallowed paddocks may produce a higher net return over two years compared with the total return from cropping continuously for two years.

Objectives

This project was designed to test the relative benefit of chemical fallow with a range of different crop types. The trials compared different crop types on chemical fallow with the aim to identify which crop is likely to produce the highest return. The trials was a joint effort with Pulse Australia with the aim also to demonstrate and test pulse species in the Corrigin district.

2013 Trial

Methodology

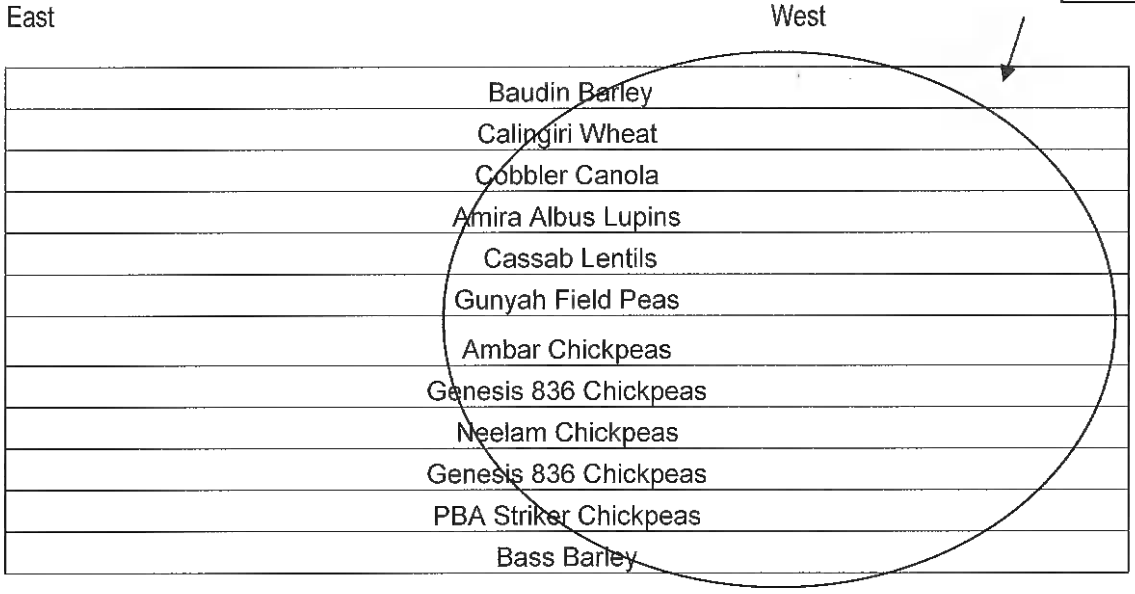
The short lead time to the first year's trial (2013) work was a limitation to finding a suitably prepared chemical fallow trial site given that chemical fallowing needs to commence in the season prior to cropping. While there were chemical fallowed paddocks in the area, none were suitable, due to the application of Group B chemicals for summer weed control. The application of this chemical was likely to carryover in the soil affecting the pulse and canola treatments in the 2013 trial. The best solution to this challenge was to locate the trial in a 2012 cropped paddock that suffered mice damage and therefore had bare areas in the 2012 growing season. For the 2014 growing season trial, a paddock was specifically prepared for this trial work.
In 2013 the trial plots were sown both through canola stubble from 2012 and the bare areas of the paddock. Soil moisture tests were conducted early in the growing season to confirm there was soil moisture carryover in the bare areas so that part of the paddock was taken represent a chemical fallow affect.
The strips were sown and harvested with farmer machinery. Soil moisture tests were conducted with a volumetric soil moisture probes. Plant establishment counts were taken early following emergence and crop yields were measured with the Corrigin Farm Improvement Group weight trailer.

Trial Layout

Figure 1. Trial layout with strips of different crops

Approximate bare area 2012

East West



Trial Details

Sown	17/05/2013
Machine	Deep Blade System (DBS) on 25cm spacing and knife points

Seeding rates

Barley	50kg/ha
Wheat	60kg/ha
Canola	3.5kg/ha
Albus Lupins	114kg/ha
Lentils	80kg/ha
Field Peas	100 kg/ha
Chickpeas	100 kg/ha

Fertiliser

30kg/ha DAPNP at sowing

Chemicals

17/05/2013	1.2 l/ha Glyphosate + 1.2kg/ha Terbyne + 2 L/ha Trifluralin + 1% Ammonium Sulphate @ 60 l/ha Water
3/07/2013	Canola Strip - 1.5 kg/ha Atrazine + 300 ml/ha Clethodim + 0.5 per cent Enhance Crop Oil + 50 ml Alpha Forte
1/9/2013	12grms Triasulfuron + 1% Hasten Crop Oil + 300mls /ha Tilt on Wheat and Barley Strip
4/09/2013	1l/ha Clethodim + 100mls/ha Quizalofop on all Pulses

Observations

Soil moisture measurements were taken on the 24th May 2013 to confirm whether there had been carry over moisture from season 2012 in the bare areas of the paddock (due to mice damage in 2012). Based on the soil moisture tests below, and with regard to the bared areas observed in the paddock, the area shaded blue was

identified as the only area with potential representation of the chemical fallow effect. So in regards to final crop yield this is the only that was used for continuous crop versus chemical fallow comparisons.

Table 1. Soil moisture test 24th May

SOUTH EAST

	10cm	20cm	30cm	10cm	20cm	30cm
Barley	DNS	DNS	DNS	DNS	DNS	DNS
Wheat	11.2	29.6	21	8.8	18.8	too hard
Canola	4.2	19.2	19.8	10.2	23.1	23.1
Amira Albus	15.9	19.6	22.2	5.6	22.3	too hard
Cassab Lentils	19.6	24.6	26.6	8.2	20.3	21.4
Gunyah Field Peas	12.4	26.4	25.4	21.1	26.2	too hard
Ambar Chickpeas	21	20.6	too hard	25.8	26.4	27.6
Genesis 836 Chickpeas	15.6	28.5	too hard	16.8	26	30.5
Neelam Chickpeas				12.3	17.2	17.6
Genesis 836 Chickpeas				DNS	DNS	DNS
PBA Striker Chickpeas				DNS	DNS	DNS
Barley				21.7	30.6	32.2

DNS = Did not sample

NORTH WEST

Plant Establishment

Plants establishment counts were taken on the 27th of June (table 2). Early crop vigour was generally poor at the site due to very dry conditions post-sowing (8.2mm May and 2mm June; Appendix 1) but plant density was generally acceptable with a few exceptions. The lentil seed was too wet from the inoculant application and caused seed block issues and very poor establishment. The Ambar and the second Genesis 836 Chickpeas plots ran short of seed during the seeding process causing very poor establishment at the end of plots (west end for Ambar and east end for Genesis 836).

Early crop establishment was affected by the very dry early period early in the season. On the 12th of July the site received substantial rainfall (62.5mm) which continued through July (112.4mm total) and the site subsequently suffered from water logging, particularly in the lower lying areas of the site. The Albus lupins were the crop, most affected by the water logging.

There was poor early vigour for some of the legumes crops, in particular those plots inoculated with the clay based inoculant, Alosca. Nodulation counts were conducted on the 19th of July (Table 3). All of the Chickpea plots had poor nodulation.

Table 2. Plant establishment 27th June, 2013. Plants per m2.

	Actual plants/m2	Desirable Plants/m2
Barley	102	150
Wheat	138	150
Canola	56	40
Amira Albus Lupins	54	40
Cassab Lentils	0	150
Gunyah Field Peas	48	50
Ambar Chickpeas	50	40-45
Genesis 836 Chickpeas	56	40-45
Neelam Chickpeas	44	40-45
Genesis 836 Chickpeas	0	40-45
PBA Striker Chickpeas	50	40-45

Gunyah Field Peas	56
Ambar	0
Genesis 836	54
Neelam	46
Genesis 836	48
PBA Striker	30
Barley	188

Table 3. 19th July Average Nodulation Ratings (score out of 10)

Amira Albus	8.5
Cassab Lentils	7.5
Gunyah Field Peas	6
Ambar	0
Genesis 836	0
Neelam	0
Genesis 836	0
PBA Striker	0

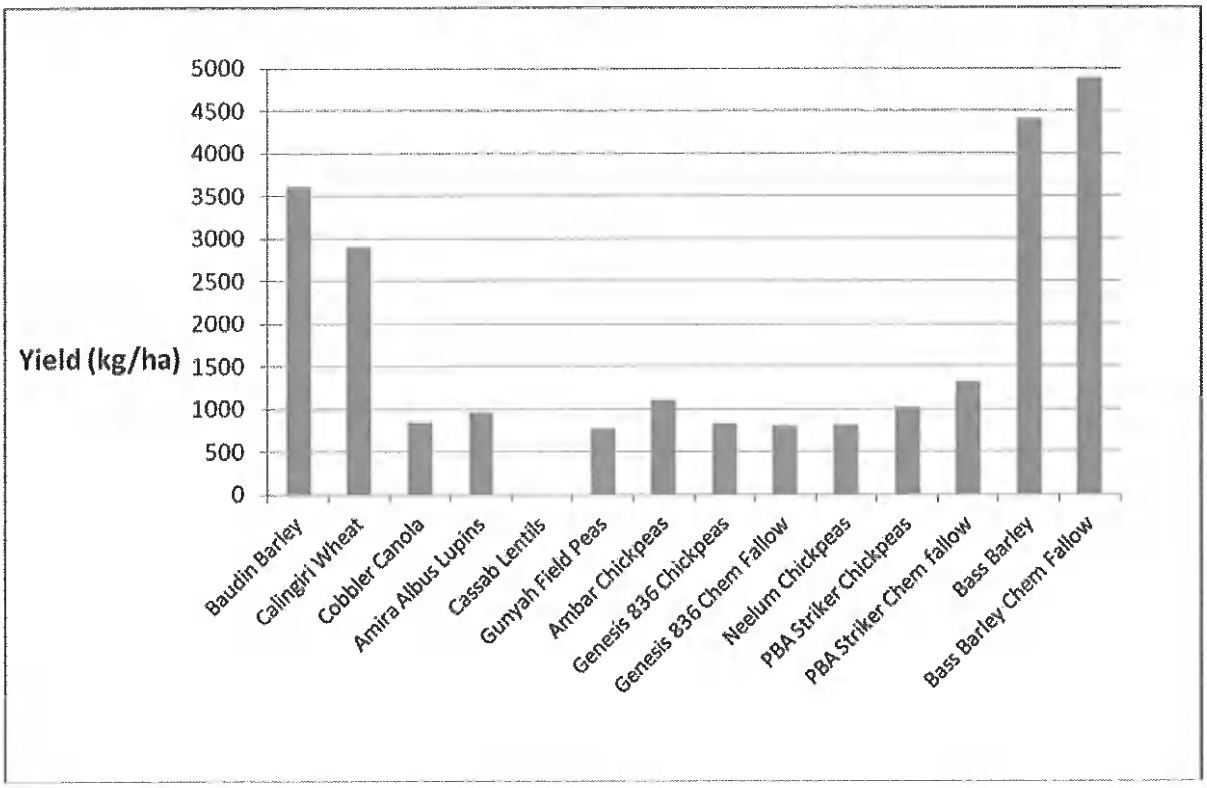
Yield Results

Barley was the highest yielding crop in this trial, with the Bass barley chemical fallow strip the highest yielding strip at 4882 kg/ha (Graph 1). This strip also produced the highest gross return ($1165/ha). The highest yielding pulse in the trial was the PBA Striker Chickpeas on chemical fallow. This also produced the highest gross return ($595/ha) of the pulse species.

The three strips suitable for chemical fallow comparison with continuous crop were Genesis 836 Chickpea, PBA Striker Chickpeas and Bass Barley. The effect of chemical fallow versus continuous crop for each of these was -36kg, +304kg and +481kg respectively (Table 4). These yield gains equate to -4%, 30% and 11% yield differences relative to continuous cropping, respectively (Table 4). For the PBA Striker Chickpea this is an income benefit of $167/ha and the Bass Barley is $122/ha from chemical fallow over continuous cropping (Table 5). This demonstrates that higher value crops such as Chickpeas may produce a higher relative benefit from a chemical fallow regime.

Given that the site received substantial rainfall in season 2013 resulting in water logging, the increased yield for the chemical fallowed PBA Striker Chickpeas and Bass Barley was surprising. But reports from farmers in the region indicate that chemical fallow can offer production benefits in both dry and wetter seasons.

The non cereal crops in this trial may offer other benefits such as disease break and nitrogen fixation from the legume species. If for example, chemical fallowing produces another 300 kg/ha of yield for chickpeas, this may be another 500 to 600 kg/ha of dry matter resulting from foliage and its root system. This could contribute 10 to 12 kg/ha per hectare extra nitrogen to the soil (based on 20kg/ha nitrogen per tonne dry matter) which is in the order of $12 to $14 equivalent fertiliser nitrogen.



Graph 1. 2013 Trial yield results

Table 4. Yield gain or loss for chemical fallow treatments for each crop respectively.

Crop	Yield gain/loss (kg)	% yield gain/loss
Genesis 836 Chickpeas chemical fallow	-36	-4%
Striker Chickpeas chemical fallow	303	30%
Bass Barley chemical fallow	481	11%

Table 5. Trial Yield and Gross Returns

	Yield (kg/ha)	Price $/t	Income ($/ha)	Total input costs* ($/ha)	Gross Return (Income - Input Costs) ($/ha)
Baudin Barley	3616	275	995	81	913
Calingiri Wheat	2902	310	900	86	814
Cobbler Canola	845	520	439	80	359
Amira Albus Lupins	959	465	446	129	317
Cassab Lentils	not harvested	n/a	n/a	n/a	n/a
Gunyah Field Peas	776	325	252	108	144
Ambar Chickpeas	1108	550	609	131	479
Genesis 836 Chickpeas	834	550	459	131	328
Genesis 836 Chickpeas Chemical Fallow	798	550	439	131	308
Neelum Chickpeas	821	550	452	131	321
PBA Striker Chickpeas	1016	550	559	131	428
PBA Striker Chickpeas Chemical fallow	1320	550	726	131	595
Bass Barley	4401	255	1122	80	1042
Bass Barley Chemical Fallow	4882	255	1245	80	1165

**Only cost of seed, fertiliser and chemical. Machinery costs not included but are the same for each crop in this trial.*

2014 Trial

Methodology

The preparation for the 2014 trial site was conducted in 2013 which included managing strips of both chemical fallow and continuous cropping treatments. The chemical fallow plots were kept bare from both winter and summer weeds for the period from July 2013 through to sowing in 2014. The continuous cropping treatments were barley grown in 2013.

The crops selected for the 2014 comparison between chemical fallow and continuous cropping systems included albus lupins, canola, barley, wheat and chickpeas. Fields peas and lentils were dropped from the trial due to the poor performance of these crops in 2013.

There were two times of sowing conducted in 2014, an early sowing for canola and albus lupins and a later sowing for the other crops. Sowing time was identified as a limiting factor for albus lupins and canola in 2013 given both of these crops tend to do better with early sowing.

Plant establishment counts and soil moisture tests were conducted during the growing season. The strips were sown and harvested with farmer machinery. Soil moisture tests were conducted with a volumetric soil moisture probes. Plant establishment counts were taken early following emergence and crop yields were measured with the Corrigin Farm Improvement Group weight trailer.

Trial Layout

North ↑

Amira Albus Lupins
Amira Albus Lupins Chemical Fallow
Canola 43Y85
Canola 43Y85 Chemical Fallow
Hindmarsh Barley
Hindmarsh Barley Chemical Fallow
Mace Wheat
Mace Wheat Chemical Fallow
Striker Chickpeas
Striker Chickpeas Chemical Fallow
Genesis836 Chickpeas
Genesis836 Chickpeas Chemical Fallow

Figure 2. Trial layout with strips of different crops

Trial Details

1st Time of sowing 23/4/2014
2nd Time of sowing 28/5/2014
Sowing Machine; Deep Blade System (DBS) on 25cm spacing and knife points

Seeding rates

Barley	60kg/ha
Wheat	60kg/ha
Canola	4.7 kg/ha
Albus Lupins	110kg/ha
Chickpeas	80 kg/ha

Fertiliser

Albus Lupins; 50kg/ha DAPNP at sowing
Canola; 50kg/ha DAPNP and 30kg/ha Urea at sowing 40l/ha UAN post emergent
Wheat and Barley; 50kg/ha DAPNP at sowing, 60l/ha UAN post emergent
Chickpeas; 50kg/ha DAPNP at sowing

Chemicals

23/4/2014 Presowing albus lupins and canola; 1.2 l/ha Glyphosate + 2 L/ha Trifluralin + 1% Ammonium Sulphate +0.2% wetter @ 60 l/ha Water. Rest of trial site; 1st knockdown 1.5l/ha Glyphosate + 0.2% wetter
28/5/2014 Presowing barley, wheat and chickpeas; 2l/ha Paraquat + 2l/ha Trifluralin.
29/5/2014 Post sowing, preemergent for chickpeas 120g/ha Balance
9/6/2014 Post emergent for albus lupins and canola; 500ml/ha Clethodim + 300ml/ha Quizalofop + 1% Hasten + 100ml/ha Alphacypermethrin + 100ml/ha Chlorpyrifos
25/6/2014 Post emergent for albus lupins; 120ml/ha Diflufenican + 120g/ha Metribuzin
27/6/2014 Post emergent for canola; 500ml/ha Intervix + 0.5% Hasten
16/7/2014 Post emergent for chickpeas; 600ml/ha Clethodim + 0.5% Uptake + 1% Ammo
31/7/2014 Post emergent for canola, wheat, barley 80g/ha Clopyralid + 40 L/ha UAN

6/8/2014 Post emergent for wheat and barley 20 l/ha UAN + 900ml/ha Triathlon (Bromoxynil + Diflufenican + 400ml/ha MCPA LVE + 180 ml/ha Propiconazole + 80 ml/ha Tebuconazole

Observations

It was observed on the 23rd of July for both the wheat and barley, continuous cropped plots, were less vigorous and weedier than the respective chemical fallowed plots. For the canola on this day the chemical fallowed plot has commenced flowering sooner than the continuous cropped canola plot. There was more purpling on the continuous cropped canola compared with the chemical fallow plots which was possibly a combination of nitrogen deficiency and herbicide damage from the chemical, Intervix. On the 23rd of July it was also observed no differences in vigour between continuous cropped chickpeas and albus lupins when compared with the respective chemical fallowed plots.
On the 31st of July it was observed that net blotch disease had infected the barley plots and needed spraying with fungicide.
On the 1st of December when the trial was harvested it was observed that the chemical fallowed albus lupins appeared to have more terminal pods when compared with the continuous cropped plot. On this day both canola plots showed symptoms of severe shedding. The continuous cropped canola plot was thinner and shorter compared the chemical fallow canola plot. For both the wheat and barley, the chemical fallowed plots were thicker than the respective continuous cropped plots.

Plant Establishment

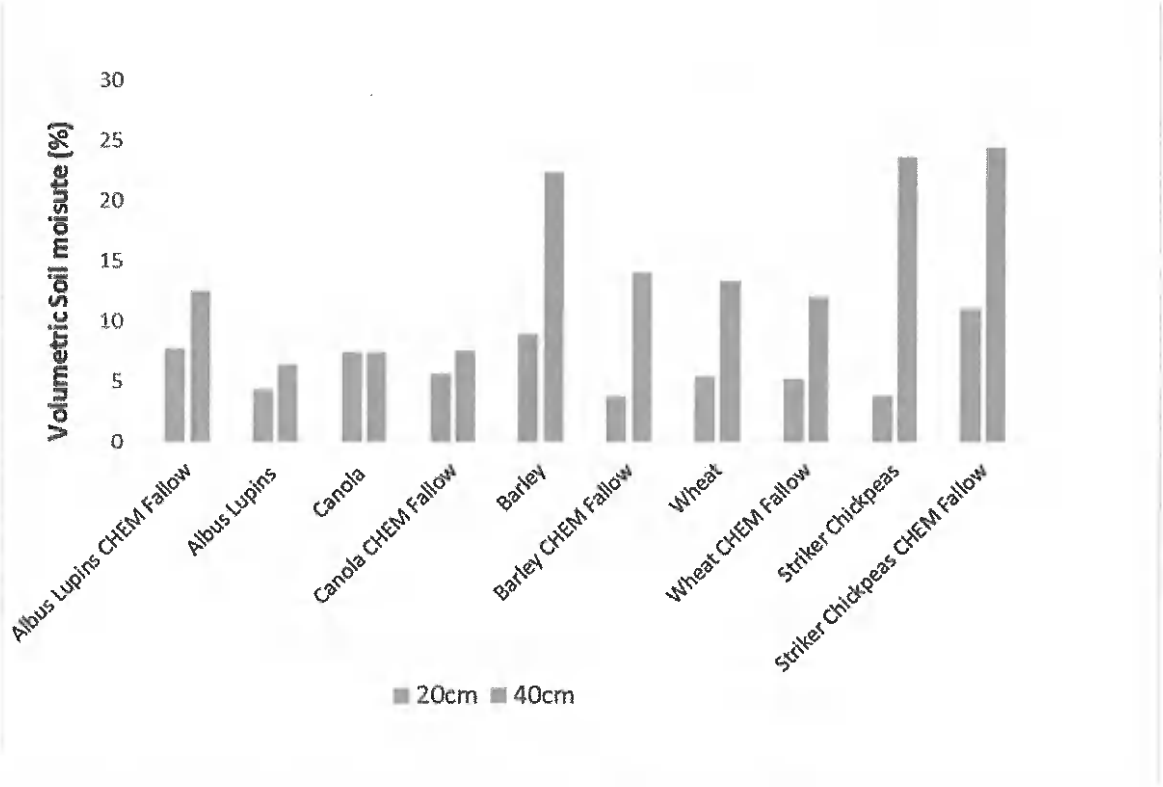
Plants establishment counts were taken on the 23rd July (Table 6). Generally crop establishment was good at the trial site with the exception of the barley, continuous cropped, plot.
Early crop vigour was good at the site given the good early soil moisture conditions. Chickpeas, in general, tend to have low early vigour and this was observed at this site when compared with the other crops.
There was good nodulation for the legumes at the site. The legumes were treated with both Alosca and peat inoculum in 2014.

Table 6. Plant establishment 23rd July 2014.

	Average plant counts (plants/m2)	Desirable plant numbers (plants/m2)
Amira Albus Lupins Chemical Fallow	43	40
Amira Albus Lupins	56	40
Canola 43Y85	51	40
Canola 43Y85 Chemical Fallow	51	40
Hindmarsh Barley	88	150
Hindmarsh Barley Chemical Fallow	131	150
Mace Wheat	160	150
Mace Wheat Chemical Fallow	165	150
Striker Chickpeas	72	40-45
Striker Chickpeas Chemical Fallow	80	40-45
Genesis836 Chickpeas	69	40-45
Genesis836 Chickpeas Chemical Fallow	67	40-45

Soil Moisture

Soil moisture measurements were taken on the 18th of September with a volumetric soil probe and auger (Graph 2). For the pulses, albus lupins and chickpeas there was more moisture at 20 and 40cm for the chemical fallow compared with continuous crop. For the cereals there was less soil moisture for the chemical fallow at 20 and 40cm. For canola there was less moisture at 20cm for the chemical fallow treatment when compared with the continuous crop treatment.



Graph 2. Soil Moisture at 20 and 40 cm on the 18th September 2014

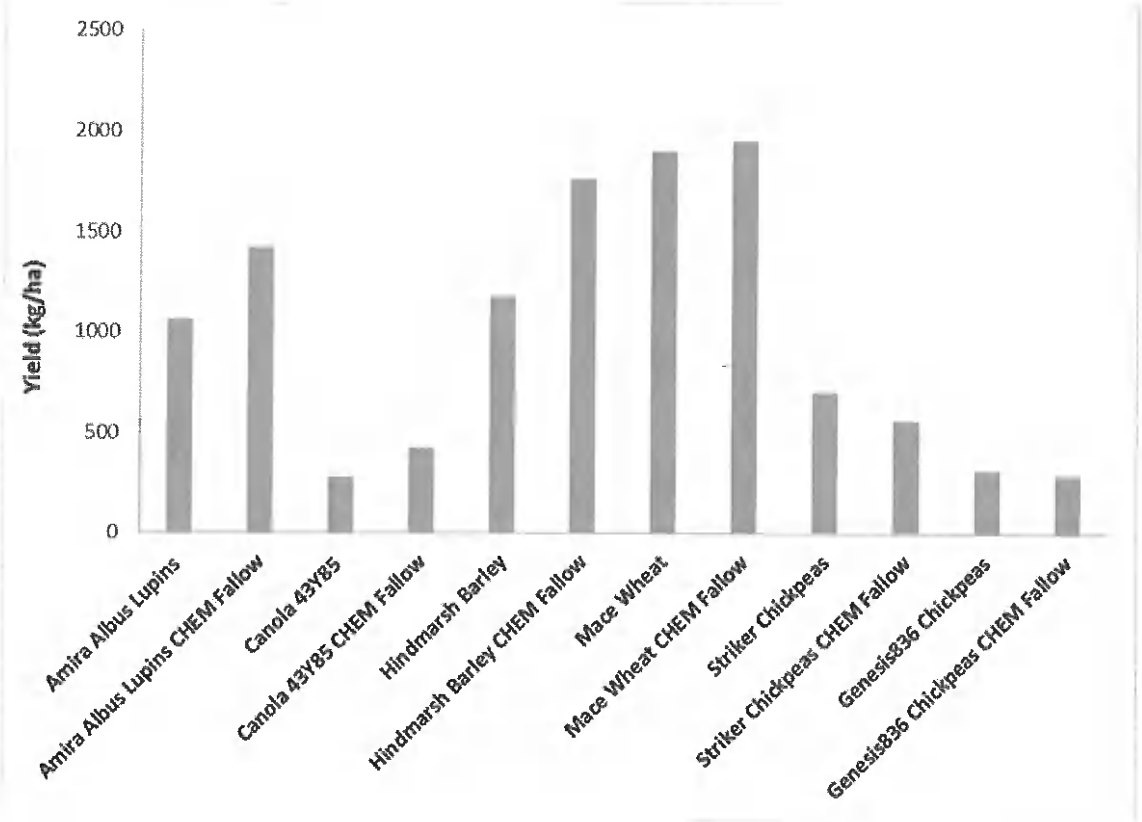
Yield Results

Wheat was the highest yielding crop in this trial, with the wheat chemical fallow plot the highest yielding treatment; 1955 kg/ha (Graph 3). This strip that produced the highest gross return was albus lupins on chemical fallow at $721 per hectare (Table 8). The albus lupins on chemical fallow were also the highest yielding pulse in the trial; 1425kg/ha (Graph 3). The canola yields were lower than expected most likely due to significant shedding of these plots most likely a result of harvest storms (Graph 3).

The chemical fallow treatments for canola, wheat and barley were clearly outperforming their respective continuous crop treatments from very early in the season in terms of vigour and biomass. The barley and canola were 50% higher yielding than the respective continuous crop treatments while the wheat was only 3% higher yielding (Table 7). There was poor establishment for the barley, continuous crop barley treatment which would have contributed to the relative higher yield benefit for the chemical fallow treatment. This may have been caused by some alleopathic effect of the barley straw from season 2013.

The chemical fallow treatment for wheat produced more biomass and was denser at harvest compared with the continuous crop treatment however this did not translate into significant yield benefit. The wheat chemical fallow treatment grain quality was poorer than the continuous crop treatment dropping ASW to AGP due to higher screenings. The wheat chemical fallow treatment did not realise its higher yield potential which may have been caused by higher foliar disease levels or late season soil moisture deficiency in relation to crop biomass. There was no obvious visual signs of higher disease pressure in the chemical fallow wheat. The soil moisture tests in September do indicate that chemical fallow crops, specially wheat and barley, can use more soil moisture in the process of growing more biomass and achieving higher yield potential (Graph 2). However one the key reason for chemical fallow is to carry

soil moisture from one season to the next. In this respect it may be possible some subsoil constraints maybe limiting the crop's ability to use this extra stored soil moisture.
The chickpeas in 2014 did not benefit from chemical fallow which may be explained by low soil pH restricting root growth of this crop (Appendix 2). Also chickpeas have low early vigour and produce low biomass compared with the other crops so may not benefit from the extra soil moisture and soil nitrogen available from chemical fallow particularly when seasonal rainfall is above average (Appendix 1&2). In 2013 the soil type was probably more suitable for chickpeas compared with the site in 2014.
The broadleaf crops, albus lupins and canola may be well suited to chemical fallow regimes as they are options to continue the weed and disease break between cereal crops. Also they are longer season crops and chemical fallow offers early sowing opportunities with higher stored soil moisture. Also, given their higher value, these crops can potentially offer higher returns than cereals in the chemical fallow year; in this trial albus lupins demonstrated that this is possible (Table 8).



Graph 3. Trial yield results 2014

Photo 1. LHS canola on barley stubble, RHS canola on chemical fallow, 2014

Table 7. Yield gain or loss for chemical fallow treatments for each crop respectively.

Crop	Yield gain/loss (kg)	% yield gain/loss
Albus Lupins	360	34%
Canola	141	50%
Barley	584	50%
Wheat	56	3%
Striker Chickpeas	-140	-20%
Genesis 836 Chickpeas	-22	-7%

Table 8. Trial Yields and Gross Returns

	Yield (kg/ha)	Price ($/t)	Income ($/ha)	Diff. in Spray Machine costs ($/ha)	Total input costs* ($/ha)	Gross Return (Income - Input Costs) ($/ha)
Amira Albus Lupins Chemical Fallow	1066	600	639	0	134	505
Amira Albus Lupins	1425	600	855	0	134	721
Canola 43Y85	283	500	141	5	117	24
Canola 43Y85 Chemical Fallow	424	500	212	5	117	94
Hindmarsh Barley	1180	300 (malt)	354	0	87	267
Hindmarsh Barley Chemical Fallow	1764	280 (feed)	494	0	87	407
Mace Wheat	1899	290 (asw)	551	0	87	464
Mace Wheat Chemical Fallow	1955	280 (agp)	547	0	87	461
Striker Chickpeas	702	495	348	-5	130	217
Striker Chickpeas Chemical Fallow	562	495	278	-5	130	148
Genesis836 Chickpeas	315	495	156	-5	130	26
Genesis836 Chickpeas Chemical Fallow	292	495	145	-5	130	14

*Seeding and harvest costs not included as assumed the same

Conclusion

The trials over the two seasons has been a valuable learning experience for members of the Corrigin Farm Improvement Group (CFIG). There has been four group field days at the sites and three other smaller group visits including members of the GRDC Western Panel in 2013. The trials have also been an opportunity for CFIG and Pulse Australia (Alan Meldrum) to work together showing farmers pulse options in our area. The results of the trials were presented at the CFIG AGM in early 2014 and will be presented in March 2015 at the CFIG Crop Updates.

The trial results show that chemical fallow can offer some large yield and margin gains and these are not limited to cereal crops. Break crops like canola and pulses may offer another seasonal break from cereals to subsequently improve the success of following cereal crops. These higher value break crops, in their own right, may be more profitable than a cereal crop on chemical fallow as indicated by the results in 2014.

Chemical fallow will continue to be adopted in medium rainfall regions if it can help reduce volatility in crop returns by improving crop yields and reducing average inputs costs over a number of seasons. These trials were conducted over two, above average seasons, yet the benefits of chemical fallow were still realised with some of the crop types. It is generally well accepted that chemical fallow can offer higher relative gain in dry seasons. So it is the combination of production upside in both poor and good seasons which means chemical fallow can help reduce the volatility in crop income.

Appendix 1.

2013 Rainfall

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Monthly Total	*89.3*	*0.2*	*28.5*	*3.5*	*53.1*	*3.3*	*112.4*	*53.2*	*54.2*	*26*	*2.9*	*17.6*

Total Rainfall	444.2
Growing Season Rainfall	305.7

2014 Rainfall

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Monthly Total	*8*	*0*	*5.5*	*68.5*	*50*	*24.5*	*62*	*41.1*	*37*	*63*	*27*	*0*

Total Rainfall	346.1
Growing Season Rainfall	386.6

Appendix 2

2104 Soil Tests

Site:	D (- ha)	E (- ha)
Lab Number:	YRS14034	YRS14035
Sample Depth:	0-10 cm	0-10 cm
pH [1:5 soil/CaCl2] (4B1)	4.7	4.5
pH [1:5 soil/water] (4A1)	5.2	5.0
EC [1:5] (dS/m) (3A1)	0.065	0.113
Organic C [W&B] (%) (6A1)	1.08	0.97
NO3-N [KCl] (mg/kg) (7C1c)	19.3	35.1
NH4-N [KCl] (mg/kg) (7C1a)	6.1	10.9
P [Colwell] (mg/kg) (9B1)	49	60
PBI+ColP (9I2a)	18	20
K [Colwell] (mg/kg) (18A1)	28	45
S [KCl-40] (mg/kg) (10D1)	15	13